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# Rate Constants for the Quenching of Excited States of Metal Complexes in Fluid Solution

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The rate constants for the quenching of the excited states of metal ions and complexes in homogeneous fluid solution are reported in this compilation. Values of $k_q$ for dynamic, collisional processes between excited species and quenchers have been critically evaluated, and are presented with the following information, among others, from the original publications, when available: description of the solution medium, temperature at which $k_q$ was determined, experimental method, range of quencher concentration used, lifetime of the excited state in the absence of quencher, activation parameters, quenching mechanism. Data collection is complete through the end of 1986, and covers the coordination compounds of 26 metals, including the ions and complexes of the inner- and outer-transition metals, and porphyrin complexes of nontransition metals. Data for 261 excited states quenched by more than 400 inorganic quenchers and 600 organic quenchers have been extracted from almost 500 publications. The introduction to the work contains a discussion of the conceptual background to quenching, including a general treatment of the kinetics, an explanation of the tables, and a list of recent review articles. Uncommon kinetics mechanisms and equations, used to obtain the reported values of $k_q$, are discussed in detail as part of the notes to the tables. Indexes of excited states, quenchers, and authors are appended.

Key words: excited states, metal complexes, quenching, rate constants, solutions, spectra.

## Contents

# 1. Introduction

Over the past 30 years, the photochemistry and photophysics of metal coordination complexes have been active areas of research, drawing upon and merging with the extensive experience of coordination chemists, spectroscopists, and organic photochemists with regard to the synthesis of compounds, the development of experimental techniques, and an understanding of the kinetics and theories of excited states. The development during this time of fast kinetics techniques (conventional and pulsed-laser flash photolysis, time-resolved spectrofluorimetry) and the use of computers for experimental control and data management have caused these research areas to evolve into mature disciplines.

Two very important events occurred almost simultaneously a little more than 15 years ago that triggered a surge of activity in the field: the observation that the luminescent excited state of tris(2,2'-bipyridine)ruthenium(2 + ) ion [$Ru(bpy)_3^{2+}$] can photosensitize electron-transfer reactions, and the first worldwide energy crisis brought on by the oil embargo as a result of the Yom Kippur War in the Middle East. It was recognized almost immediately that the electron-transfer reactions of the excited state of $Ru(bpy)_3^{2+}$ and, by extension, those of other coordination complexes, in fluid solution leads to the formation of energy-rich species which, through the manipulation of their subsequent reactions, can result in the generation of storable fuels. The development of schemes for the photochemical conversion and storage of solar energy involving coordination complexes began in earnest, and with it detailed studies of all the quenching reactions of excited states (electron transfer, energy transfer, proton transfer, etc.) and the chemistry of the products of those processes.

Theoretical treatments soon made the connection between the rate constant of the quenching reaction ($k_q$) and the energetics of the reactants. Existing $k_q$ data were applied to theory, resulting in a demand for more data to test the theory. As a result, values of $k_q$ for the reactions of the excited states of many coordination complexes with many quenchers under widely diverse experimental conditions have been published in the literature to date. Up to now, it has been very difficult for researchers to find the values of $k_q$ they want, or to know exactly what has been done and what has not. In addition, those values of $k_q$ that have been published in the review literature have not been subjected to a critical evaluation of their quality, not have they been part of a compilation in which the experimental conditions of their determination, and thus their validity, have been described.

This compilation is devoted to the presentation and critical evaluation of $k_q$ for dynamic, collisional processes between electronically excited species and quenchers in fluid homogeneous solution. The excited states have been limited to those of ions and complexes of the inner- and outer-transition metals, and porphyrin complexes of nontransition metals. Quenchers include inorganic and organic species, as well as the ground state of the substrates. In addition to displaying the $k_q$ values for excited state/quencher couples and the literature references for the sources of the rate constants, the tables contain descriptions of the solution medium, the temperature at which the experiment was performed, the experimental method used, the range of quencher concentrations used, and activation parameters, as well as other pieces of information extracted from the original publications that could be useful to the reader for the evaluation of the quality of the results.

This introduction to the compilation continues, in Sec. 2, with a discussion of the conceptional background to quenching: the excitation of coordination complexes, the decay of the excited states, the types of quenching processes, and the fundamental "Stern–Volmer" kinetics of quenching. Consideration is given to the conditions that lead to deviations from Stern–Volmer behavior, the relationship of the kinetics of diffusion to $k_q$, and the efficiency of escape of redox products from the solvent cage as a result of electron-transfer quenching. The structure of the tables is examined in Sec. 3: the scope of the compilation, the procedures for the selection of values of $k_q$ from the literature, the problems of nomenclature and speciation, and our concern with the errors and uncertainties that accompany the numerical quantities. The detailed arrangement of the tables is described, as well as the experimental methods used by authors to obtain the data. We offer, in Sec. 4, a list of recent review articles about aspects of the quenching of excited states of coordination complexes that may be useful to the reader. A list of abbreviations and symbols, and the molecular structures of some of the more complicated polymeric and heterocyclic quenchers precede the tables; the tables are followed by notes which describe the mechanisms and equations that have been used in specifically referenced papers for the extraction of the values of $k_q$. A number of indexes have been included: Author Index, Index of Excited States, Index of Inorganic Quenchers, and Index of Organic Quenchers.

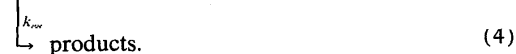# 2. Conceptual Background

## 2.1. Excitation of Substrates

Absorption of light in the ultraviolet, visible, or near-infrared regions of the spectrum by a coordination complex substrate (S) of the general form M–L, where M is the metal center and L represents the ligands in generic terms, results in the generation of electronically excited states within the period of photon absorption ($\sim 10^{-16}$ s). The subsequent rapid passage of the system along deactivation routes leads to the eventual formation, generally, of the lowest excited state of the substrate (*S), which is relatively long lived due to the spin restrictions governing its conversion back to the ground state; the efficiency of population of *S from the absorption of one photon at the wavelength of excitation is $\eta^*$. Depending on the coordination complex involved, *S can be charge–transfer (metal-to-ligand, ligand-to-metal, complex-to-solvent), metal-centered, or ligand-localized in nature; the excitation may reside in nonbonding or antibonding orbitals, may be localized or diffuse, and will have orientations in space appropriate to the symmetry of the state.

Irrespective of the nature of the specific system, *S and S are different species; *S is a stronger reductant and oxidant, is more energetic, and, because of its unique electronic configuration, has the possibility of exhibiting greatly differing patterns of reactivity (acid–base, substitution, etc.). These reactive pathways are kinetically competitive with nonradiative and radiative modes of decay; this latter route results in the emission of light (luminescence) which can serve as a marker for the presence of *S, depending upon the relative rate constants of the various competing processes. In

the case of some complexes, luminescent decay is not kinetically competitive, emission is not observed, and the detection of *S must be accomplished through the use of an alternative technique, such as the monitoring of the absorption of *S.

## 2.2. Decay of Excited States

In the most general sense, the formation of *S and its subsequent decay, when unperturbed, via radiative, nonradiative, and reactive intramolecular modes can be described by reactions (1)–(4), where $I_a$ is the rate at which the light is absorbed by S:

$$S + h\nu \xrightarrow{I_a\eta^*} {}^*S, \tag{1}$$

$$
{}^*S
\begin{cases}
\xrightarrow{k_{rd}} S + h\nu', & (2) \\
\xrightarrow{k_{nr}} S + \text{heat}, & (3) \\
\xrightarrow{k_{rx}} \text{products}. & (4)
\end{cases}
$$

The lifetime of unperturbed *S, $\tau_0$, is defined as $\tau_0 = 1/k_0$, where $k_0 = k_{rd} + k_{nr} + k_{rx}$.

## 2.3. Quenching of Excited States

The subject of this compendium is the second-order rate constant $k_q$ for the bimolecular reaction between an electronically excited species *S and a quencher Q which contributes to the deactivation of *S. The simplest view of the primary processes in quenching is that of irreversible reaction (5) occurring in a single step:

$$
{}^*S + Q \xrightarrow{k_q} \text{products}. \tag{5}
$$

When the microscopic details of quenching are considered, the diffusion of *S and Q together to form *S–Q, a precursor complex in which a very weak interaction exists between the pair, is written explicitly. *S–Q is an outer-sphere encounter complex which is held within the solvent cage for a short period of time (sub-ns); the deactivation of the encounter complex to yield products with a rate constant $k_{de}$ must compete with the breakup of the solvent cage and the release of *S and Q into the bulk solvent [reaction (6)]:

$$
{}^*S + Q \underset{k_{-d}}{\overset{k_d}{\rightleftarrows}} {}^*S\text{–}Q \xrightarrow{k_{de}} \text{products}. \tag{6}
$$
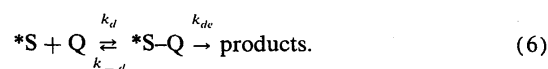
By making use of the scheme in reaction (6) and the steady-state approximation for the concentration of *S–Q, the observed quenching rate constant $k_q$ can be expressed by Eq. (7),

$$
k_q = \frac{k_d k_{de}}{k_{-d} + k_{de}}. \tag{7}
$$

In this mechanism, $k_d$ is the rate constant for the bimolecular diffusional encounter of *S and Q, which can be calculated by use of the Debye–Smoluchowski equation [M. V. Smoluchowski, Phys. Z. 17, 557 (1916); P. Debye, Trans. Electrochem. Soc. 82, 265 (1942)], and $k_{-d}$ is the rate con-

stant for the unimolecular dissociation of *S–Q into the parent components. In the case of outer-sphere encounters, $k_{-d}$ can be calculated by means of the Eigen equation [M. Eigen, Z. Physik. Chem. (Frankfurt am Main) 1, 176 (1954)].

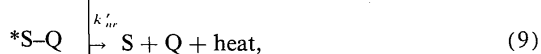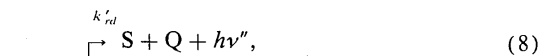The deactivation of *S–Q can be visualized as occurring via competing radiative, nonradiative, and reactive reactions (8)–(10), which are analogous to those of *S [reactions (2)–(4) above].

$$
\text{*S–Q}\quad
\begin{cases}
\xrightarrow{k'_{rd}} & S + Q + h\nu'', & (8)\\[1em]
\xrightarrow{k'_{nr}} & S + Q + \text{heat}, & (9)\\[1em]
\xrightarrow{k'_{rx}} & Q + \text{photoproducts}. & (10)
\end{cases}
$$

In addition, the "precursor complex" can engage in reactions not available to *S in bulk solution: transformation into a "successor complex" via intramolecular energy transfer, electron transfer, proton transfer, or formation of an exciplex via the redistribution of the electronic energy across the entire species [reaction (11)],

$$\text{*S–Q} \xrightarrow{k'_{pr}} \text{successor complex.} \qquad (11)$$
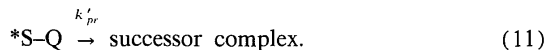
Therefore, $k_{de}$ is defined in terms of the rate constants of reactions (8)–(11) as $k_{de} = k'_0 + k'_{pr}$, where $k'_0 = k'_{rd} + k'_{nr} + k'_{rx}$.

In the case of outer-space encounters, it is commonly assumed that $k'_{rd}$, $k'_{nr}$, and $k'_{rx}$ have values very similar to those of the corresponding reactions of *S, and that quenching is mainly, if not exclusively, due to reaction (11) which defines the nature of the quenching process. Very likely, $k'_{pr} \gg 1/\tau_0$, where $\tau_0$ is the lifetime of *S.
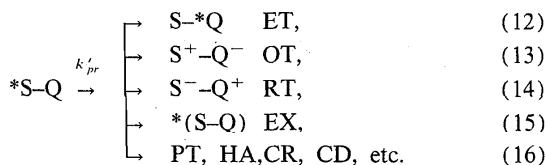
## 2.4. Types of Quenching Processes

Quenching can occur via one or more of the following primary processes simultaneously:

(I) Transfer of electronic energy from *S to Q, with the formation of *Q, an electronically excited state of Q, (ET);

(II) transfer of one electron from *S to Q (oxidative electron transfer, OT);

(III) transfer of one electron from Q to *S (reductive electron transfer, RT);

(IV) formation of an exciplex between *S and Q (EX);

(V) transfer of one proton from *S to Q or vice versa (proton transfer, PT);

(VI) hydrogen abstraction or some other chemical reaction between *S and Q (HA, CR);

(VII) catalysis of the radiationless deactivation of *S by Q (collisional deactivation, CD).

The most predominant processes involving coordination complexes are I, II, and III; the other processes are only seldom observed.

Generally, each of these processes can be represented by a different successor complex. Therefore, reaction (11) can be expanded into reactions (12)–(16) to show the var-

ious successor complexes, which undergo further conversion toward the final products.

$$
\text{*S–Q}\xrightarrow{k'_{pr}}
\begin{cases}
\rightarrow & S\text{–*Q} & \text{ET}, & (12)\\
\rightarrow & S^+\text{–}Q^- & \text{OT}, & (13)\\
\rightarrow & S^-\text{–}Q^+ & \text{RT}, & (14)\\
\rightarrow & \text{*(S–Q)} & \text{EX}, & (15)\\
\rightarrow & \text{PT, HA,CR, CD, etc.} & & (16)
\end{cases}
$$

Intramolecular reactions (12)–(16) are written as irreversible processes. Of course, the principle of microscopic reversibility demands that consideration be given to the possibility of the reformation of *S–Q through the occurrence of the reverse reactions that are, undoubtedly, energetically unfavorable.

Processes II, III, V, and VI can be experimentally demonstrated by the identification of their products as stable compounds or transient intermediates following flash excitation. The experimental evidence for the formation of an exciplex is generally the observation of its absorption or emission in flash photolysis. Energy transfer is experimentally demonstrated if the emission or photoreaction of *Q is observed. In addition, thermodynamic considerations and comparisons with analogous systems are widely used to suggest the most probable mechanism, at least among energy and electron transfer.

Nevertheless, it remains a challenge to obtain a clear answer concerning the exact nature of the intermediates, inasmuch as the same final products could arise from different successor complexes existing simultaneously in the same reaction. Similarly, analogous final products from analogous systems may arise from different successor complexes.

Experimental evidence in favor of a particular quenching process does not exclude the possibility that some fraction of the quenching acts occurs via a different mechanism. The experimentally determined value of $k_q$ is, however, an overall rate constant representing the sum of the $k_q$ values for the individual processes; the relative importance of the various processes can only be evaluated indirectly.

## 2.5. Fundamental Quenching Kinetics

The experimental determination of $k_q$ is based on the measurement of a property ($\Lambda$) that is proportional to the concentration of one or more of the species involved in the overall photochemical process. The mathematical relationship between $\Lambda$ and $k_q$ is derived from the assumed mechanism by the use of the usual treatment of time-independent (steady-state) and -dependent kinetics. The derived relationship contains $\Lambda$ and [Q] as variables, and $k_q$ and/or other rate constants as invariant parameters when Q and the other species are present as unique species; the problem of the variation in the nature of Q as a function of solution medium is addressed in Sec. 2.6.b below.

It is obvious that the reliability of the values of $k_q$ reported by a researcher depends ultimately on the validity of the relationship derived from the assumed mechanism. Evidence in favor of a specific mechanism is generally obtained by the measurement of $\Lambda$ for a set of experiments in which [S] is maintained constant and [Q] is changed across an

appropriately wide range (at least one order of magnitude); clearly, the observed dependence of $\Lambda$ on [Q] must be that expected for the assumed mechanism. Of course, a mechanism may be assumed, and $k_q$ evaluated at only one [Q]; such a procedure, however, does not give any evidence for the mechanism, and the quality of the value of $k_q$ determined in that way is open to question. It is important to note that $k_q$ is always related to $k_{de}$, which is the sum of the rate constants of all the deactivation processes of *S–Q. The relative contribution of each deactivation mode to the overall quenching process can be evaluated, in principle, through additional measurements; this point, however, will not be discussed further.

The most commonly measured properties ($\Lambda$) are the intensity of emission from *S under continuous steady-state excitation, and the decay of emission from *S, or absorption by *S, after pulsed excitation.

By assuming that the quenching mechanism is represented by reactions (1)–(5), application of the steady-state treatment, where $d[*S]/dt = 0$ and $[S]_{ss}$ is the steady-state concentration of *S [Eq. (17)], leads to the relationship [Eq. (18)] between $k_q$ and the intensity of the emission from *S in the absence ($I_l^0$) and presence ($I_l$) of Q.

$$[*S]_{ss} = \frac{I_a \eta^*}{k_0 + k_q[Q]},$$ (17)

$$I_l^0/I_l = 1 + (k_q/k_0)[Q].$$ (18)

Similarly, by defining the lifetime of *S in the presence of Q as $\tau = 1/(k_0 + k_q[Q])$, an equivalent relationship [Eq. (19)] between the lifetime of *S can also be derived from the expressions describing the time-dependent behavior of the concentrations of the species.

$$\tau_0/\tau = 1 + (k_q/k_0)[Q].$$ (19)

These are the Stern–Volmer (S–V) relationships that are very widely used in the evaluation of $k_q$. The S–V constant ($K_{SV}$) is defined as:

$$K_{SV} = k_q/k_0 = k_q\tau_0.$$ (20)

S–V plots of $I_l^0/I_l$ vs [Q] or $\tau_0/\tau$ vs [Q] are predicted, by Eqs. (18) and (19), to be linear with slopes equal to $K_{SV}$, provided that Q does not absorb the exciting and emitting light, or that appropriate corrections have been made.

Similarly, if reaction (4) leads to a product, the quantum yield of which can be measured in the absence ($\Phi_0$) and presence ($\Phi$) of Q, Eq. (21) predicts that a plot of $\Phi_0/\Phi$ vs [Q] be linear:

$$\Phi_0/\Phi = 1 + K_{SV}[Q].$$ (21)

If reaction (5) leads to a product, the quantum yield of which is determined as a function of [Q], the steady-state treatment of the quenching mechanism predicts that a plot of $1/\Phi$ versus $1/[Q]$ be linear with an intercept/slope ratio equal to $K_{SV}$.

The calculation of $k_q$ from $K_{SV}$, requires the independent measurement of $\tau_0$ under the same experimental conditions. The use of a value of $\tau_0$ measured under different conditions implies that $\tau_0$ is independent of the change in the conditions, an assumption that must be proven for the value of $k_q$ to be valid.

If the quenching is assumed to involve reaction (6) instead of (5), a contribution from *S–Q to the emission intensity under continuous excitation should, in principle, be taken into consideration; Eqs. (22)–(24) result, where $\gamma = \beta' k'_{rd}/\beta k_{rd}$, and $\beta$ and $\beta'$ are the ratios of the intensity of the emission at the selected wavelength and that under the entire emission band for *S and *S–Q, respectively.

$$[*S]_{ss} = \frac{I_a \eta^*(k_{-d} + k_{de})}{k_0(k_{-d} + k_{de}) + k_{de}k_d[Q]},$$ (22)

$$[*S-Q]_{ss} = \frac{I_a \eta^* k_d[Q]}{k_0(k_{-d} + k_{de}) + k_{de}k_d[Q]},$$ (23)

$$\frac{I_l^0}{I_l} = \frac{1 + \{k_d k_{de}[Q]/k_0(k_{-d} + k_{de})\}}{1 + \gamma\{(k_d[Q]/k_{-d} + k_{de})\}}.$$ (24)

Clearly, a plot of $I_l^0/I_l$ vs [Q], based on Eq. (24), is not linear; the plot has a negative deviation from linearity, and reaches a plateau for $[Q] \to \infty$. The limiting value of $I_l^0/I_l$ for $[Q] \to \infty$ is $k_{de}/\gamma k_0$. When $\gamma = 0$, i.e., when no emission occurs from *S–Q, Eq. (24) reduces to Eq. (25), which is identical to Eq. (18) via Eq. (7).

$$\frac{I_l^0}{I_l} = 1 + \left[\frac{k_d k_{de}}{k_0(k_{-d} + k_{de})}\right][Q].$$ (25)

Even if $\gamma \neq 0$, the nonlinearity predicted by Eq. (24) is commonly not perceived because of the limitations of the experiment. The initial portion of the plot of $I_l^0/I_l$ vs [Q] can be observed to be linear within the experimental error when $k_d[Q] < (k_{de} + k_{-d})$, i.e., $[*S-Q]_{ss} < [*S]_{ss}$. However, the initial slope has a value of $k_d(k_{de} - \gamma k_0)/[k_0(k_{-d} + k_{de})]$ which is not equal to $k_q/k_0$ via Eq. (7). Only if $k_{de} \gg k_0$, which is the usual case, will the initial slope approximate $K_{SV}$.

The steady-state approximation cannot be applied to the concentrations of intermediates following the absorption of light from a short-lived source. The solution of differential equations (26) and (27), that describe the dependence of the concentrations of *S and *S–Q as a function of time $t$, results in Eqs. (28) and (29), assuming that $[*S] = [*S]_0$ and $[*S-Q] = 0$ at $t = 0$.

$$\frac{d[*S]}{dt} = k_{-d}[*S-Q]$$
$$- (k_{rd} + k_{nr} + k_{rx} + k_d[Q])[*S], \quad (26)$$

$$\frac{d[*S-Q]}{dt} = k_d[*S][Q] - (k_{-d} + k_{de})[*S-Q],$$ (27)

$$[*S]_t - C_1[*S]_0\exp(-m_1t) + C_2[*S]_0\exp(-m_2t),$$ (28)

$$[*S-Q] = C_3[*S]_0[\exp(-m_2t) - \exp(-m_1t)],$$ (29)

where

$$m_1 = \tfrac{1}{2}(k_0 + k_{de} + k_{-d} + k_d[Q]) + \tfrac{1}{2}R^{1/2},$$
$$m_2 = \tfrac{1}{2}(k_0 + k_{de} + k_{-d} + k_d[Q]) - \tfrac{1}{2}R^{1/2}, \quad (30)$$
$$R = (k_0 + k_{de} + k_{-d} + k_d[Q])^2$$
$$- 4(k_0 k_{-d} + k_0 k_{de} + k_{de}k_d[Q]),$$

and

$$C_1 = (k_0 + k_d[Q] - m_2)/(m_1 - m_2),$$

$$C_2 = (m_1 - k_0 - k_d[Q])/(m_1 - m_2),$$

$$C_3 = \frac{(k_0 + k_d[Q] - m_2)(m_1 - k_0 - k_d[Q])}{k_{-d}(m_1 - m_2)}.$$

According to these equations, [*S] decreases with time via biexponential kinetics, while [*S–Q] increases at short times, reaches a maximum, and then decreases. With increasing [Q], $m_1$ increases monotonically while $m_2$ reaches a limiting value of $m_2(\lim) = k_{de}$. The limiting value of $m_2$ at [Q] = 0 is $k_0$.

In most cases, however, the faster component of the decay of *S, and the build-up period of *S–Q occur in times too short with respect to the resolution time of the apparatus; only the slower component of the decay is experimentally observed, and is identical for both *S and *S–Q. Under such conditions, provided that Q is not consumed to any significant extent during the time period of the experiment, the observed decay follows pseudo-first-order kinetics; the apparent rate constant $m_2$ can be evaluated, and a lifetime of *S under quenching conditions, $\tau = 1/m_2$, can be defined. In spite of the apparent differences between Eqs. (24) and (30), the plot of $m_2/k_0 = \tau_0/\tau$ versus [Q] from Eq. (30) is quite similar to that of $I_i^0/I_i$ versus [Q] from Eq. (24). As with the intensity plot discussed above, the experimentally measurable portion of the $\tau_0/\tau$ plot generally appears to be linear within the experimental error, with an initial slope equal to $k_d(k_{de} - k_0)/(k_{-d} + k_{de} - k_0)$, which is approximately equal to $K_{SV}$ if $k_{de} \gg k_0$. Under these conditions, Eq. (31) can be applied:

$$\frac{\tau_0}{\tau} = 1 + \left[ \frac{k_d k_{de}}{k_0(k_{de} + k_{-d})} \right][Q] = 1 + (k_q/k_0)[Q]$$

$$= 1 + K_{SV}[Q]. \tag{31}$$

It is clear that whenever the approximations mentioned above are valid, the quenching of emission intensity and the quenching of the excited-state lifetime are exactly coincident. The lack of such coincidence is generally taken as evidence for a more complex mechanism, although this may not necessarily be the case.

## 2.6. Other Considerations of the Kinetics

There are several factors that cause the kinetics of quenching to become more complex than expected from the S–V equations.

### 2.6.a. Effects of Ionic Strength

When both S and Q are ionic species, the value of $k_q$ is a function of the ionic strength of the solution ($\mu$). Because $\mu$ will change as [Q] is changed, the value of $k_q$ thus obtained will no longer be a constant for a set of measurements, the result being that the observed relationship between $\Lambda$ and [Q] may be different from that expected for the proposed mechanism. In order for $k_q$ to remain constant for a set of experiments in which [Q] is changed, it is necessary for $\mu$ to be maintained constant through the addition of appropriate

amounts of an inert electrolyte. Due consideration must be given to the possibility that pairing of the presumed innocent added ions with S and/or Q can change the kinetic properties of *S and its successors.

Often, $k_q$ is evaluated from measurements at very low [Q] in the absence of added electrolyte, where effects due to variations in the low values of $\mu$ are probably negligible; such values, obtained in the presence of low [S], can be taken as approximating $k_q$ in the limit of $\mu \to 0$. Other methods of obtaining limiting values of $k_q$ from measurements at constant (but variable) $\mu$ involve the use of the Debye–Hückel theory (subject to the usual limitations in its use) or, more valuably, the extrapolation of a plot of $k_q(\mu)$ versus an appropriate semiempirical function of $\mu$ (e.g., $\mu^{1/2}$).

### 2.6.b. Multiple Forms of the Quencher

If, in solution, Q is involved in equilibrium reaction (32) (e.g., acid–base, metal ion complexation, etc.) among its various $i$ forms ($Q_a, Q_b, Q_c$, etc.), the quenching process can occur from some or all of the Q species, and will be a function of the solution medium parameters that affect the position of equilibrium. For experimental convenience, $\Lambda$ is generally determined as a function of the total concentration of Q([Q]$_{tot}$), where [Q]$_{tot} = \Sigma[Q_i]$, and the mole fractions of each of the species ($X_i$) are expressed as $X_i = [Q_i]/[Q]_{tot}$.

$$Q_a \rightleftharpoons Q_b \rightleftharpoons Q_c. \tag{32}$$

If the values of $X_i$ are independent of [Q]$_{tot}$, the value of $k_q$ can be obtained in the usual way, where $k_q$ is actually the weighted average of the quenching rate constants for the individual forms: $k_q = \Sigma X_i k_q(Q_i)$. Because $X_i$ is a function of the solution medium, it is possible, in principle, to obtain the specific values of $k_q(Q_i)$ through the judicious control of the medium. If, on the other hand, $X_i$ changes with [Q]$_{tot}$, the concept of an average value of $k_q$ is meaningless, and the constant cannot be calculated. The specific $k_q(Q_i)$ values can be estimated from measurements in various solution media by means of appropriate algebraic procedures (e.g., best-fitting routines), provided that $X_i$ can be independently determined for each experimental condition.

### 2.6.c. Nonselective Measurements

If the analytical methods used in the quenching experiments are not selective, and reflect the concentrations (and their changes) of *S and species that originate directly or indirectly from the quenching step (i.e., exciplex), nonlinear S–V plots for emission intensity under steady-state conditions and very complex time-dependent behavior of the system under pulse conditions may be observed. Very severe assumptions are often required to derive appropriate kinetics equations, and to calculate $k_q$.

### 2.6.d. Secondary Reactions

Measurements based on the quantum yields of photochemical products may be affected by secondary thermal and/or photochemical reactions. For example, the primary products of an electron-transfer quenching reaction are frequently consumed (and even depleted) through back elec-

tron-transfer reactions to form the ground state reactants. Secondary reactions must be included in the mechanistic scheme, and the corresponding kinetic equation must be used to calculate $k_q$. It is worth noting that data obtained from such systems have a larger uncertainty than those obtained by means of the usual S–V equations; moreover, assumptions about unknown parameters are often required.

### 2.6.e. Partially Unquenchable Reactions

If a photochemical reaction originates from two excited states of the substrate, but only one state is quenched, Eq. (21) applies only to the quantum yield of the quenchable part of the reaction; experimentally, the measured quantum yield is the sum of those quantities for both the quenchable and unquenchable parts of the reaction. Appropriate corrections must be made to the experimental values of $\Phi_0$ and $\Phi$ in order for $k_q$ to be calculated.

### 2.6.f. Quenching of a Higher-Energy Excited State

It is possible that a compound used for quenching *S is also capable of quenching a higher-energy excited state of the substrate **S. If *S originates from the intramolecular deactivation of **S, the quenching of **S causes the population of *S and the resulting luminescence to follow a quadratic dependence on [Q]. However, the lifetime of *S is generally unaffected by the involvement of short-lived **S.

### 2.6.g. Static Quenching

If the substrate and quencher form labile adducts in the ground state, such as in the case of ion pairs between ions of different signs, excitation of S in the adduct results in the quenching of the emission from *S due to intramolecular interactions within the adduct; the extent of adduct formation is governed by the concentrations of S and Q, and the equilibrium constant of the process. As a result, the population of *S, and the resulting luminescence and photoproduct formation are less than those occurring in the absence of static quenching, and are a complex function of [S] and [Q]. The existence of static quenching does not affect the lifetime of *S after pulsed excitation.

## 2.7. Corrections of $k_q$ for Diffusion

When quenching is viewed as occurring via reaction (6), $k_q$, as expressed by Eq. (7), is approximately equal to $k_d k_{de}/k_{-d}$ when $k_{de} \ll k_{-d}$, and to $k_d$ when $k_{de} \gg k_{-d}$. In the latter case, in order to reveal the relative importance of $k_{de}$ in a homologous series of quenching processes, it is often convenient to use the classical Noyes theory of diffusional reactions to obtain a rate constant ($k_{cor}$) for the final step of a reaction, exclusive of diffusion. From the theory, this rate constant is calculated via Eq. (33):

$$1/k_{cor} = 1/k_q - 1/k_d.$$ (33)

When the mechanism of quenching is given by reaction (6), the expression for $k_q$ in Eq. (7) can be substituted into Eq. (33), yielding Eq. (34), which is an expression for $k_{cor}$ in terms of the elementary processes in reaction (6).
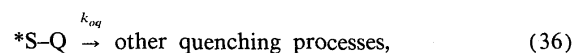
$$k_{cor} = k_d k_{de}/k_{-d}.$$ (34)

When $k_q \ll k_d$, $k_{cor} \sim k_q$; when $k_q \sim k_d$, $k_{cor} > k_q$. We have included $k_{cor}$ values in this compilation only when the corresponding values of $k_q$ were not reported in the original publication and could not be easily calculated from $k_{cor}$.

## 2.8. Cage Escape Efficiency

Because of the importance of electron-transfer quenching to potential applications of photosensitization, it is important to know the efficiency with which the primary products of quenching escape back electron transfer within the solvent cage and diffuse freely into the bulk solution. The major experimental approaches for the determination of this quantity ($\eta_{ce}$) are the measurement of the quantum yield of formation of a primary product [e.g., $\Phi(S^+)$ for $S^+$ from oxidative quenching] under continuous irradiation, and the measurement of [*S] and the concentration of one of the primary products of quenching after pulsed excitation; the latter technique requires that the molar absorptivities of the two species be known in order to effect the conversion of absorbance to concentration. When the measurement of $\Phi(S^+)$, for example, is used as the basis of the determination of $\eta_{ce}$, care must be taken to account for the back electron-transfer reaction of the redox products of quenching in the bulk solution, or to avoid it completely by the use of a selective sacrificial scavenger for one of the products. These secondary reactions must be included in the overall mechanism from which the kinetic equation for $\Phi(S^+)$ is derived.

If the quenching is assumed to occur via reactions (1)–(4), (6), and (35)–(38), a steady-state treatment leads to Eq. (39).

$$*S\text{–}Q \xrightarrow{k_{et}} S^+\text{–}Q^-,$$ (35)

$$*S\text{–}Q \xrightarrow{k_{oq}} \text{other quenching processes},$$ (36)

$$S^+\text{–}Q^- \xrightarrow{k_{bt}} S\text{–}Q \rightarrow S + Q,$$ (37)

$$S^+\text{–}Q^- \xrightarrow{k_{ce}} S^+ + Q^-,$$ (38)

$$\Phi(S^+) = \eta^* \left[ \frac{k_q[Q]}{k_q[Q] + k_0} \right] \left[ \frac{k_{et}}{k_{et} + k_{oq}} \right] \eta_{ce},$$ (39)

where

$$k_q = k_d(k_{et} + k_{oq})/(k_{et} + k_{oq} + k_{-d}),$$ (40)

and

$$\eta_{ce} = \frac{k_{ce}}{k_{ce} + k_{bt}}.$$ (41)

Inasmuch as $\eta^*$, $k_0$, $k_q$, and $\Phi(S^+)$ can be experimentally determined, the quantity $f$ can easily be evaluated by the use of its defining Eq. (42),

$$f = \left[ \frac{k_{et}}{k_{et} + k_{oq}} \right] \eta_{ce}.$$ (42)

It is important to note that $f$ represents the fraction of all the quenching acts that eventually leads to the production of electron-transfer products in the bulk solution. Only when electron transfer is the sole quenching process ($k_{oq} = 0$)

does $f$ represent the cage escape efficiency in electron-transfer quenching.

# 3. Explanation of the Tables

## 3.1. Scope of the Compilation

The compilation is complete through the end of 1986. The computer search of the bibliographic data base of the Radiation Chemistry Data Center (RCDC) of the University of Notre Dame, using the names of the metals and "porphyrin" as key words, the review of the personal literature files of the authors, and the examination of cross-referenced papers yielded a list of publications in books, serials, and periodicals. Publications of limited diffusion, such as dissertations, theses, and abstracts of conferences, were excluded from the list.

## 3.2. Procedures of Selection

In order to be included in this compilation, values of $k_q$ had to be explicitly given in the published paper, or be capable of being calculated by us from values of $K_{SV}$ and $\tau_0$ (or $k_0$, $k_d$, $k_{-d}$, and $k_{de}$) reported in the same paper. No values of $k_q$ were extracted from graphical treatments, nor were any calculated from $K_{SV}$ and $\tau_0$ taken from different sources.

The rate constant of quenching is that of a dynamic process occurring in a fluid solution in which there is the uniform distribution of substrate and quencher. Data concerning systems in which either the substrate or the quencher, but not both, might be preferentially confined to localized regions of a microenvironment, such as in the presence of micelles and polyelectrolytes, were accepted only if there was clear evidence that quenching requires the diffusion of at least one species through the medium.

In addition, preference was given to data concerning sufficiently well characterized chemical species obtained under sufficiently well defined experimental conditions. Data concerning poorly defined systems were included in the compilation only if more precise reports were lacking; we have taken the point-of-view that poor data are better than none at all, as long as the reader is provided with the information to evaluate the quality of the result.

We have found, not unexpectedly, the repetition of the same values of $k_q$ for the same excited state/quencher couple under the same experimental conditions from the same laboratory in a number of references. In this case, reference is made only to the paper containing the largest amount of information and/or published in the most widely disseminated journal. The other references, however, are cited in the bibliography, and indication of their existence is made in the tables as a "comment." Occasionally, we have found *different* values of $k_q$ for the same excited state/quencher couple under the same experimental conditions from the same laboratory; this situation can occur due to the reevaluation of data over the course of time by the authors, their recognition of the limitations in their experimental procedures, or the existence of inadvertent typographical errors. In this case, we have made a critical evaluation, on the basis of the information available, of the quality of the values, and have cho-

sen one for display; as before, the other references are cited in the bibliography, and the alternative values are indicated as a comment.

For some very well-studied systems, there are multiple reports from different laboratories for the same excited state/quencher couple under the same, or very similar, experimental conditions. In these cases, all values are presented as independent entries for the following reasons. When the values of $k_q$ are different, we believe that it is impossible for us to establish which value is more valid short of performing the experiment ourselves; the users of these data are urged to make their own evaluation of the quality of the numbers from the information given in the papers based on their own expertise. When the values are the same, or very similar, we have chosen not to average the values and combine the entries so as to avoid the loss of valuable pieces of information contained in the individual papers. To remove entries, we feel, would deprive the reader of the opportunity to make direct comparisons.

## 3.3. Nomenclature and Speciation

For all the coordination compounds, both substrates and quenchers, in this compilation, names and formulas are written with the symbol of the central metal as the initial portion for reasons of alphabetical ordering. The use of abbreviations for the ligands in the substrates was limited to 2,2'-bipyridine (bpy) and 1,10-phenanthroline (phen) and their derivatives, but were widely used for the quenchers as a space-saving measure; a list of all the abbreviations and symbols used appear below in Sec. 6.

The oxidation states of metallic quenchers, as superscripts in Roman numerals to the symbol of the element, are designated only in those cases where the exact nature of the species in solution is unclear. For labile complexes, which require the presence of both the free metal ion and the ligands in solution, the metal ion/ligand ratio ([M]/[L]) *in the bulk solution* is indicated in the "Solution Medium" column of the tables; labile complexes of unknown formulation, or those that may actually be a mixture of various species in equilibrium are indicated as M–L with the oxidation number of the metal shown.

Organic quenchers are indicated by their names, but the use of abbreviations is very widespread. Names and abbreviations were chosen in an attempt to achieve a delicate balance among several highly desirable features: succinctness, unambiguousness, uniformity, and clarity to even those not fluent in organic nomenclature. Therefore, the names used in the compilation may be different than those that appear in the original publications. For organic quenchers with complicated structures and correspondingly complicated formal names, such as polymeric viologens and heterocycles, generic abbreviations (PolyVio, OrgQue) are used; their structural formulas are shown below in the Figures (Sec. 7).

In a few cases, the nomenclature is, regretfully, ambiguous, reflecting analogous ambiguities in the original publications.

For the majority of ionic substrates and quenchers, the counterion has not been shown; it has been indicated as a comment in the tables in those few cases in which there is

evidence that its presence affects the photophysical properties of the substrate.

In addition to the substitutional equilibria exhibited by some metal complexes discussed above, a number of substrates and quenchers in this compilation undergo equilibrium reactions (e.g., acid–base, monomer–oligomer) in solution, so that the predominant species is a critical function of the solution composition and the total concentration of the substance. In general, the name used is that indicated in the original publication: no attempt was made to identify the predominant species under the experimental conditions used, although where important, information about the species is presented as a comment. As a result, the reader will find the names of both the acidic and basic forms, for example, in the tables and indexes.

A special case is represented by those transition metal ion quenchers that may be present in the solution as fully solvated and/or partially anated species. We have used the symbol of the simple ion (e.g., $Co^{2+}$) to indicate the ensemble of these species, the formula of the fully solvated ion [e.g., $Co(H_2O)_6^{2+}$] for that specific species, and abbreviated notations without the solvent molecules (e.g., $CoCl^+$, $CoCl_3^-$) to indicate partially anated species.

For the majority of the substrates reported in the compilation, only the lowest-energy excited state is quenched, and no indication of its term symbol is required to avoid ambiguity. When quenching is experienced by two lowest-energy excited states of a substrate, each state is identified by its spin multiplicity ([singlet] and [triplet] for the upper and lower state, respectively) or, in the case of $Tb^{3+}$, by the usual spectroscopic notations ($[^5D_3]$ and $[^5D_4]$ for the upper and lower state, respectively).

## 3.4. Errors and Uncertainties

In many cases, values of $k_q$ are given with an error range or uncertainty estimation in the original publications; however, the criteria used by authors to evaluate the uncertainty in reported values are rarely disclosed, and range from well-defined statistical treatments (e.g., standard deviation) based on multiple replicate experiments, to empirical estimations based on the author's experience. As a result, it is impossible to express the uncertainty in values of $k_q$ in a uniform way, and we have preferred not to report any errors at all. Similarly, no errors are given for values of $\tau_0$, $K_{SV}$, temperature, or any other experimental value.

In addition, we have found that values of $k_q$ and $\tau_0$ are reported in the literature with a wide variation of significant figures which, it is presumed, reflects the quality of the data as evaluated by the author. However, in our opinion, the uncertainty in values of $k_q$ and $\tau_0$ obtained from independent measurements is unlikely to be less than $\sim 10\%$, even if the reproducibility of the single experimental result is better. As a result, we have reported all $k_q$ and $\tau_0$ values with a maximum of two significant figures, unless they were given to only one significant figure in the original publication, or the reported error involves the first figure. Data having an error larger than 40–50% have been labeled with "$\sim$." In cases where upper or lower limiting values are reported in the literature, only one significant figure is used.

The same criteria were used for the presentation of activation parameters and other experimental data with the exception of temperature and solute concentrations; in the latter case, for the sake of succinctness, values are given to one significant figure if the second figure is zero.

Despite the fact that rate constants and excited-state lifetimes are functions of temperature, many publications in the literature omit a reference to a specific temperature, or express it in a nonquantitative manner (e.g., room temperature, ambient temperature). In such cases, the "$T$" column is blank for such entries in the tables. Otherwise, the temperatures or their ranges are listed as presented by the authors. If the uncertainty in the temperature is greater than 1° C, the $\sim$ label is used.

## 3.5. Arrangement of the Tables

The data are contained in 29 tables which are ordered alphabetically according to the name of the metal of the substrate. In the case of ruthenium, which constitutes a large fraction of the total, the entries are subdivided further to display separately $Ru(bpy)_3^{2+}$ and inorganic quenchers, $Ru(bpy)_3^{2+}$ and organic quenchers except methylviologen $N, N'$-dimethyl-4,4'-bipyridinium dication; $MV^{2+}$), $Ru(bpy)_3^{2+}$ and $MV^{2+}$, and all other complexes of ruthenium.

### 3.5.a. Excited States

Within each table, the various excited states with the same metal are ordered alphabetically according to the letters in the formula; some formulas denote the exact molecular composition while others incorporate names of abbreviations of the ligands. Each successive excited state is numbered with a table number $t$ and a sequence number $m$ in a $t.m$ format.

### 3.5.b. Column Headings

The columns of the tables are headed with the following entries: No. (of the excited state), Quencher, Solvent, Solution Medium, $T$ (temperature, °C), $k_q$, Comments, and Ref.

### 3.5.c. Quenchers

For any given excited state, the quenchers are divided into two groups: "inorganic" and "organic." Within each group, they are further ordered alphanumerically, and are preceded by a number of the form $t.m.n$, where $t$ = the table number, $m$ = the excited state number, and $n$ = the quencher number.

### 3.5.d. Solvent

For any given quencher, the order of presentation of the data is alphabetical according, to the name, formula, or abbreviation of the solvent. For mixed solvent systems, the more abundant solvent is listed first; their ratio ($v/v$) is given in parentheses. When the ratio is 1:1 and $H_2O$ is one of the solvents, that substance is listed first.

### 3.5.e. Temperature

Within any given solvent or solvent mixture, the ordering is by ascending values of the temperature, with the explicit value first and the approximate value second. The lowest level of ordering is given to those systems for which no value of the temperature is entered.

### 3.5.f. Solution Medium

Within any temperature group, the ordering is determined by the absence or presence of additional solutes, and by the degree of detail to which the solution medium is known. Systems that consist of the substrate and the quencher as the only solutes are presented first with the "Solution Medium" column blank; thereafter, $pH$ and ionic strength ($\mu$ is units of mol/liter (L); salt used to control ionic strength in parentheses) conditions are given in ascending order, followed by buffers and other solutes in ascending values of their concentrations. Within this hierarchy of ordering, we have attempted to group data obtained in similar media close together.

When more than one additional solute is used in the experiments, we have adopted a specific protocol for the designation of the components, depending on the degree to which the information is specified in the original paper. For example, if both LiCl and NaCl were present, the designation "LiCl and NaCl" is used. However, if independent measurements were made on solutions containing LiCl and NaCl separately which gave the same value of $k_q$, "LiCl, NaCl" is shown. If, on the other hand, experiments were performed with either LiCl or NaCl, but the actual contents are not specified, "LiCl or NaCl" is displayed.

### 3.5.g. Rate Constants

Values of $k_q$ are given in the units of L mol$^{-1}$ s$^{-1}$ for the second-order reaction. Values of $k_{cor}$ are reported here, and are labeled as "(corr)." For values of $k_q$ calculated by us from $K_{SV}$ and $\tau_0$ values, or from $k_0$, $k_d$, $k_{-d}$, and $k_{de}$ values appearing in the same paper, the indicator "(calc)" is appended.

### 3.5.h. Comments

The Comments column contains a wealth of information in highly abbreviated form in essentially this order: the experimental method used in the evaluation of $k_q$; the lifetime of *S in the absence of quencher ($\tau_0$ in the absence of air, $\tau_0^{air}$ in air- equilibrated solutions, $\tau_0^{und}$ in solutions of unknown $O_2$ content); the experimental method used for the determination of the lifetime in the absence of quencher, or the literature reference for the value used; the quenching mechanism (if uncertain, "?" is added); the range of [Q] used over which the value of $k_q$ was determined, and, presumably, is valid; activation parameters; acid–base properties of *S; references to duplicate or alternative entries; other relevant information. Values of $f$, the fraction of the quenching acts that yield electron-transfer products in the bulk solution, are reported here; when $\eta^* < 1$, the value of $\eta^*$ used in its calculation is also given.

### 3.5.i. References

References whether given for the source of $k_q$ in the "Ref." column, for the source of $\tau_0$ in the Comments column, or for alternate values of $k_q$ in the Comments column, are presented as the RCDC bibliographic number; all numbered references are cited in full in the Bibliography (Sec. 10) in ascending numerical and chronological order.

### 3.5.j. Indexes

Following the Bibliography are the Author Index, Index of Excited States, Index of Inorganic Quenchers, and Index of Organic Quenchers. Every author in every paper cited in the Ref. column as a source of $k_q$ is listed in the Author Index with the relevant RCDC number of each reference and the locator of the entry in the form $t.m$, where $t$ = table number and $m$ = excited state number. Each entry in the quencher indexes is coded in the $t.m.n$ format, where $n$ = quencher number. The substrates in the excited state index are coded in the $t.m$ format. In order to obviate problems in organic nomenclature, the Index of Organic Quenchers is cross-referenced with alternative and common names, and abbreviations

## 3.6. Experimental Methods

The methods used to obtain $k_q$ are coded in the Comments column as follows: excitation source/analytical measurement/signal recording. The same coding appears in parentheses after the value of $\tau_0$ (or $\tau_0^{air}$) if that quantity was independently determined in the paper. If the method used for $k_0$ and $\tau_0$ is the same, no additional coding is given. If the lifetime was taken from the literature, the RCDC number of the reference is given in parentheses. The codes are given below in the List of Abbreviations and Symbols (Sec. 6).

If more than one experimental method was used, and both methods gave the same value of $k_q$, the entry "SS/ LUM, LP/LUM/SST," for example, is used. When "SS/ LUM or LP/LUM/SST," for example, is used, it means that we do not know which one of the two methods was actually used to obtain the reported $k_q$ value.

### 3.6.a. Excitation Sources

The excitation of the substrate is accomplished by means of two main types of light sources: steady-state lamps, and lasers that provide a continuous light beam that is monochromatic or that can be passed through a wavelength selection device; pulsed lamps, lasers, or spark gaps that emit a flash of light with a short duration (ns to $\mu$s). The intensity of steady-state sources can also be modulated.

### 3.6.b. Analytical Measurements

Values of $k_q$ are calculated on the basis of one or more of the following analytical measurements:

(i) Intensity of the luminescence of *S, either as an instantaneous measurement during continuous excitation or as a function of time after pulsed excitation, with the intensity being proportional to [*S];

(ii) Absorbance of *S, measured as a function of time

after pulsed excitation, with the magnitude of the absorbance being proportional to [*S];

(iii) amount of a photoproduct produced during a period of continuous or pulsed excitation, which, from the independent knowledge of the intensity of the monochromatic light absorbed by the substrate, can be converted into the quantum yield of formation of the product;

(iv) intensity of luminescence from *Q as an instantaneous measurement during continuous excitation;

(v) photocurrent and electric conductivity, which are generally measured as a function of time after pulsed excitation.

### 3.6.c. Signal Recording

Luminescence intensity, absorbance, photocurrent, and conductivity methods result in the generation of an electric signal that can be recorded as a function of the time elapsed after pulsed excitation. Each signal can be recorded independently as a single shot, or many signals from the same system may be collected together and averaged, generally via computer, in order to increase the signal/noise ratio and improve the quality of the value of $k_q$ that results.

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## 5. Acknowledgments

# 6. Lists of Abbreviations and Symbols

## LIGANDS

| | |
|---|---|
| acac | Acetylacetonate ion |
| AMcapten | 1-Methyl-8-amino-6,13,19-triaza-3,10,16-trithiabicyclo[6.6.6]eicosane |
| AMMEsar | 1-Amino-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| AMMEsarH | 1-Amino-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, protonated |
| 13-At | 1,4,7,10-Tetraazacyclotrideca-10-13-dienate ion, Fig. 1 |
| AZAcapten | 1-Methyl-6,8,13,19-tetraaza-3,10,16-trithiabicyclo[6.6.6]eicosane |
| AZAMEsar | 8-Methyl-1,3,6,10,13,16,19-heptaazabicyclo[6.6.6]eicosane |
| benzo-15-crown-5 | 2,3-Benzo-1,4,7,10,13-pentaoxapentadeca-2-ene |
| bpy | 2,2'-Bipyridine |
| -bpy | 2,2'-Bipyridine (as monodentate ligand) |
| $C^3,N'$-bpy | 2,2'-Bipyridyl-$C^3,N'$ |
| 5-Brphen | 5-Bromo-1,10-phenanthroline |
| 4,4'-Bu$_2$bpy | 4,4'-Bis(*tert*-butyl)-2,2'-bipyridine |
| (BUG)$_2$bpy | 2,2'-Bipyridine with polymeric side chains, Fig. 2 |
| bzac | 1-Phenyl-1,3-butanedionate ion |
| 4,4'-Cl$_2$bpy | 4,4'-Dichloro-2,2'-bipyridine |
| CLNOsar | 1-Chloro-8-nitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| CLOHsar | 1-Chloro-8-hydroxy-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| 5-Clphen | 5-Chloro-1,10-phenanthroline |
| CLsar | 1-Chloro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| CMMEabsar | 1-Chloromethyl-8-methyl-3,6,10,13,15,18-hexaazabicyclo[6.6.6]nonadecane |
| 4,4'-(COO)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylate ion |
| 4,4'-(COObz)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, dibenzyl ester |
| 4,4'-(COOchl)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, di(3β-cholestyl) ester |
| 4,4'-(COOcyc)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, dicyclohexyl ester |
| 4,4'-(COOdec)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, di(1-decahydronaphthyl) ester |
| 4,4'-(COOet)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, diethyl ester |
| 4,4'-(COOH)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid |
| 4,4'-(COOnap)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, di(2-naphthyl) ester |
| 4,4'-(COOpr)$_2$bpy | 2,2'-Bipyridine-4,4'-dicarboxylic acid, di(2-propyl) ester |
| crypt | 4,7,13,16,21-Pentaoxa-1,10-diazabicyclo[8.8.5]tricosane |
| cyclam | 1,4,8,11-Tetraazacyclotetradecane |
| dbm | 1,3-Diphenyl-1,3-propanedionate ion |
| diAMchar | 1,12-Diamino-3,10,14,21,24,31-hexaazapentacyclo[10.10.10.$^{4,9}$.0$^{15,20}$.0$^{25,30}$]dotriacontane |
| diAMsar | 1,8-Diamino-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| diAMsarH$_2$ | 1,8-Diamino-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, diprotonated |
| diAZAchar | 1,3,10,12,14,21,24,31-Ocataazapentacyclo[10.10.10.$^{4,9}$.0$^{15,20}$.0$^{25,30}$]dotriacontane |
| diCLsar | 1,8-Dichloro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| diNOsar | 1,8-Dinitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| DMF | $N,N$-Dimethylformamide |
| DMG | Dimethylglyoximate ion |
| DMSO | Dimethylsulfoxide |
| Do$_2$Ca$_2$bpy | 1,1'-Didodecyl-2,2'-bipyridine-4,4'-dicarboxamide |
| EDTA | Ethylenediaminetetraacetate ion |
| EFMEoxosar-H | 1-Carbethoxy-2-oxo-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, deprotonated form |
| en | Ethylenediamine |
| etioporphyrin I | 2,7,12,17-Tetraethyl-3,8,13,18-tetramethylporphyrin |
| 4-(Et$_3$P)bpy | 2,2'-Bipyridine-4-(triethylphosphonio) cation |
| gly | Glycinate ion |
| $C^3,N'$-Hbpy | 2,2'-Bipyridyl-$C^3,N'$, protonated |
| HEDTA | Monohydrogen ethylenediaminetetraacetate ion |
| hfac | 1,1,1,5,5,5-Hexafluoro-2,4-pentanedionate ion |
| HYMEoxosar-H | 2-Oxo-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, deprotonated form |
| 3,3'-Me$_2$bpy | 3,3'-Dimethyl-2,2'-bipyridine |
| 4,4'-Me$_2$bpy | 4,4'-Dimethyl-2,2'-bipyridine |
| Me$_6$cycladiene | 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene |
| Me$_6$cyclam | 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecane |

| | |
|---|---|
| Me$_2$dibenzoH$_2$phen | 6,7-Dihydro-5,8-dimethyldibenzo[b,j]1,10-phenanthroline (DMCH) |
| MENOsar | 1-Methyl-8-nitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane |
| 5-Mephen | 5-Methyl-1,10-phenanthroline |
| 2,9-Me$_2$phen | 2,9-Dimethyl-1,10-phenanthroline |
| 4,7-Me$_2$phen | 4,7-Dimethyl-1,10-phenanthroline |
| 5,6-Me$_2$phen | 5,6-Dimethyl-1,10-phenanthroline |
| 3,4,7,8-Me$_4$phen | 3,4,7,8-Tetramethyl-1,10-phenanthroline |
| 3,5,6,8-Me$_4$phen | 3,5,6,8-Tetramethyl-1,10-phenanthroline |
| MePh$_2$P | Methyldiphenylphosphine |
| mesoporphyrin IX | 7,12-Diethyl-3,8,13,17-tetramethylporphyrin-2,18-dipropionic acid |
| $N$-Mevio | $N$-Methyl-4-(4-pyridyl)pyridinium cation |
| 5-(NH$_2$)phen | 5-Amino-1,10-phenanthroline |
| 2-(NO$_2$)benz | 2-Nitrobenzoate ion |
| 4-(NO$_2$)benz | 4-Nitrobenzoate ion |
| 4-(NO$_2$)bpy | 4-Nitro-2,2'-bipyridine |
| 5-(NO$_2$)phen | 5-Nitro-1,10-phenanthroline |
| NTA | Nitrilotriacetate ion |
| OEP | 2,3,7,8,12,13,17,18-Octaethylporphyrin |
| pdo | 1,3-Propanedionate ion |
| 4,4'-Ph$_2$bpy | 4,4'-Diphenyl-2,2'-bipyridine |
| phen | 1,10-Phenanthroline |
| 5-Phphen | 5-Phenyl-1,10-phenanthroline |
| 2,9-Ph$_2$phen | 2,9-Diphenyl-1,10-phenanthroline |
| 4,7-Ph$_2$phen | 4,7-Diphenyl-1,10-phenanthroline |
| 4,7-(PhSO$_3$)$_2$phen | 1,10-Phenanthroline-4,7-di(phenyl-4-sulfonate) ion |
| py | Pyridine |
| sar | 3,6,10,13,16,19-Hexaazabicyclo[6.6.6]eicosane |
| sep | 1,3,6,8,10,13,16,19-Octaazabicyclo[6.6.6]eicosane |
| 4,4'-(SO$_3$)$_2$bpy | 2,2'-Bipyridine-4,4'-disulfonate ion |
| TEOA | Triethanolamine |
| terpy | 2,2',2''-Terpyridine |
| tfac | 1,1,1-Trifluoro-2,4-pentanedionate ion |
| tfbzac | 1-Phenyl-4,4,4-trifluoro-1,3-butanedionate ion |
| thd | 2,2,6,6-Tetramethyl-3,5-heptanedionate ion |
| TMePyP | 5,10,15,20-Tetrakis(1-methylpyridinium-4-yl)porphyrin |
| TPP | 5,10,15,20-Tetraphenylporphyrin |
| TPTZ | 2,4,6-Tris(2-pyridyl)-1,3,5-triazine |
| tta | 1-Thienyl-4,4,4-trifluoro-1,3-butanedionate ion |
| uroporphyrin I | Porphyrin-2,7,12,17-tetraacetic-3,8,13,18-tetrapropionic acid |

## ORGANIC QUENCHERS

| | |
|---|---|
| bpy | 2,2'-Bipyridine |
| bpy$^{2+}$ | 2,2'-Bipyridinium dication (in $N,N'$-disubstituted derivatives) |
| bpyH$^+$ | 2,2'-Bipyridine, monoprotonated |
| bpyH$_2^{2+}$ | 2,2'-Bipyridine, diprotonated |
| β-CD | β-Cyclodextrin |
| CDTA | *trans*-1,2-Diaminocyclohexane-$N,N,N',N'$-tetraacetic acid |
| DDT | 2,2-Bis(4-chlorophenyl)-1,1,1-trichloroethane |
| DMSO | Dimethylsulfoxide |
| DQ$^{2+}$ | $N,N'$-Ethylene-2,2'-bipyridinium dication (Diquat) |
| EDTA | Ethylenediaminetetraacetic acid |
| H-3-pyl | Pyridinium-3-yl cation radical |
| H-4-pyl | Pyridinium-4-yl cation radical |
| Me-2-pyl | $N$-Methylpyridinium-2-yl cation radical |
| Me-3-pyl | $N$-Methylpyridinium-3-yl cation radical |
| Me-4-pyl | $N$-Methylpyridinium-4-yl cation radical |
| MV$^{2+}$ | $N,N'$-Dimethyl-4,4'-bipyridinium dication (methylviologen, Paraquat) |
| OrgQue1 | see Fig. 3 |
| OrgQue2 | see Fig. 3 |
| OrgQue3 | see Fig. 3 |
| OrgQue4 | see Fig. 3 |
| OrgQue5 | see Fig. 3 |
| OrgQue6 | 2,1,3-Benzothiadiazole-4,7-dicarbonitrile, Fig. 4 |
| OrgQue7 | 1,1'-Bis(phenylmethyl)-3,3'-dicarboxamide-1,1',4,4'-tetrahydro-4,4'-bipyridine, Fig. 5 |
| OrgQue8 | see Fig. 6 |
| OrgQue9 | see Fig. 6 |
| OrgQue10 | see Fig. 6 |

| | |
|---|---|
| OrgQue11 | see Fig. 7a |
| OrgQue12 | see Fig. 7b |
| OrgQue13 | 2,2,6,6-Tetramethyl-4-oxopiperidine-1-oxyl radical, Fig. 8a |
| OrgQue14 | 2,2,6,6-Tetramethylpiperidine-1-oxyl radical, Fig. 8b |
| phen$^{2+}$ | 1,10-Phenanthrolinium dication (in $N,N'$-disubstituted derivatives) |
| phenH$^+$ | 1,10-Phenanthroline, monoprotonated |
| phenH$_2$$^{2+}$ | 1,10-Phenanthroline, diprotonated |
| Poly-2,4-ionene | Poly[(dimethylimino)-1,4-butanediyl(dimethylimino)-1,2-ethanediyl dication], Fig. 9 |
| PolyPTZ | Polymeric phenothiazine, see Fig. 10 |
| PolyVio1 | Polymeric viologen, see Fig. 11 |
| PolyVio2 | Polymeric viologen, see Fig. 12 |
| PolyVio3 | Polymeric viologen, see Fig. 13 |
| PolyVio4 | Polymeric viologen, see Fig. 13 |
| PolyVio5 | Polymeric viologen, see Fig. 13 |
| PolyVio6 | Polymeric viologen, see Fig. 13 |
| PolyVio7 | Polymeric viologen, see Fig. 13 |
| PolyVio8 | Polymeric viologen, see Fig. 13 |
| PolyVio9 | Polymeric viologen, see Fig. 13 |
| PolyVio10 | Polymeric viologen, see Fig. 14 |
| PolyVio11 | Polymeric viologen, see Fig. 15 |
| PolyVio12 | Polymeric viologen, see Fig. 16 |
| PolyVio13 | Polymeric viologen, see Fig. 16 |
| PolyVio14 | Polymeric viologen, see Fig. 17 |
| py | Pyridine |
| py$^+$ | Pyridinium cation (in $N$-substituted derivatives) |
| pyH$^+$ | Pyridine, protonated |
| sydnone | 1,2,3-Oxadiazol-5-one, Fig. 18 (in mono- and disubstituted derivatives) |
| Triton X-100 | $C_8H_{17}C_6H_4(OCH_2CH_2)_xOH$ (x = 9 or 10) |
| vio$^+$ | 4-(4-Pyridyl)pyridinium cation (in $N$-monosubstituted derivatives) |
| vio$^{2+}$ | 4,4'-Bipyridinium dication (in $N,N'$-disubstituted derivatives) |
| vioH$^+$ | 4,4'-Bipyridine, monoprotonated |
| vioH$^{2+}$ | 4-(4-Pyridyl)pyridinium cation, protonated (in $N$-mono-substituted derivatives) |
| vioH$_2$$^{2+}$ | 4,4'-Bipyridine, diprotonated |

## OTHER MATERIALS

| | |
|---|---|
| ACbuf | Acetate buffer |
| AN | Acetonitrile |
| AQN | Poly[imino-2-(dimethylamino)hexamethylene-1-oxo], Fig. 19 |
| BHDC | Benzyldimethyl-$n$-hexadecylammonium chloride |
| BObuf | Borate buffer |
| BRbuf | Britton-Robinson buffer (0.008 mol/L acetate, 0.008 mol/L phosphate, 0.008 mol/L borate) |
| $n$-BuOH | 1-Butanol |
| $t$-BuOH | $tert$-Butyl alcohol |
| BuN | $iso$-Butyronitrile |
| CAbuf | Carbonate buffer |
| 6CB | Cyanohexylbiphenyl |
| β-CD | β-Cyclodextrin |
| CMC | critical micelle concentration |
| CTAB | Cetyltrimethylammonium bromide |
| CTAC | Cetyltrimethylammonium chloride |
| DMA | $N,N$-Dimethylacetamide |
| DMF | $N,N$-Dimethylformamide |
| DMSO | Dimethylsulfoxide |
| dTBP | Tributylphosphate (perdeuterated) |
| EDTA | Ethylenediaminetetraacetic acid |
| EtMO | $N$-Ethylmorpholine |
| EtOH | Ethanol |
| FA | Formamide |
| HAc | Acetic acid |
| HSEtOH | Mercaptoethanol |
| IMIDbuf | Imidazole buffer |
| MeCH | Methylcyclohexane |
| MeOH | Methanol |
| Me$_2$SO$_4$ | Sulfuric acid, dimethyl ester |
| MF | $N$-Methylformamide |
| MP | $N$-Methylpropionamide |
| NaAc | Sodium acetate |

| | |
|---|---|
| NTA | Nitrilotriacetate ion |
| Pbuf | Phosphate buffer |
| PHTHbuf | Phthalate buffer |
| PMA | Poly(methacrylic acid) |
| polybrene | Poly[(dimethyliminio)-1,3-propanediyl(dimethyliminio)-1,6-hexadiyl dication], Fig. 20; concentration based on the ionic charge |
| PPh$_3$ | Triphenylphosphine |
| 1-PrOH | 1-Propanol |
| 2-PrOH | 2-Propanol |
| PVA | Poly(vinylalcohol) |
| PVS | Poly(vinylsulfate) |
| py | Pyridine |
| PYbuf | Pyridine buffer |
| SLS | Sodium lauryl sulfate |
| TBAB | Tetrabutylammonium bromide |
| TBAC | Tetrabutylammonium chloride |
| TBAF | Tetrabutylammonium hexafluorophosphate |
| TBAP | Tetrabutylammonium perchlorate |
| TBAS | Tetrabutylammonium trifluoromethylsulfate |
| TBP | Tributylphosphate |
| TEAC | Tetraethylammonium chloride |
| TEAP | Tetraethylammonium perchlorate |
| TEOA | Triethanolamine |
| THF | Tetrahydrofuran |
| TMAC | Tetramethylammonium chloride |
| TMP | Trimethylphosphate |
| TOAB | Tetraoctylammonium bromide |
| TPeAC | Tetrapentylammonium chloride |
| TPrAB | Tetrapropylammonium bromide |
| TPrAC | Tetrapropylammonium chloride |
| TRbuf | Tris buffer |

## OTHER ABBREVIATIONS AND SYMBOLS

| | |
|---|---|
| (calc) | calculated from $\tau$ and $K_{SV}$ or from rate constants for specific steps |
| (corr) | corrected for diffusional effects |
| $E_a$ | activation energy |
| EQ | quenching of an higher-energy state |
| estd | estimated |
| $f$ | fraction of quenching acts that yield electron-transfer products in the bulk solution |
| $k_{dif}$ | diffusion rate constant (L mol$^{-1}$ s$^{-1}$) |
| $k_{obs}$ | experimentally observed rate constant |
| $k_q$ | quenching rate constant |
| $K_{SV}$ | Stern-Volmer constant |
| $K_{SV}^{\tau}$ | Stern-Volmer constant from lifetime measurements |
| L | ligand |
| $p_Q$ | partial pressure of gaseous Q in equilibrium with the solution |
| $p_{app}$ | applied pressure |
| Q | quencher |
| S | substrate |
| *S | excited state of the substrate involved in quenching |
| SQ | static quenching |
| S-V | Stern-Volmer |
| TT | triplet-triplet annihilation |
| $\Delta G^*$ | free energy of activation |
| $\Delta H^*$ | enthalpy of activation |
| $\Delta S^*$ | entropy of activation |
| $\Delta V^*$ | volume of activation |
| $\eta^*$ | efficiency of population of the quenched excited state |
| $\mu$ | ionic strength (mol/L) |
| $\tau_0$ | lifetime in the absence of quencher, air-free solution |
| $\tau_0^{air}$ | lifetime in the absence of quencher, air-equilibrated solution |
| $\tau_0^{und}$ | lifetime in the absence of quencher, solution of unknown O$_2$ content |
| φ | quantum yield of formation of the quenched excited state |

*Experimental methods*

| | |
|---|---|
| ABS | absorption |
| AVE | multiple shot with signal averaging |
| ECM | electric conductivity |

| EMI | emission quenching (method not specified) |
|-----|-------------------------------------------|
| FP | conventional flash |
| LIF | lifetime quenching (method not specified) |
| LP | laser flash |
| LUM | luminescence |
| MS | modulated light source |
| PCM | photocurrent |
| PM | phase modulation |
| PR | pulse radiolysis |
| QYP | quantum yield of a photoproduct |
| SL | spark lamp |
| SPC | single photon counting |
| SS | steady state irradiation |
| SST | single shot signal |

*Quenching mechanisms*

| CD | collisional deactivation |
|----|--------------------------|
| CR | chemical reaction |
| ET | energy transfer |
| EX | exciplex formation |
| HA | hydrogen abstraction |
| OT | oxidative electron transfer |
| PT | proton transfer |
| RT | reductive electron transfer |

# 7. Figures

FIG. 5. OrgQue7.

FIG. 6. OrgQue8 (R = Br); OrgQue9 (R = H); OrgQue10 (R = OCH$_3$).
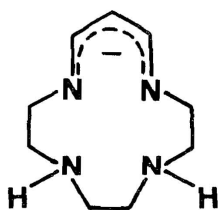
FIG. 1. 13-At.
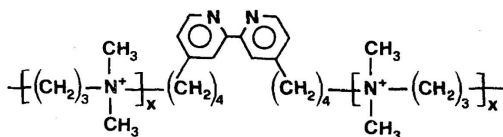
FIG. 2. (BUG)$_2$ bpy.
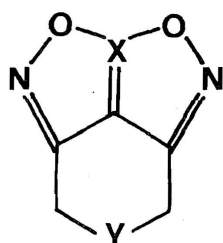
FIG. 3. OrgQue1 (X = S, Y = SO$_2$); OrgQue2 (X = Se, Y = S); OrgQue3 (X = Se, Y = CH$_2$); OrgQue4 (X = S, Y = CH$_2$); OrgQue5 (X = S, Y = S).

FIG. 4. OrgQue6.
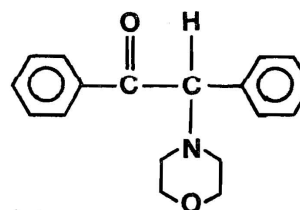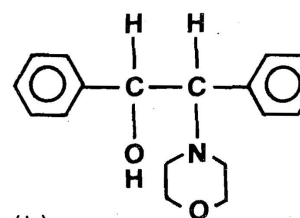
(a)    (b)

FIG. 7. (a) OrgQue11; (b) OrgQue12.
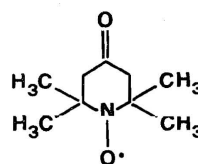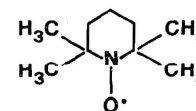
(a)    (b)

FIG. 8. (a) OrgQue13; (b) OrgQue14.
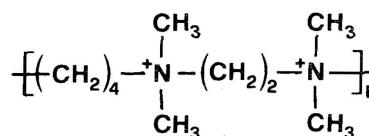
FIG. 9. Poly-2, 4-ionene.
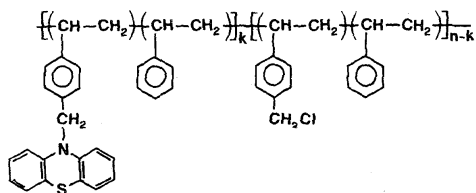
FIG. 10. PolyPTZ.
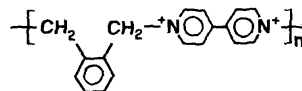
FIG. 15. PolyVio11.
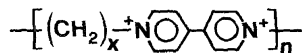
FIG. 16. PolyVio12 ($x = 4$);
PolyVio13 ($x = 3$).
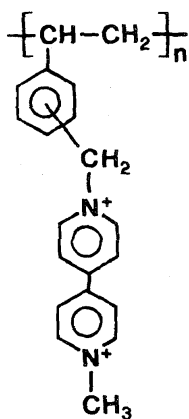
FIG. 11. PolyViol (41% quaternization).
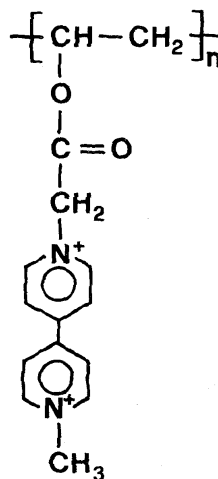
FIG. 17. PolyVio14 (40% quaternization).

; (b)
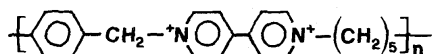
FIG. 12. PolyVio2.
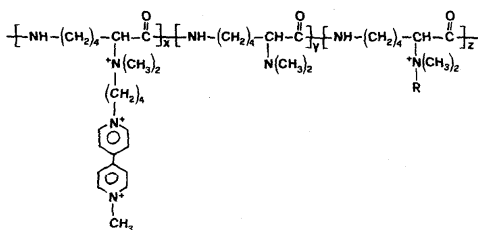
FIG. 18. Sydnone.

FIG. 13. PolyVio3 ($X = 5\%$, $Y = 95\%$); PolyVio4 ($X = 10\%$, $Y = 90\%$);
PolyVio5 ($X = 12\%$, $Y = 88\%$); PolyVio6 ($X = 25\%$, $Y = 75\%$);
PolyVio7 ($X = 5\%$, $Y = 45\%$, $Z = 50\%$, R = $C_2H_5$); PolyVio8
($X = 5\%$, $Z = 95\%$, R = $C_2H_5$); PolyVio9 ($X = 5\%$, $Z = 95\%$,
R = $C_3H_6SO_3$ ).
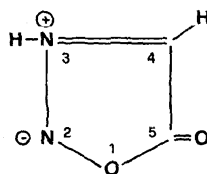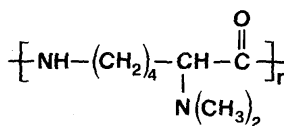
FIG. 19. AQN.
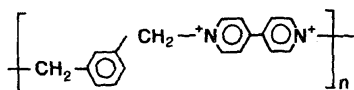
FIG. 20. Polybrene.

FIG. 14. PolyVio10.
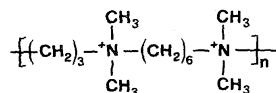
# 8. Tables of Quenching Data

TABLE 1. Quenching of excited aluminum complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **1.1.** | **Al(phthalocyanine)Cl** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 1.1.1. | Co(bpy)$_3$$^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $2.3 \times 10^7$ | LP/AES/AVE; ET'; [Q] < 0.001 mol/L | 84A122 |
| 1.1.2. | Co(bpy)$_3$$^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $8.3 \times 10^7$ | LP/AES/AVE; OT $f$ = 0.38; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| 1.1.3. | Co(phen)$_3$$^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $5.3 \times 10^7$ | LP/AES/AVE; ET'; [Q] < 0.001 mol/L | 84A122 |
| 1.1.4. | Co(phen)$_3$$^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $1.9 \times 10^8$ | LP/AES/AVE; OT $f$ = 0.53; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| 1.1.5. | Co(terpy)$_2$$^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $1.3 \times 10^8$ | LP/AES/AVE; ET! | 84A122 |
| 1.1.6. | Co(terpy)$_2$$^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $1.5 \times 10^8$ | LP/AES/AVE; OT $f$ ≈ 0.066; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| 1.1.7. | Fe(bpy)(CN)$_4$$^-$ | DMA/H$_2$O (2.3/1) | | ~15 | $2.8 \times 10^8$ | LP/AES/SST; OT; $f$ = 0 | 83E088 |
| 1.1.8. | Fe(bpy)(CN)$_4$$^{2-}$ | DMSO/H$_2$O (4/1) | | ~28 | $5.8 \times 10^8$ | LP/AES/SST; RT; $f$ = 0 | 83E088 |
| 1.1.9. | cis-Fe(bpy)$_2$(CN)$_2$$^+$ | DMA/H$_2$O (2.3/1) | | ~15 | $4.4 \times 10^8$ | LP/AES/SST; OT; $f$ = 0 | 83E088 |
| 1.1.10. | Fe(C$_5$H$_5$)$_2$ | DMSO/H$_2$O (9/1) | | ~28 | $6.6 \times 10^8$ | LP/AES/SST; RT; $f$ = 0.07 | 83E088 |
| 1.1.11. | Fe(CN)$_6$$^{3-}$ | DMA/H$_2$O (2.3/1) | | ~15 | $1.1 \times 10^7$ | LP/AES/SST; OT; $f$ = 0 | 83E088 |
| 1.1.12. | cis-Fe(phen)$_2$(CN)$_2$$^+$ | DMA/H$_2$O (2.3/1) | | ~15 | $5.2 \times 10^8$ | LP/AES/SST; OT | 83E088 |
| *Organic Quenchers* | | | | | | | |
| 1.1.13. | 1,4-Benzoquinone | DMA/H$_2$O (2.3/1) | | ~15 | $9.2 \times 10^8$ | LP/AES/SST; OT; $f$ = 0.40 | 83E088 |
| 1.1.14. | 1,4-Bis(*N*,*N*-dimethylamino)benzene | DMA/H$_2$O (2.3/1) | | ~28 | $7.2 \times 10^8$ | LP/AES/SST; RT; $f$ = 0.84 | 83E088 |
| | 1,4-Bis(*N*,*N*-dimethylamino)benzene | DMSO/H$_2$O (4/1) | | ~28 | $1.9 \times 10^9$ | LP/AES/SST; RT; $f$ = 0.85 | 83E088 |
| 1.1.15. | 4,4'-Bis(*N*,*N*-dimethylamino)biphenyl | DMSO/H$_2$O (4/1) | | ~28 | $1.7 \times 10^8$ | LP/AES/SST; RT; $f$ = 0.72; [Q] = (1-7) × 10$^{-5}$ mol/L | 83E088 |

TABLE 1. Quenching of excited aluminum complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **1.1.** | **Al(phthalocyanine)Cl**—Continued | | | | | | |
| 1.1.16. | 2,5-Dichloro-1,4-benzoquinone | DMA/H$_2$O (2.3/1) | | ~15 | $5.5 \times 10^8$ | LP/ABS/SST; OT; $f = 0.53$ | 83E088 |
| 1.1.17. | 2,6-Dichloro-1,4-benzoquinone | DMA/H$_2$O (2.3/1) | | ~15 | $4.8 \times 10^8$ | LP/ABS/SST; OT; $f = 0.59$; [Q] = (2-10) $\times$ 10$^{-5}$ mol/L | 83E088 |
| 1.1.18. | 3,3'-Dimethyl-4,4'-diaminobiphenyl | DMSO/H$_2$O (4/1) | | ~28 | $7.9 \times 10^7$ | LP/ABS/SST; RT; $f = 0.52$ | 83E088 |
| 1.1.19. | MV$^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $\sim 1 \times 10^2$ | LP/ABS/SST; OT | 83E088 |
| 1.1.20. | Phencthiazine | DMSO/H$_2$O (4/1) | | ~28 | $1 \times 10^6$ | LP/ABS/SST; RT; $f = 0.52$ | 83E088 |
| 1.1.21. | Tetrachloro-1,4-benzoquinone | DMA/H$_2$O (2.3/1) | | ~15 | $4.5 \times 10^8$ | LP/ABS/SST; OT; $f = 0.60$ | 83E088 |
| **1.2.** | **Al(5,10,15,20-tetraphenylporphyrin)$^+$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 1.2.1. | 1,4-Benzoquinone | EtOH | | | $1.0 \times 10^9$ | LP/ABS/SST; OT; $f = 0.25$; $\phi = 0.85$ (82E428) | 83F182 |
| **1.3.** | **Al(5,10,15,20-tetraphenylporphyrin)(OH)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 1.3.1. | 1,4-Benzoquinone | Toluene | | | $7 \times 10^7$ (calc) | FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718 | 82E636 |
| 1.3.2. | Methyl-1,4-benzoquinone | Toluene | | | $2 \times 10^7$ (calc) | FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718 | 82E636 |
| 1.3.3. | 1,4-Naphthoquinone | Toluene | | | $3 \times 10^7$ (calc) | FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718 | 82E636 |
| 1.3.4. | 9,10-Phenanthrenequinone | Toluene | | | $6 \times 10^7$ (calc) | FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718 | 82E636 |
| 1.3.5. | Tetramethyl-1,4-benzoquinone | Toluene | | | $8 \times 10^6$ (calc) | FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718 | 82E636 |

TABLE 2. Quenching of excited cadmium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **2.1.** | **Cd(mesoporphyrin IX dimethyl ester)** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 2.1.1. | $O_2$ | Toluene | | | $3.2 \times 10^9$ | LP/ABS/SST; ET; [Q] = 0.0011 mol/L | 81E738 |
| **2.2.** | **Cd(5,10,15,20-tetraphenylporphyrin)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 2.2.1. | 1,4-Benzoquinone | EtOH | | | $3.0 \times 10^9$ | LP/ABS/SST; OT; $f = 0.16$ | 83F182 |

TABLE 3. Quenching of excited cerium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **3.1.** | **Ce$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 3.1.1. | Cr$^{3+}$ | $H_2O$ | 1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$ | | $7.7 \times 10^7$ | SL/LUM/SPC; $\tau_0^{air} = 44$ ns; OT; [Q] $\leq 0.15$ mol/L | 80A287 |
| 3.1.2. | Cu$^{2+}$ | $H_2O$ | 1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$ | | $5.2 \times 10^8$ | SL/LUM/SPC; $\tau_0^{air} = 44$ ns; OT; [Q] $\leq 0.08$ mol/L | 80A287 |
| 3.1.3. | Eu$^{3+}$ | $H_2$ | 1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$ | | $1.1 \times 10^7$ | SL/LUM/SPC; $\tau_0^{air} = 44$ ns; OT; [Q] $\leq 0.50$ mol/L | 80A287 |
| 3.1.4. | Fe$^{3+}$ | H. | 1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$ | | $1.1 \times 10^9$ | SL/LUM/SPC; $\tau_0^{air} = 44$ ns; OT; [Q] $\leq 0.008$ mol/L | 80A287 |
| 3.1.5. | Tl$^{3+}$ | H | 1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$ | | $6.7 \times 10^8$ | SL/LUM/SPC; $\tau_0^{air} = 44$ ns; OT; [Q] $\leq 0.029$ mol/L | 80A287 |

TABLE 4. Quenching of excited chromium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.1. Cr(5-Brphen)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.1.1. | Cr(5-Brphen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $5.4 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.18$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(5-Brphen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $8.1 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.17$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| 4.1.2. | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $4.0 \times 10^7$ | SS/LUM; $\tau_0 = 0.16$ ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) $\times$ 10$^{-4}$ mol/L | 78F366 |
| **4.2. Cr(CN)$_6$$^{3-}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.2.1. | ICN | DMF | | 22 | $3.2 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $E_a = 38$ kJ/mol ($-55$ to 60 °C); $\Delta S^\ddagger = -48$ J/mol·K; $\tau_0$ at 25 °C | 83E203 |
| | ICN | DMF | $5 \times 10^{-4}$ mol/L TOAB | 22 | $2.4 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| | ICN | DMF | 0.005 mol/L TOAB | 22 | $1.6 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| | ICN | DMF | 0.015 mol/L TOAB | 22 | $1.0 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| | ICN | DMF | 0.025 mol/L TOAB | 22 | $5 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| | ICN | DMF | 0.1 mol/L TOAB | 22 | $1 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| 4.2.2. | O$_2$ | DMF | | 22 | $1.7 \times 10^6$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; [Q] = 0.0012 mol/L; $\tau_0$ at 25 °C | 83E203 |
| *Organic Quenchers* | | | | | | | |
| 4.2.3. | Benzophenone | DMF | | 22 | $2.0 \times 10^1$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.4. | 1-Chloro-4-nitrobenzene | DMF | | 22 | $1.6 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.5. | 2,4-Dinitroaniline | DMF | | 22 | $3.3 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.6. | 2,4-Dinitrobenzaldehyde | DMF | | 22 | $6.5 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.7. | 1,2-Dinitrobenzene | DMF | | 22 | $1.3 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.2.** | **Cr(CN)$_6$$^{3-}$**—Continued | | | | | | |
| 4.2.8. | 1,3-Dinitrobenzene | DMF | | 22 | $1 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.9. | Methyl iodide | DMF | | 22 | $1.6 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| 4.2.10. | Naphthacene | DMF | | 22 | $3.5 \times 10^7$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $E_a = 2.6$ kJ/mol ($-55$ to 60 °C); $\Delta S^{\ddagger} = -100$ J/mol·K; ET; $\tau_0$ at 25 °C | 83E203 |
| 4.2.11. | 4-Nitroaniline | DMF | | 22 | $1.1 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.12. | 2-Nitrobenzaldehyde | DMF | | 22 | $2 \times 10^4$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.13. | Nitrobenzene | DMF | | 22 | $2.2 \times 10^2$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.14. | 2-Nitrotoluene | DMF | | 22 | $2.2 \times 10^2$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.15. | 9,10-Phenanthrenequinone | DMF | | 22 | $6 \times 10^3$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C; OT? | 83E203 |
| 4.2.16. | Tetrabutylammonium bromide | DMF | | 22 | $1 \times 10^2$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $\tau_0$ at 25 °C | 83E203 |
| 4.2.17. | Tetrabutylammonium iodide | DMF | | 22 | $3 \times 10^2$ | LP/LUM/SST; $\tau_0 = 6.5$ ms; $E_a = 28$ kJ/mol ($-55$ to 60 °C); $\Delta S^{\ddagger} = -110$ J/mol·K; $\tau_0$ at 25 °C | 83E203 |
| **4.3.** | **Cr(5-Clphen)$_3$$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.3.1. | Cr(5-Clphen)$_3$$^{3+}$ | H$_2$O | 1 mol/L HCl | 22 | $1.7 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.18$ ms; CD; [Q] = [S] $\leq 0.0013$ mol/L; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(5-Clphen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $3.5 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.15$ ms; CD; $\tau_0$ extrap'd to [S] = 0; same $k_q$ with SS/QYP, see Mech. [5] | 81E458 |
| 4.3.2. | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $4.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.18$ ms (LP/LUM/AVE); RT | 78F366 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $1.2 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/AVE); RT | 79E270 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.3.** | **Cr(5-Clphen)$_3$$^{2+}$—Continued** | | | | | | |
| 4.3.3 | I$^-$ | H$_2$O | 1 mol/L HCl | 25 | $8.0 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 50$ μs (LP/LUM/AVE); RT? | 79E270 |
| 4.3.4 | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $3.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.16$ ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L | 78F366 |
| | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $3.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.13$ ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| **4.4.** | **Cr(4,4'-Me$_2$bpy)$_3$$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.4.1. | Cr(4,4'-Me$_2$bpy)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 5 mol/L HCl | 22 | $2.0 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.31$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| 4.4.2. | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $8.2 \times 10^5$ | SS/LUM; $\tau_0 = 0.21$ ms (LP/LUM/AVE); RT | 78F366 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $2.2 \times 10^6$ | SS/LUM; $\tau_0{}^{air} = 77$ μs (estd); RT | 79E270 |
| 4.4.3. | I$^-$ | H$_2$O | 1 mol/L HCl | 25 | $4.0 \times 10^7$ | SS/LUM; $\tau_0{}^{air} = 77$ μs (estd); RT? | 79E270 |
| 4.4.4. | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $4.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.18$ ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L | 78F366 |
| | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $3.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.23$ ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| **4.5.** | **Cr(3,4,7,8-Me$_4$phen)$_3$$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.5.1. | Cr(3,4,7,8-Me$_4$phen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $1.5 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.64$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(3,4,7,8-Me$_4$phen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $3.9 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.62$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| 4.5.2. | Fe$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $9.2 \times 10^5$ | SS/LUM; $\tau_0{}^{air} = 26$ μs (estd); RT | 79E270 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.5.** | **Cr(3,4,7,8-Me$_4$phen)$_3$$^{3+}$—Continued** | | | | | | |
| 4.5.3. | I$^-$ | H$_2$O | 1 mol/L HCl | 25 | $4.7 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 26 μs (estd); RT? | 79E270 |
| 4.5.4. | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $1.5 \times 10^8$ | SS/LUM; $\tau_0$ = 0.47 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) $\times$ 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| **4.6.** | **Cr(4,7-Me$_2$phen)$_3$$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.6.1. | Cr(4,7-Me$_2$phen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $1.0 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.57 ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(4,7-Me$_2$phen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $1.4 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.42 ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| 4.6.2. | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $8.9 \times 10^5$ | SS/LUM; $\tau_0$ = 0.64 ms (LP/LUM/AVE); RT | 78F366 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $6.0 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 37 μs (LP/LUM/AVE); RT | 79E270 |
| 4.6.3. | I$^-$ | H$_2$O | 1 mol/L HCl | 25 | $1.5 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 37 μs (LP/LUM/AVE); RT? | 79E270 |
| 4.6.4. | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $8.8 \times 10^7$ | SS/LUM; $\tau_0$ = 0.58 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) $\times$ 10$^{-4}$ mol/L | 78F366 |
| | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | $1.9 \times 10^8$ | SS/LUM; $\tau_0$ = 0.34 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) $\times$ 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| **4.7.** | **Cr(5-Mephen)$_3$$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.7.1. | Cr(5-Mephen)$_3$$^{3+}$ | H$_2$O | 1 mol/L HCl | 22 | $5.6 \times 10^6$ | LP/LUM/SST; $\tau_0$ = 0.42 ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(5-Mephen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $1.4 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.27 ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| 4.7.2. | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1.0 \times 10^7$ | SS/LUM; $\tau_0$ = 0.38 ms (LP/LUM/AVE); RT | 78F366 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.7. Cr(5-Mephen)$_2$$^{3+}$**—Continued | | | | | | | |
| 4.7.3. O$_2$ | | H$_2$O | 1 mol/L HCl | 25 | $6.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.31$ ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) $\times 10^{-4}$ mol/L | 78F365 |
| **4.8. Cr(5,6-Me$_2$phen)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.8.1. Cr(5,6-Me$_2$phen)$_3$$^{3+}$ | | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $7.5 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.42$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E453 |
| | Cr(5,6-Me$_2$phen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $1.7 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.29$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E453 |
| **4.9. Cr(NH$_3$)$_5$(CN)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.9.1. Cr(CN)$_3$$^{3-}$ | | DMF | | 20 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 19$ μs (LP/LUM/SST); ET; [Q] = (1-20) $\times 10^{-5}$ mol/L | 84E097 |
| | Cr(CN)$_3$$^{3-}$ | H$_2$O | $5 \times 10^{-4}$ mol/L HClO$_4$ | 20 | $6.2 \times 10^8$ | LP/LUM/SST; $\tau_0 = 22$ μs; ET; [Q] $\leq 2.5 \times 10^{-4}$ mol/L | 84E097 |
| 4.9.2. OH$^-$ | | H$_2$O | | 20 | $6.2 \times 10^9$ | LP/LUM/SST; $\tau_0 = 22$ μs; PT?; [Q] $\leq 3.3 \times 10^{-5}$ mol/L | 84E097 |
| **4.10. *trans*-Cr(NH$_3$)$_4$(CN)$_2$$^+$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.10.1. OH$^-$ | | H$_2$O | | 20 | $2.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 42$ μs; PT?; [Q] $\leq 2.5 \times 10^{-5}$ mol/L | 84E097 |
| **4.11. Cr(4,4'-Ph$_2$bpy)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.11.1. Cr(4,4'-Ph$_2$bpy)$_3$$^{3+}$ | | H$_2$O/MeOH (1.5/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $6.0 \times 10^7$ | LP/LUM/SST; $\tau_0 = 53$ μs; CD; $\tau_0$ extrap'd to [S] = 0 | 81E453 |
| | Cr(4,4'-Ph$_2$bpy)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $1.4 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.17$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E453 |
| | Cr(4,4'-Ph$_2$bpy)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 5 mol/L HCl | 22 | $1.0 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.19$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E453 |
| 4.11.2. Fe$^{2+}$ | | H$_2$O | 1 mol/L HCl | 25 | $2.0 \times 10^7$ | SS/LUM; $\tau_0^{air} = 17$ μs (LP/LUM/AVE); RT | 79E270 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.11. Cr(4,4'-Ph$_2$bpy)$_3^{3+}$**—Continued | | | | | | | |
| 4.11.3. I$^-$ | | H$_2$O | 1 mol/L HCl | 25 | $2.2 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 17 μs (LP/LUM/AVE); RT? | 79E270 |
| 4.11.4. O$_2$ | | H$_2$O | 1 mol/L HCl | 25 | $1.7 \times 10^8$ | SS/LUM; $\tau_0$ = 0.14 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) $\times$ 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| **4.12. Cr(4,7-Ph$_2$phen)$_3^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.12.1. Cr(4,7-Ph$_2$phen)$_3^{3+}$ | | H$_2$O/MeOH (1.5/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $3 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 89 μs; CD; $\tau_0$ extrap'd to [S] = 0; same $k_q$ with SS/QYP, see Mech. [5] | 81E458 |
| | Cr(4,7-Ph$_2$phen)$_3^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $7.4 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.57 ms; CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| 4.12.2. Fe$^{2+}$ | | H$_2$O | 1 mol/L HCl | 25 | $2.5 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 16 μs (LP/LUM/AVE); RT | 79E270 |
| 4.12.3. I$^-$ | | H$_2$O | 1 mol/L HCl | 25 | $5.9 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 16 μs (LP/LUM/AVE); RT? | 79E270 |
| 4.12.4. O$_2$ | | H$_2$O | 1 mol/L HCl | 25 | $3.1 \times 10^8$ | SS/LUM; $\tau_0$ = 0.37 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) $\times$ 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| *Organic Quenchers* | | | | | | | |
| 4.12.5. 1,4-Bis(N,N-dimethylamino)benzene | | AN | | ~15 | $2.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.20 ms (LP/ABS/AVE); RT; $f$ = 0.73 | 84E387 |
| 4.12.6. 4,4'-Bis(N,N-dimethylamino)biphenyl | | AN | | ~15 | $6.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.20 ms (LP/ABS/AVE); RT; $f$ = 0.21 | 84E387 |
| 4.12.7. 1,2-Diaminobenzene | | AN | | ~15 | $1.5 \times 10^{10}$ | LP/ABS/AVE; $\tau_0$ = 0.20 ms; RT; $f$ = 0.14 | 84E387 |
| 4.12.8. 1,4-Diaminobenzene | | AN | | ~15 | $6.6 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 0.20 ms; RT; $f$ = 0.50 | 84E387 |
| 4.12.9. 3,3'-Dimethyl-4,4'-diaminobiphenyl | | AN | | ~15 | $6.6 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 0.20 ms; RT; $f$ = 0.11 | 84E387 |
| 4.12.10. Triphenylamine | | AN | | ~15 | $9.2 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 0.20 ms; RT; $f$ = 0.019 | 84E387 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.13. Cr(5-Phphen)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.13.1. | Cr(5-Phphen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L HCl | 22 | $5.7 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.22$ ms; CD; [Q] = [S] ≤ 0.0012 mol/L; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(5-Phphen)$_3$$^{3+}$ | H$_2$O/AN (24/1) | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $9.3 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.18$ ms; CD; $\tau_0$ extrap'd to [S] = 0; same $k_q$ with SS/QYP, see Mech. [5] | 81E458 |
| **4.14. Cr(bpy)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.14.1. | Co(acac)$_3$ | Acetone | | ~22 | $2.0 \times 10^8$ | LP/LUM/SST; ET | 83E223 |
| 4.14.2. | Co(CN)$_6$$^{3-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | $<2 \times 10^5$ | SS/LUM; $\tau_0$$^{air}$ = 51 μs (SL/LUM/SPC) | 78F263 |
| | Co(CN)$_6$$^{3-}$ | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | $<1 \times 10^6$ | SS/LUM; $\tau_0$ = 70 μs (LP/LUM/SST); ET, RT | 83F230 |
| 4.14.3. | *trans*-Co(cyclam)Cl$_2$$^+$ | H$_2$O | 1 mol/L NaClO$_4$; pH 2 | 25 | $2.5 \times 10^7$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.4. | *trans*-Co(cyclam)(H$_2$O)$_2$$^{3+}$ | H$_2$O | 1 mol/L NaClO$_4$; pH 2 | 25 | $1.8 \times 10^6$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.5. | *trans*-Co(cyclam)(H$_2$O)(N$_3$)$^{2+}$ | H$_2$O | 1 mol/L NaClO$_4$; pH 1 | 25 | $1.6 \times 10^8$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.6. | Co(DMG)$_2$(C$_2$H$_5$)(H$_2$O) | H$_2$O | 0.01 mol/L HCl | ~22 | $1.4 \times 10^9$ | LP/LUM/SST; ET | 83E223 |
| 4.14.7. | Co(en)$_3$$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $1 \times 10^6$ | SS/LUM; $\tau_0$$^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| 4.14.8. | *cis*-Co(en)$_2$Cl$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $1.8 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 38 μs (LP/LUM/AVE); ET; [Q] = (1-8) $\times 10^{-4}$ mol/L | 83E586 |
| 4.14.9. | *trans*-Co(en)$_2$Cl$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $1.0 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 38 μs (LP/LUM/AVE); ET; [Q] = (1-9) $\times 10^{-4}$ mol/L | 83E586 |
| 4.14.10. | *cis*-Co(en)$_2$(H$_2$O)Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $2.2 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| 4.14.11. | *cis*-Co(en)$_2$(NCS)$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $3.9 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 38 μs (LP/LUM/AVE); ET; [Q] = (1-5) $\times 10^{-4}$ mol/L | 83E586 |
| 4.14.12. | *trans*-Co(en)$_2$(NCS)$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $9.2 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 38 μs (LP/LUM/AVE); ET; [Q] = (1-8) $\times 10^{-4}$ mol/L | 83E586 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.14.** | **Cr(bpy)$_3$$^{3+}$—Continued** | | | | | | |
| 4.14.13. | cis-Co(en)$_2$(NCS)Cl$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $3.6 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET; [Q] = (1-5) × 10$^{-4}$ mol/L | 83E586 |
| 4.14.14. | trans-Co(en)$_2$(NCS)Cl$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $6.2 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET; [Q] = (1-8) × 10$^{-4}$ mol/L | 83E586 |
| 4.14.15. | cis-Co(en)$_2$(NH$_3$)Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $3.2 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| 4.14.16. | Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $2 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| | Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | 1 mol/L HCl | 25 | $4.3 \times 10^6$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.17. | Co(NH$_3$)$_5$(CN)$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $5.0 \times 10^6$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.18. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $2.0 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| 4.14.19. | Co(NH$_3$)$_5$F$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $2 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| | Co(NH$_3$)$_5$F$^{2+}$ | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | $2.0 \times 10^6$ | SS/LUM; $\tau_0$ = 70 μs (LP/LUM/SST); ET, RT | 83F230 |
| 4.14.20. | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $1 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 1 mol/L HCl | 25 | $4.0 \times 10^6$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.21. | Co(NH$_3$)$_5$(N$_3$)$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 25 | $1.6 \times 10^8$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.22. | Co(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $9.1 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| | Co(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 25 | $1.9 \times 10^8$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.14.23. | Co(NH$_3$)$_5$(NO$_2$)$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $1.6 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| 4.14.24. | Co(NH$_3$)$_5$[OC(O)H]$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | 22 | $3 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 38 μs (LP/LUM/AVE); ET | 83E586 |
| 4.14.25. | Cr(bpy)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 10 | 14.9 | $1.6 \times 10^6$ | LP/LUM/SST; $\tau_0$ = 0.11 ms; CD; [Q] = [S] = (1-100) × 10$^{-5}$ mol/L; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(bpy)$_3$$^{3+}$ | H$_2$O | 5 mol/L HCl | 22 | $1.3 \times 10^6$ | LP/LUM/SST; $\tau_0$ = 0.10 ms; CD; same $k_q$ from same lab in 80E076; [Q] = [S] ≤ 0.012 mol/L; $\tau_0$ extrap'd to [S] = 0 | 81E458 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.14. Cr(bpy)$_3$$^{3+}$—Continued** | | | | | | | |
| 4.14.26. Cr(CN)$_6$$^{3-}$ | | H$_2$O | 0.5 mol/L NaCl | ~20 | $4.1 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 51 $\mu$s (SL/LUM/SPC); ET | 78F263 |
| 4.14.27. Fe$^{2+}$ | | H$_2$O | 1 mol/L HCl | ~15 | $4 \times 10^7$ | LP/ABS/AVE; $\tau_0$ = 60 $\mu$s; RT; $f$ = 0.081; Q as Cl$^-$ complex | 84E387 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L HClO$_4$ | ~15 | $7 \times 10^6$ | LP/ABS/AVE; $\tau_0$ = 60 $\mu$s; RT; $f$ = 0.17 | 84E387 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $3.7 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 55 $\mu$s (LP/LUM/AVE); RT | 79E270 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1.6 \times 10^7$ | SS/LUM; $\tau_0$ = 76 $\mu$s (LP/LUM/AVE); RT | 78F366 |
| | Fe$^{2+}$ | H$_2$O | $\mu$ = 1 | | $4.1 \times 10^7$ | RT | 767517 |
| 4.14.28. Fe(C$_5$H$_5$)$_2$ | | AN/H$_2$O (2.3/1) | | ~15 | $6.2 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 60 $\mu$s; RT; $f$ = 0.18; Q] < 5 × 10$^{-4}$ mol/L | 84E387 |
| 4.14.29. Fe(C$_5$H$_5$)(C$_5$H$_4$COOH) | | AN/H$_2$O (2.3/1) | | ~15 | $7.3 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 60 $\mu$s; RT; $f$ = 0.069; [Q] < 5 × 10$^{-4}$ mol/L | 84E387 |
| 4.14.30. Fe(CN)$_6$$^{3-}$ | | H$_2$O | 0.5 mol/L NaCl | ~20 | $2.6 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 51 $\mu$s (SL/LUM/SPC); OT? | 78F263 |
| 4.14.31. Fe(CN)$_6$$^{4-}$ | | H$_2$O | 0.5 mol/L NaCl | ~20 | $4.9 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 51 $\mu$s (SL/LUM/SPC); RT | 78F263 |
| 4.14.32. H$_2$O | | AN | | 22 | $1.3 \times 10^3$ | LP/LUM/SST; $\tau_0$ = 43 $\mu$s | 83E110 |
| 4.14.33. I$^-$ | | H$_2$O | $\mu$ = 1.0 (NaCl) | 11 | $8.5 \times 10^8$ | SS/LUM and SL/LUM/SPC; $\tau_0$$^{air}$ = 80 $\mu$s; RT?; [Q] = (1-12) × 10$^{-5}$ mol/L | 78F122 |
| | I$^-$ | H$_2$O | $\mu$ = 1.0 (NaCl) | 22 | $1.2 \times 10^9$ | LP/ABS/SST; $\tau_0$ = 63 $\mu$s; RT?; same $k_q$ from same lab in 776321 | 78F122 |
| | I$^-$ | H$_2$O | 1 mol/L HCl | 25 | $1.4 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 55 $\mu$s (LP/LUM/AVE); RT? | 79E270 |
| 4.14.34. Mo(CN)$_8$$^{4-}$ | | H$_2$C | 0.5 mol/L NaCl | ~20 | $5.2 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 51 $\mu$s (SL/LUM/SPC); RT | 78F263 |
| 4.14.35. Ni(13-At)$^+$ | | AN | | | $2.6 \times 10^8$ | SS/LUM; $\tau_0$ = 0.12 ms; RT | 81A335 |
| 4.14.36. Ni(CN)$_4$$^{2-}$ | | H$_2$C | 0.5 mol/L NaCl | ~20 | $1.4 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 51 $\mu$s (SL/LUM/SPC); RT | 78F263 |
| 4.14.37. Ni(Me$_6$cyclam)$^{2+}$ | | AN | | | $1.2 \times 10^6$ | SS/LUM; $\tau_0$ = 0.12 ms; RT | 81A335 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|------|------------------------|----------|------|
| **4.14.** | **Cr(bpy)$_3$$^{3+}$—Continued** | | | | | | |
| 4.14.38. O$_2$ | | H$_2$O | $\mu$ = 1.0 (NaCl) | 22 | 1.7 × 10$^7$ | LP/ABS/SST; $\tau_0$ = 63 $\mu$s; $p_Q$ = (2, 10) × 10$^4$ Pa; same $k_q$ from same lab in 776321 | 78F122 |
| | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | 2.7 × 10$^7$ | SS/LUM; $\tau_0$ = 66 $\mu$s (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L | 78F366 |
| | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | 1.7 × 10$^7$ | SS/LUM; $\tau_0$ = 63 $\mu$s (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| 4.14.39. OH$^-$ | | H$_2$O | | 5 | ≤2 × 10$^4$ | LP/ABS/SST | 78F122 |
| 4.14.40. Os(bpy)$_3$$^{2+}$ | | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 1.5 × 10$^9$ | SS/LUM; $\tau_0$ = 76 $\mu$s (LP/LUM/AVE); RT | 78F366 |
| 4.14.41. Os(bpy)$_3$$^{3+}$ | | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | <1 × 10$^6$ | SS/LUM; $\tau_0$ = 76 $\mu$s (LP/LUM/AVE); [Q] = ~0.001 mol/L | 78F366 |
| 4.14.42. PtBr$_4$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$) | | 2.0 × 10$^9$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 65 $\mu$s; ET; [Q] ≤ 9 × 10$^{-6}$ mol/L | 83E719 |
| 4.14.43. PtBr$_6$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$) | | 2 × 10$^7$ | LP/LUM/SST; $\tau_0$$^{air}$ = 60 $\mu$s; ET; [Q] ≤ 0.001 mol/L | 83A403 |
| 4.14.44. Pt(CN)$_4$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$ or H$_2$SO$_4$) | | ~1 × 10$^5$ | EMI; RT | 85A469 |
| 4.14.45. Pt(C$_2$O$_4$)$_2$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$) | | 7.5 × 10$^6$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 65 $\mu$s; RT; [Q] ≤ 9 × 10$^{-4}$ mol/L; same $k_q$ from same lab in 85A469 | 83E719 |
| 4.14.46. PtCl$_4$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$) | | 1.4 × 10$^7$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 65 $\mu$s; ET; [Q] ≤ 9 × 10$^{-4}$ mol/L | 83E719 |
| 4.14.47. PtCl$_6$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$) | | <2 × 10$^5$ | LP/LUM/SST; $\tau_0$$^{air}$ = 60 $\mu$s; ET; [Q] ≤ 0.001 mol/L | 83A403 |
| 4.14.48. Pt(en)$_2$$^{2+}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$ or H$_2$SO$_4$) | | 6 × 10$^5$ | EMI; RT | 85A469 |
| 4.14.49. PtF$_6$$^{2-}$ | | H$_2$O | $\mu$ = 2 (HClO$_4$) | | <2 × 10$^5$ | LP/LUM/SST; $\tau_0$$^{air}$ = 60 $\mu$s; ET; [Q] ≤ 0.001 mol/L | 83A403 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.14.** | **Cr(bpy)$_3$$^{3+}$**—Continued | | | | | | |
| 4.14.50. | Pt(NH$_3$)$_4$$^{2+}$ | H$_2$O | $\mu = 2$ (HClO$_4$ or H$_2$SO$_4$) | | $4 \times 10^5$ | EMI; RT | 85A469 |
| 4.14.51. | Pt(NO$_2$)$_4$$^{2-}$ | H$_2$O | $\mu = 2$ (HClO$_4$ or H$_2$SO$_4$) | | $2 \times 10^5$ | EMI; RT | 85A469 |
| 4.14.52. | Pt(SCN)$_4$$^{2-}$ | H$_2$O | $\mu = 2$ (HClO$_4$) | | $1.3 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 65$ μs; RT; [Q] $\leq 9 \times 10^{-6}$ mol/L | 83E719 |
| 4.14.53. | Pt(SCN)$_6$$^{2-}$ | H$_2$O | $\mu = 2$ (HClO$_4$) | | $1.5 \times 10^8$ | LP/LUM/SST; $\tau_0^{air} = 60$ μs; ET; [Q] $\leq 0.001$ mol/L | 83A403 |
| 4.14.54. | Ru(bpy)$_3$$^{2+}$ | H$_2$O | $\mu = 0.2$ | 23 | $4.0 \times 10^8$ | SS/LUM; $\tau_0^{air} = 36$ μs (SL/LUM/SST); RT | 756325 |
| | Ru(bpy)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $6.1 \times 10^8$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.55. | Ru(bpy)$_3$$^{3+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $6 \times 10^6$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); ET?; [Q] $= \sim 0.001$ mol/L | 78F366 |
| 4.14.56. | Ru(CN)$_6$$^{4-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | $5.5 \times 10^9$ | SS/LUM; $\tau_0^{air} = 51$ μs (SL/LUM/SPC); RT | 78F263 |
| 4.14.57. | Ru(5-Clphen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $6.1 \times 10^8$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.58. | Ru(4,4'-Me$_2$bpy)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.59. | Ru(3,4,7,8-Me$_4$phen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1 \times 10^9$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.60. | Ru(4,7-Me$_2$phen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.61. | Ru(5-Mephen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $9.9 \times 10^8$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.62. | Ru(NH$_3$)$_6$$^{3+}$ | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | $<1 \times 10^6$ | SS/LUM; $\tau_0 = 70$ μs (LP/LUM/SST); ET, RT | 83F230 |
| 4.14.63. | Ru[5-(NO$_2$)phen]$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| 4.14.64. | Ru(phen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $9.1 \times 10^8$ | SS/LUM; $\tau_0 = 76$ μs (LP/LUM/AVE); RT | 78F366 |
| *Organic Quenchers* | | | | | | | |
| 4.14.65. | 1-Aminonaphthalene | AN | 0.02 mol/L TEAP | ~22 | $7.2 \times 10^9$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.14.** | **Cr(bpy)$_3$$^{3+}$**—Continued | | | | | | |
| 4.14.66. | 2-Aminonaphthalene | AN | 0.02 mol/L TEAP | ~22 | $8.2 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.67. | $N$-(4-Aminophenyl)aniline | AN | 0.02 mol/L TEAP | ~22 | $9.4 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.68. | Aniline | AN | 0.02 mol/L TEAP | ~22 | $9.9 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.69. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | | ~15 | $5.6 \times 10^9$ | SS/LUM; $\tau_0$ = 60 μs (LP/ABS/AVE); RT; $f$ = 0.29 | 84E387 |
| 4.14.70. | 4,4'-Bis($N,N$-dimethylamino)biphenyl | AN | | ~15 | $3.5 \times 10^9$ | SS/LUM; $\tau_0$ = 60 μs (LP/ABS/AVE); RT; $f$ = 0.12 | 84E387 |
| | 4,4'-Bis($N,N$-dimethylamino)biphenyl | AN | 0.02 mol/L TEAP | ~22 | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.71. | 1,4-Bis($N$-phenylamino)benzene | AN | 0.02 mol/L TEAP | ~22 | $7.2 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.72. | *tert*-Butylamine | AN | 0.02 mol/L TEAP | ~22 | $1.4 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.73. | 1,2-Diaminobenzene | AN | | ~15 | $3.6 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 60 μs; RT; $f$ = 0.05 | 84E387 |
| 4.14.74. | 1,4-Diaminobenzene | AN | | ~15 | $4.6 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 60 μs; RT; $f$ = 0.22 | 84E387 |
| 4.14.75. | 4,4'-Diaminobiphenyl | AN | 0.02 mol/L TEAP | ~22 | $8.7 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.76. | Dibenzylamine | AN | 0.02 mol/L TEAP | ~22 | $1.0 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.77. | Dibutylamine | AN | 0.02 mol/L TEAP | ~22 | $1.6 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.78. | Dicyclohexylamine | AN | 0.02 mol/L TEAP | ~22 | $2.0 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.79. | Diethylamine | AN | 0.02 mol/L TEAP | ~22 | $8.9 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.80. | $N,N$-Diethylaniline | AN | 0.02 mol/L TEAP | ~22 | $6.4 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.81. | 1,2-Dimethoxybenzene | AN | 0.02 mol/L TEAP | ~22 | $2.4 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |
| 4.14.82. | 1,4-Dimethoxybenzene | AN | 0.02 mol/L TEAP | ~22 | $1.1 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 50 μs (LP/LUM/SST); RT | 78E518 |

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TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.14.** | **Cr(bpy)$_3$$^{3+}$—Continued** | | | | | | |
| 4.14.83. | $N,N$-Dimethylbenzylamine | AN | 0.02 mol/L TEAP | ~22 | $2.5 \times 10^8$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.84. | 3,3'-Dimethyl-4,4'-diaminobiphenyl | AN | | ~15 | $3.2 \times 10^9$ | LP/ABS/AVE; $\tau_0 = 60$ μs; RT; $f = 0.068$ | 84E387 |
| 4.14.85. | Diphenylamine | AN | | ~15 | $3.3 \times 10^9$ | LP/ABS/AVE; $\tau_0 = 60$ μs; RT; $f = 0$ | 84E387 |
| | Diphenylamine | AN | 0.02 mol/L TEAP | ~22 | $9.1 \times 10^9$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.86. | Dipropylamine | AN | 0.02 mol/L TEAP | ~22 | $1.5 \times 10^8$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.87. | $N$-Methylaniline | AN | 0.02 mol/L TEAP | ~22 | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.88. | $cis$-1-Phenyl-2-(2-naphthyl)ethene | AN | | | $5 \times 10^7$ | SS/LUM, LP/LUM/SST; $\tau_0 = 48$ μs; RT; [Q] = (1-20) $\times 10^{-4}$ mol/L | 84F249 |
| 4.14.89. | $trans$-1-Phenyl-2-(2-naphthyl)ethene | AN | | | $8 \times 10^8$ | SS/LUM, LP/LUM/SST; $\tau_0 = 48$ μs; RT; [Q] = (7-80) $\times 10^{-6}$ mol/L | 84F249 |
| 4.14.90. | Tributylamine | AN | 0.02 mol/L TEAP | ~22 | $6.9 \times 10^8$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.91. | Triethylamine | AN | 0.02 mol/L TEAP | ~22 | $7.4 \times 10^8$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.92. | 1,2,3-Trimethoxybenzene | AN | 0.02 mol/L TEAP | ~22 | $4.3 \times 10^7$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.93. | 1,2,4-Trimethoxybenzene | AN | 0.02 mol/L TEAP | ~22 | $2.8 \times 10^9$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.94. | 1,3,5-Trimethoxybenzene | AN | 0.02 mol/L TEAP | ~22 | $1.9 \times 10^7$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |
| 4.14.95. | Triphenylamine | AN | | ~15 | $2.4 \times 10^9$ | LP/ABS/AVE; $\tau_0 = 60$ μs; RT; $f = 0.006$ | 84E387 |
| | Triphenylamine | AN | 0.02 mol/L TEAP | ~22 | $7.3 \times 10^9$ | SS/LUM; $\tau_0^{air} = 50$ μs (LP/LUM/SST); RT | 78E518 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.15. Cr(en)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.15.1. | CoCl$^+$ | H$_2$O | KCl or MgCl$_2$ ([Cl$^-$]$_{tot}$ = 2-5.2 mol/L) | | $5 \times 10^6$ | SS/LUM, LP/LUM/SST; $\tau_0$$^{air}$ = 1.3 μs; ET; nonlinear S-V plots; $k_q$ eval'd from best fit of $k_{obs}$ at various [Co$^{II}$]$_{tot}$ and [Cl$^-$]$_{tot}$; [Co$^{II}$]$_{tot}$ = 0.1-1.6 mol/L | 736183 |
| 4.15.2. | CoCl$_2$ | H$_2$O | KCl or MgCl$_2$ ([Cl$^-$]$_{tot}$ = 2-5.2 mol/L) | | $8 \times 10^7$ | SS/LUM, LP/LUM/SST; $\tau_0$$^{air}$ = 1.3 μs; ET; nonlinear S-V plots; $k_q$ eval'd from $k_{obs}$ at various [Co$^{II}$]$_{tot}$ and [Cl$^-$]$_{tot}$; [Co$^{II}$]$_{tot}$ = 0.1-1.6 mol/L | 736183 |
| 4.15.3. | CoCl$_3$$^-$ | H$_2$O | KCl or MgCl$_2$ ([Cl$^-$]$_{tot}$ = 2-5.2 mol/L) | | $\sim 2 \times 10^8$ | SS/LUM, LP/LUM/SST; $\tau_0$$^{air}$ = 1.3 μs; ET; nonlinear S-V plots; $k_q$ eval'd from best fit of $k_{obs}$ at various [Co$^{II}$]$_{tot}$ and [Cl$^-$]$_{tot}$; [Co$^{II}$]$_{tot}$ = 0.1-1.6 mol/L | 736183 |
| 4.15.4. | Co(H$_2$O)$_6$$^{2+}$ | H$_2$O | KCl or MgCl$_2$ ([Cl$^-$]$_{tot}$ = 2-5.2 mol/L) | | $1.5 \times 10^5$ | SS/LUM, LP/LUM/SST; $\tau_0$$^{air}$ = 1.3 μs; ET; nonlinear S-V plots; $k_q$ eval'd from $k_{obs}$ at various [Co$^{II}$]$_{tot}$ and [Cl$^-$]$_{tot}$; [Co$^{II}$]$_{tot}$ = 0.1-1.6 mol/L | 736183 |
| **4.16. *trans*-Cr(en)$_2$(NCS)$_2$$^+$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 4.16.1. | Co(CN)$_6$$^{3-}$ | H$_2$O | pH 3 | 15 | $<1 \times 10^5$ | SS/LUM; $\tau_0$$^{air}$ = 11 μs (SL/LUM/SST) | 776252 |
| 4.16.2. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | pH 3 | 15 | $1.8 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 11 μs (SL/LUM/SST); ET | 776252 |
| 4.16.3. | Cr(CN)$_6$$^{3-}$ | H$_2$O | pH 3 | 15 | $2.3 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 11 μs (SL/LUM/SST); ET | 776252 |
| 4.16.4. | I$^-$ | H$_2$O | pH 3 | 15 | $<1 \times 10^5$ | SS/LUM; $\tau_0$$^{air}$ = 11 μs (SL/LUM/SST) | 776252 |
| 4.16.5. | Ni(gly)$_2$ | H$_2$O | | 15 | $7.5 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 11 μs (SL/LUM/SST); ET | 776252 |
| 4.16.6. | OH$^-$ | H$_2$O | 0.05 mol/L Pbuf | 15 | $1.3 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 11 μs (SL/LUM/SST); CR | 776252 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.17.** | **trans-Cr(en)$_2$(NH$_3$)F$^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.17.1. | Cr(CN)$_6$$^{3-}$ | H$_2$O | 0.01 mol/L H$_2$SO$_4$ | 18 | 6 × 10$^8$ | LP/LUM/SST; $\tau_0{}^{und}$ = 0.23 µs | 82F278 |
| **4.18.** | **Cr(phen)$_3$$^{3-}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 4.18.1. | Co(acac)$_3$ | Acetone | | ~22 | 1.7 × 10$^8$ | LP/LUM/SST; ET | 83E223 |
| 4.18.2. | Co(CN)$_6$$^{3-}$ | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | <2 × 10$^5$ | SS/LUM; $\tau_0$ = 90 µs (LP/LUM/SST); ET, RT | 83F230 |
| 4.18.3. | trans-Co(cyclam)Cl$_2$$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 5.4 × 10$^7$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.4. | trans-Co(cyclam)(H$_2$O)$_2$$^{3+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 1.1 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.5. | trans-Co(cyclam)(H$_2$O)Br$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 2.4 × 10$^7$ | SS/LUM; $\tau_0$ = 0.40 ms (LP/LUM/SST); ET, RT | 83F230 |
| 4.18.6. | trans-Co(cyclam)(H$_2$O)Cl$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 2.1 × 10$^7$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.7. | trans-Co(cyclam)(H$_2$O)(N$_3$)$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 1.2 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.8. | trans-Co(cyclam)(N$_3$)$_2$$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 4.3 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.9. | trans-Co(cyclam)(NCS)$_2$$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 1.6 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.10. | trans-Co(cyclam)(NCS)Cl$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 6.2 × 10$^7$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.11. | trans-Co(cyclam)(NCS)(N$_3$)$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 3.0 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.12. | trans-Co(cyclam)(N$_3$)Cl$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 2.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.40 ms (LP/LUM/SST); ET, RT | 83F230 |
| 4.18.13. | trans-Co(cyclam)(NO$_2$)$_2$$^+$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 5.4 × 10$^7$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.40 ms; ET, RT | 83F230 |
| 4.18.14. | Co(DMG)$_2$(C$_2$H$_5$)(H$_2$O) | H$_2$O | 0.01 mol/L HCl | ~22 | 1.7 × 10$^9$ | LP/LUM/SST; ET; [Q $\leq$ 1.6 × 10$^{-4}$ mol/L | 83E223 |
| 4.18.15. | Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | 1 mol/L HCl | 25 | 3.5 × 10$^6$ | SS/LUM (LP/LUM/SST); ET, RT | 83F230 |
| 4.18.16. | Co(NH$_3$)$_5$Br$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | 1.5 × 10$^8$ | LP/LUM/SST; ET, RT | 83F230 |
| | Co(NH$_3$)$_5$Br$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 25 | 1.1 × 10$^8$ | FP/ABS/SST; ET, RT | 83F230 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.18. Cr(phen)$_3$$^{3+}$**—Continued | | | | | | | |
| 4.18.17. Co(NH$_3$)$_5$Cl$^{2+}$ | | H$_2$O | 1 mol/L HCl | 15 | $5.3 \times 10^7$ | SS/LUM; $\tau_0 = 0.13$ ms (LP/LUM/SST); ET, RT | 83F230 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 25 | $4.1 \times 10^7$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.18.18. Co(NH$_3$)$_5$F$^{2+}$ | | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | $1.6 \times 10^6$ | SS/LUM; $\tau_0 = 88$ $\mu$s (LP/LUM/SST); ET, RT | 83F230 |
| 4.18.19. Co(NH$_3$)$_5$(H$_2$O)$^{3-}$ | | H$_2$O | 1 mol/L HCl | 15 | $3.5 \times 10^6$ | FP/ABS/SST; $\tau_0 = 0.13$ ms; ET, RT | 83F230 |
| | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | $3.5 \times 10^6$ | LP/LUM/SST; ET, RT | 83F230 |
| | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 1 mol/L HCl | 25 | $4.3 \times 10^6$ | FP/ABS/SST; ET, RT | 83F230 |
| 4.18.20. Co(NH$_3$)$_5$(N$_3$)$^{2+}$ | | H$_2$O | 1 mol/L HCl | 15 | $3.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.13$ ms (LP/LUM/SST); ET, RT | 83F230 |
| | Co(NH$_3$)$_5$(N$_3$)$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | $2.4 \times 10^8$ | LP/LUM/SST; ET, RT | 83F230 |
| 4.18.21. Co(NH$_3$)$_5$(NCS)$^{2+}$ | | H$_2$O | 1 mol/L HCl | 15 | $3.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.13$ ms (LP/LUM/SST); ET, RT | 83F230 |
| | Co(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | $2.5 \times 10^8$ | LP/LUM/SST; ET, RT | 83F230 |
| | Co(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | $2.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.11$ ms (LP/LUM/SST); ET, RT | 83F230 |
| 4.18.22. Co(NH$_3$)$_5$(NO$_2$)$^{2+}$ | | H$_2$O | 1 mol/L NaHSO$_4$ | 15 | $7.1 \times 10^7$ | LP/LUM/SST; ET, RT | 83F230 |
| 4.18.23. Cr(phen)$_3$$^{3+}$ | | H$_2$O | 1 mol/L NaCl, BRbuf; pH 10 | 13.5 | $4.0 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.42$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl; 0.008 mol/L BRbuf; pH 10.5 | 15 | $1.6 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.25$ ms; CD; [Q] = [S] ≤ 0.003 mol/L | 83A192 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L HCl | 22 | $2.3 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.33$ ms; CD; same $k_q$ from same lab in 80E076; [Q] = [S] ≤ 0.0012 mol/L; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L HClO$_4$ | 22 | $4.7 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.49$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 22 | $2.1 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.36$ ms; CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.18.** | **Cr(phen)$_3$$^{3+}$—Continued** | | | | | | |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaBr | 22 | $3.3 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.30$ ms CD; [Q] = [S] $\leq 0.001$ mol/L; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L Na$_2$SO$_4$ | 22 | $2.9 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.26$ ms CD; [Q] = [S] $\leq 0.001$ mol/L; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaBrO$_3$ | 22 | $3.0 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.25$ ms CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L KNO$_3$ | 22 | $4.1 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.29$ ms CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 5 mol/L HCl | 22 | $3.0 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.32$ ms CD; $\tau_0$ extrap'd to [S] = 0 | 81E458 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 9.5 | 22 | $6.1 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.23$ ms CD; $\tau_0$ extrap'd [S] = 0 | 81E458 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 10 | 22.0 | $5.4 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.25$ ms $\Delta H^\ddagger = 18$ kJ/mol; $\Delta S^\ddagger = -38$ J/mol·K; CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 10 | 29.2 | $6.5 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.16$ ms CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 10 | 36.1 | $7.5 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.10$ ms CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| | Cr(phen)$_3$$^{3+}$ | H$_2$O | 1 mol/L NaCl, BRbuf; pH 10 | 42.1 | $8.8 \times 10^6$ | LP/LUM/SST; $\tau_0 = 71$ $\mu s$; CD; $\tau_0$ extrap'd to [S] = 0 | 83E317 |
| 4.18.24. | Cu$^{II}$-azurin | H$_2$O | 0.027 mol/L Na$_2$HPO$_4$; 0.020 mol/L NaH$_2$PO$_4$; pH 7; $\mu = 0.1$ | 25 | $1.0 \times 10^8$ | LP/LUM/AVE; ET; [Q] $\leq$ 1 $\times$ 10$^{-4}$ mol/L | 85A362 |
| 4.18.25. | Cu$^{II}$-plastocyanin | H$_2$O | 0.027 mol/L Na$_2$HPO$_4$; 0.020 mol/L NaH$_2$PO$_4$; pH 7; $\mu = 0.1$ | 25 | $6.0 \times 10^8$ | LP/LUM/AVE; ET; [Q] $\leq$ 5 $\times$ 10$^{-5}$ mol/L | 85A362 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.18.** | **Cr(phen)$_3$$^{3+}$—Continued** | | | | | | |
| 4.18.26. | Cu$^{II}$-stellacyanin | H$_2$O | 0.027 mol/L Na$_2$HPO$_4$; 0.020 mol/L NaH$_2$PO$_4$; pH 7; μ = 0.1 | 25 | 4.9 × 10$^7$ | LP/LUM/AVE; ET; [Q] ≤ 1.2 × 10$^{-4}$ mol/L | 85A362 |
| 4.18.27. | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 1.5 × 10$^7$ | SS/LUM; $\tau_0$ = 0.33 ms (LP/LUM/AVE); RT | 78F366 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L HCl | 25 | 3.2 × 10$^7$ | SS/LUM; $\tau_0^{air}$ = 71 μs (LP/LUM/AVE); RT | 79E270 |
| 4.18.28. | Hg$^{2+}$ | H$_2$O | 1 mol/L NaClO$_4$; pH 1 | 25 | <1 × 10$^5$ | FP/ABS/SST | 83F230 |
| 4.18.29. | I$^-$ | H$_2$O | 1 mol/L NaCl; 0.008 mol/L BRbuf; pH 10.5 | 15 | 2.8 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 30 μs (LP/LUM/AVE); RT?; [Q] ≤ 2 × 10$^{-5}$ mol/L; $\tau_0^{air}$ is a function of [S]; $\tau_0^{air}$ for [S] = 0.0012 mol/L | 83A192 |
| | I$^-$ | H$_2$O | 1 mol/L HCl | 25 | 2.1 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 71 μs (LP/LUM/AVE); RT? | 79E270 |
| 4.18.30. | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | 4.9 × 10$^7$ | SS/LUM; $\tau_0$ = 0.27 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L | 78F366 |
| | O$_2$ | H$_2$O | 1 mol/L HCl | 25 | 2.7 × 10$^7$ | SS/LUM; $\tau_0$ = 0.27 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10$^{-4}$ mol/L; same $k_q$ from same lab in 78A388 | 79E270 |
| 4.18.31. | Os(bpy)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 1.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 ms (LP/LUM/AVE); RT | 78F366 |
| 4.18.32. | Rh(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | <2 × 10$^5$ | SS/LUM; $\tau_0$ = 90 μs (LP/LUM/SST) | 83F230 |
| 4.18.33. | Ru(bpy)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 8.3 × 10$^8$ | SS/LUM; $\tau_0$ = 0.33 ms (LP/LUM/AVE); RT | 78F366 |
| 4.18.34. | Ru(5-Clphen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 8.1 × 10$^8$ | SS/LUM; $\tau_0$ = 0.33 ms (LP/LUM/AVE); RT | 78F366 |
| 4.18.35. | Ru(4,7-Me$_2$phen)$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 1.4 × 10$^6$ | SS/LUM; $\tau_0$ = 0.33 ms (LP/LUM/AVE); RT | 78F366 |
| 4.18.36. | Ru(NH$_3$)$_6$$^{3+}$ | H$_2$O | 1.5 mol/L NaHSO$_4$ | 25 | <2 × 10$^5$ | SS/LUM; $\tau_0$ = 90 μs (LP/LUM/SST) | 83F230 |
| 4.18.37. | Ru[5-(NO$_2$)phen]$_3$$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 2.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.33 ms (LP/LUM/AVE); RT | 78F366 |

TABLE 4. Quenching of excited chromium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **4.19.** | **Cr(5,10,15,20-tetraphenylporphyrin)$^+$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 4.19.1. | 1,4-Benzoquinone | EtOH | | | $2 \times 10^9$ | LP/ABS/SST; OT; $f =$ <0.002 | 83F182 |

QUENCHING OF EXCITED METAL COMPLEXES IN FLUID SOLUTION

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TABLE 5. Quenching of excited copper complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **5.1. Cu(MePh$_2$P)$_3$Cl** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 5.1.1. | Norbornadiene | Benzene | [CuCl] = 0.001 mol/L; [MePh$_2$P] = 0.003 mol/L | | $8 \times 10^7$ | SS/QYP; ET; [Q] = 0.1-1 mol/L; see Mech. [6]; other Cu$_x$(MePh$_2$P)$_y$Cl$_x$ species present | 85F395 |
| **5.2. Cu(2,9-Me$_2$phen)$_2$$^+$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 5.2.1. | Co(acac)$_3$ | CH$_2$Cl$_2$ | | 25 | $1.4 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.2. | Cr(acac)$_3$ | CH$_2$Cl$_2$ | | 25 | $1 \times 10^8$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); ET; [Q] ≤ 0.009 mol/L | 80F403 |
| *Organic Quenchers* | | | | | | | |
| 5.2.3. | 2-Chlorobenzonitrile | CH$_2$Cl$_2$ | | 25 | $<1 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.4. | 1,3-Dinitrobenzene | CH$_2$Cl$_2$ | | 25 | $5.5 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.5. | Hexachlorobenzene | CH$_2$Cl$_2$ | | 25 | $<1 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.6. | 1-Methoxy-4-nitrobenzene | CH$_2$Cl$_2$ | | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.7. | 4-Nitroaniline | CH$_2$Cl$_2$ | | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.8. | Nitrobenzene | CH$_2$Cl$_2$ | | 25 | $1.8 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT; [Q] ≤ 0.007 mol/L | 80F403 |
| 5.2.9. | 4-Nitrotoluene | CH$_2$Cl$_2$ | | 25 | $1.4 \times 10^9$ | SS/LUM; $\tau_0^{und}$ = 54 ns (LP/LUM/SST); OT | 80F403 |
| 5.2.10. | py | 1,2-C$_2$H$_4$Cl$_2$ | | | $1 \times 10^9$ | SS/LUM | 85E277 |
| **5.3. Cu(2,9-Ph$_2$phen)$_2$$^+$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 5.3.1. | Cr(acac)$_3$ | CH$_2$Cl$_2$ | | 20 | $1.0 \times 10^7$ | LP/LUM/AVE; ET | 85E063 |
| 5.3.2. | cis-Cr(bzac)$_3$ | CH$_2$Cl$_2$ | | 20 | $1.6 \times 10^7$ | LP/LUM/AVE; ET | 85E063 |
| 5.3.3. | trans-Cr(bzac)$_3$ | CH$_2$Cl$_2$ | | 20 | $2.8 \times 10^7$ | LP/LUM/AVE; ET | 85E063 |
| 5.3.4. | Cr(dbm)$_3$ | CH$_2$Cl$_2$ | | 20 | $6.5 \times 10^7$ | LP/LUM/AVE; ET | 85E063 |
| 5.3.5. | Cr(hfac)$_3$ | CH$_2$Cl$_2$ | | 20 | $7.7 \times 10^9$ | LP/LUM/AVE; OT; Q is probably trans | 85E063 |
| 5.3.6. | Cr(hfac)(tfbzac)$_2$ | CH$_2$Cl$_2$ | | 20 | $4.7 \times 10^9$ | LP/LUM/AVE; OT | 85E063 |

TABLE 5. Quenching of excited copper complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **5.3. Cu(2,9-Ph$_2$phen)$_2$$^+$—Continued** | | | | | | | |
| 5.3.7. | Cr(pdo)$_3$ | CH$_2$Cl$_2$ | | 20 | $3.9 \times 10^7$ | LP/LUM/AVE; ET | 85E063 |
| 5.3.8. | Cr(tfac)$_3$ | CH$_2$Cl$_2$ | | 20 | $9.5 \times 10^7$ | LP/LUM/AVE; ET, OT; Q is probably *trans* | 85E063 |
| 5.3.9. | Cr(tfbzac)$_3$ | CH$_2$Cl$_2$ | | 20 | $1.3 \times 10^9$ | LP/LUM/AVE; OT; Q is probably *trans* | 85E063 |
| 5.3.10. | Cr(tta)$_3$ | CH$_2$Cl$_2$ | | 20 | $2.0 \times 10^9$ | LP/LUM/AVE; OT; Q is probably *trans* | 85E063 |
| *Organic Quenchers* | | | | | | | |
| 5.3.11. | Anthracene-9-carboxylate ion | EtOH | | 40 | $1 \times 10^9$ | SS/LUM; $\tau_0 = \sim 70$ ns (assumed); ET | 84S117 |
| 5.3.12. | 1-Chloro-4-nitrobenzene | CH$_2$Cl$_2$ | | 20 | $2.9 \times 10^7$ | LP/LUM/AVE; OT | 85E063 |
| 5.3.13. | 1,3-Dinitrobenzene | CH$_2$Cl$_2$ | | 20 | $3.2 \times 10^9$ | LP/LUM/AVE; OT | 85E063 |
| 5.3.14. | 1,4-Dinitrobenzene | CH$_2$Cl$_2$ | | 20 | $1.1 \times 10^{10}$ | LP/LUM/AVE; OT | 85E063 |
| 5.3.15. | 4,4'-Dinitrobiphenyl | CH$_2$Cl$_2$ | | 20 | $2.9 \times 10^8$ | LP/LUM/AVE; OT | 85E063 |
| 5.3.16. | MV$^{2+}$ | EtOH | | 40 | $3 \times 10^9$ | SS/LUM; $\tau_0 = \sim 70$ ns (assumed); OT | 84S117 |
| 5.3.17. | Nitrobenzene | CH$_2$Cl$_2$ | | 20 | $2.4 \times 10^6$ | LP/LUM/AVE; OT | 85E063 |
| **5.4. Cu(etioporphyrin I)** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 5.4.1. | Perylene | Toluene | | | $5.5 \times 10^9$ | EMI; $\tau_0 = 0.15$ μs (72E321); ET; [Q] = (5-40) $\times 10^{-4}$ mol/L | 74E520 |
| **5.5. Cu(mesoporphyrin IX dimethyl ester)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 5.5.1. | O$_2$ | Toluene | | | $6.4 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.12$ μs; ET; [Q] = 0.0011 mol/L | 81E738 |
| **5.6. Cu(5,10,15,20-tetraphenylporphyrin)** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 5.6.1. | 1,4-Benzoquinone | EtOH | | | $2 \times 10^9$ | LP/ABS/SST; OT; $f =$ < 0.002 | 83F182 |

TABLE 6. Quenching of excited dysprosium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **6.1. Dy$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 6.1.1. | Nd$^{3+}$ | H$_2$O | pH 5.9; $\mu$ = 0.6 | 22 | $9.3 \times 10^4$ | LP/LUM/SST; ET | 80E879 |
| 6.1.2. | O$_3$ | H$_2$SO$_4$ (98%) | | 25 | $9.9 \times 10^6$ | SS/LUM; $\tau_0$ = 30 μs (LP/LUM/SST); [Q] $\leq$ 6 $\times$ 10$^{-4}$ mol/L | 77E799 |
| *Organic Quenchers* | | | | | | | |
| 6.1.3. | 2-Acetylnaphthalene | Acetone | | 20 | $7.6 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 14 μs; ET | 706153 |
| 6.1.4. | 9-Fluorenone | Acetone | | 20 | $8.9 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 14 μs; ET | 706153 |
| **6.2. Dy(anthranilato)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 6.2.1. | Nd(H$_2$O)$_n$$^{3+}$ | H$_2$O | pH 5.9; $\mu$ = 0.6; ([Dy]+[Nd])/[L] = 1000 | 22 | $2.1 \times 10^5$ | LP/LUM/SST; ET | 80E879 |
| **6.3. Dy(salicylato)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 6.3.1. | Nd(H$_2$O)$_n$$^{3+}$ | H$_2$O | pH 5.9; $\mu$ = 0.6; ([Dy]+[Nd])/[L] = 1000 | 22 | $6.0 \times 10^6$ | LP/LUM/SST; ET | 80E879 |
| **6.4. Dy(5-sulfosalicylato)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 6.4.1. | Nd(H$_2$O)$_n$$^{3+}$ | H$_2$O | pH 5.9; $\mu$ = 0.6; ([Dy]+[Nd])/[L] = 1000 | 22 | $1.0 \times 10^7$ | LP/LUM/SST; ET | 80E879 |

TABLE 7. Quenching of excited europium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **7.1. Eu$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 7.1.1. | $Co(CN)_6{}^{3-}$ | $H_2O$ | 1 mol/L KCl | | $<7 \times 10^6$ | LP/LUM/SST | 86E832 |
| 7.1.2. | $Cr(CN)_6{}^{3-}$ | $H_2O$ | 1 mol/L KCl | | $1.0 \times 10^8$ | LP/LUM/SST; ET | 86E832 |
| 7.1.3. | $Fe(CN)_6{}^{4-}$ | $H_2O$ | 1 mol/L KCl | | $6.0 \times 10^8$ | LP/LUM/SST; RT | 86E832 |
| 7.1.4. | $Nd^{3+}$ | Acetone | | 20 | $1.3 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 0.39 ms; ET; same $k_q$ from same lab in 68E121 | 69E237 |
| 7.1.5. | $Pr^{3+}$ | Acetone | | 20 | $3.3 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 0.39 ms; ET; same $k_q$ from same lab in 68E121 | 69E237 |
| 7.1.6. | $Ru(CN)_6{}^{4-}$ | $H_2O$ | 1 mol/L KCl | | $3.0 \times 10^8$ | LP/LUM/SST; RT | 86E832 |
| *Organic Quenchers* | | | | | | | |
| 7.1.7. | 1-Acetylanthracene | Acetone | | 20 | $4.7 \times 10^6$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; ET | 706153 |
| 7.1.8. | Acridine | Acetone | | 20 | $1.2 \times 10^6$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; ET; [Q] $\leq$ 0.008 mol/L | 706153 |
| 7.1.9. | 1-Aminonaphthalene | Acetone | | 20 | $4.4 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; RT; some SQ? | 706153 |
| 7.1.10. | Aniline | Acetone | | 20 | $5.0 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; RT; [Q] $\leq$ 0.3 mol/L; some SQ? | 706153 |
| 7.1.11. | Anthracene | Acetone | | 20 | $1 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; ET | 706153 |
| 7.1.12. | 3-Chloroaniline | Acetone | | 20 | $1.1 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 0.35 ms | 706153 |
| 7.1.13. | $N,N$-Dimethylaniline | Acetone | | 20 | $5.3 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; RT; some SQ? | 706153 |
| 7.1.14. | Diphenylamine | Acetone | | 20 | $4.2 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; RT; some SQ? | 706153 |
| 7.1.15. | 9,10-Diphenylanthracene cation radical | $H_2SO_4$ (95%)/DMF (5/1) | | 20 | $7.2 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 73E368 |
| 7.1.16. | Diphenylmethylamine | Acetone | | 20 | $1.7 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.35 ms; RT; some SQ? | 706153 |
| 7.1.17. | Naphthacene cation radical | $H_2SO_4$ (95%) | | 20 | $2.9 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 73E368 |
| 7.1.18. | Naphthacene, protonated | $H_2SO_4$ (95%) | | 20 | $3.7 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 73E368 |

TABLE 7. Quenching of excited europium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **7.1.** | **Eu$^{3+}$—Continued** | | | | | | |
| 7.1.19. | Perylene cation radical | H$_2$SO$_4$ (95%) | | 20 | $5.7 \times 10^7$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 73E368 |
| 7.1.20. | Triphenylamine | Acetone | | 20 | $8.1 \times 10^4$ | FP/LUM/SST; $\tau_0 = 0.35$ ms; RT; some SQ? | 706153 |
| **7.2.** | **Eu(acetylacetonato)$_3$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.2.1. | 1-Aminonaphthalene | Acetone | | 27 | $5.8 \times 10^4$ | FP/LUM/SST; $\tau_0 = 0.16$ ms; RT | 746333 |
| 7.2.2. | Anthracene | Acetone | | 27 | $5.9 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.16$ ms; ET; [Q] $\leq 0.0028$ mol/L; larger $K_{SV}$ with SS/LUM | 746333 |
| **7.3.** | **Eu(crypt)$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 7.3.1. | Co(CN)$_6^{3-}$ | H$_2$O | 1 mol/L KCl | | $<4 \times 10^5$ | LP/LUM/SST | 86E832 |
| 7.3.2. | Cr(CN)$_6^{3-}$ | H$_2$O | 1 mol/L KCl | | $\sim 2 \times 10^6$ | LP/LUM/SST; ET | 86E832 |
| 7.3.3. | Fe(CN)$_6^{4-}$ | H$_2$O | 1 mol/L KCl | | $5.0 \times 10^8$ | LP/LUM/SST; RT; $k_q = 7.5 \times 10^8$ L mol$^{-1}$ s$^{-1}$ at 22 °C and with SS/LUM and $\tau_0^{air} = 0.22$ ms from same lab in 84F176; ion-pairing at high [S] and [Q] | 86E832 |
| 7.3.4. | Os(CN)$_6^{4-}$ | H$_2$O | 1 mol/L KCl | 22 | $7.8 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.22$ ms (LP/LUM/AVE); RT; ion-pairing at high [S] and [Q] | 84F176 |
| 7.3.5. | Ru(CN)$_6^{4-}$ | H$_2$O | 1 mol/L KCl | | $2.0 \times 10^8$ | LP/LUM/SST; RT; $k_q = 2.2 \times 10^8$ L mol$^{-1}$ s$^{-1}$ at 22 °C and with SS/LUM and $\tau_0^{air} = 0.22$ ms from same lab in 84F176; ion-pairing at high [S] and [Q] | 86E832 |
| **7.4.** | **Eu(1,3-diphenyl-1,3-propanedionato)$_4^-$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.4.1. | 1-Aminonaphthalene | Acetone | | 27 | $1.2 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0 = 0.11$ ms; RT; [Q] $\leq 0.009$ mol/L; S may be present as *tris* complex | 746333 |
| 7.4.2. | Anthracene | Acetone | | 27 | $1.8 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.11$ ms; ET; S may be present as *tris* complex | 746333 |

TABLE 7. Quenching of excited europium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **7.5.** | **Eu(phen)$_3$$^{3+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.5.1. | Anthracene | Acetone | | 20 | $2 \times 10^6$ | FP/LUM/SST, SS/LUM; ET | 706153 |
| 7.5.2. | Fluorene | Acetone | | 20 | $1 \times 10^3$ | FP/LUM/SST, SS/LUM; ET | 706153 |
| 7.5.3. | Naphthalene | Acetone | | 20 | $1 \times 10^3$ | FP/LUM/SST, SS/LUM; ET | 706153 |
| 7.5.4. | Triphenylamine | AN | 0.01 mol/L TBAP | | $3.7 \times 10^7$ | SS/LUM; $\tau_0 \approx 0.74$ ms (FP/LUM/SST); RT | 767009 |
| **7.6.** | **Eu(phen)(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_3$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.6.1. | Anthracene | AN | | 20 | $1.5 \times 10^7$ | FP/LUM/SST, SS/LUM; ET | 706153 |
| | Anthracene | Toluene | | 20 | $6.8 \times 10^6$ | FP/LUM/SST; ET; also EQ | 706153 |
| 7.6.2. | N,N-Dimethylaniline | Acetone | | 20 | $9.0 \times 10^3$ | FP/LUM/SST, SS/LUM; RT | 706153 |
| 7.6.3. | Diphenylamine | Acetone | | 20 | $4.0 \times 10^3$ | FP/LUM/SST, SS/LUM; RT | 706153 |
| **7.7.** | **Eu(1-phenyl-1,3-butanedionato)$_4$$^-$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.7.1. | 1-Acetylanthracene | Acetone | | 20 | $8.0 \times 10^5$ | FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex | 706153 |
| 7.7.2. | Anthracene | Toluene | | 20 | $8.8 \times 10^5$ | FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex | 706153 |
| 7.7.3. | N,N-Dimethylaniline | Acetone | | 20 | $1 \times 10^3$ | FP/LUM/SST, SS/LUM; RT; S may be present as *tris* complex | 706153 |
| **7.8.** | **Eu(1-phenyl-4,4,4-trifluoro-1,3-butanedionato)$_4$$^-$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.8.1. | Anthracene | Toluene | | 20 | $2.3 \times 10^6$ | FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex | 706153 |
| **7.9.** | **Eu(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_4$$^-$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 7.9.1. | Anthracene | AN | | 20 | $2.5 \times 10^6$ | FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex | 706153 |

TABLE 7. Quenching of excited europium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **7.9.** | **Eu(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_4$$^-$**—Continued | | | | | | |
| | Anthracene | Toluene | | 20 | $3.3 \times 10^6$ | FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex | 706153 |

TABLE 8. Quenching of excited indium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **8.1.** | **In(phthalocyanine)Cl** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 8.1.1. | Co(bpy)$_3{}^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | 2.2 × 10$^8$ | LP/ABS/AVE; OT; $f$ = 0.55; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| 8.1.2. | Co(phen)$_3{}^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | 3.2 × 10$^8$ | LP/ABS/AVE; OT; $f$ = 0.62; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| 8.1.3. | Co(terpy)$_2{}^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | 5.4 × 10$^8$ | LP/ABS/AVE; OT; $f$ = 0.15; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| **8.2.** | **In(5,10,15,20-tetraphenylporphyrin)$^+$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 8.2.1. | MV$^{2+}$ | MeOH | | | 3 × 10$^7$ (calc) | LP/ABS/SST; $\tau_0$ = 56 μs; EX, OT?; [Q] ≤ 0.02 mol/L; nonlinear S-V plot, see Mech. [1] | 85A013 |
| **8.3.** | **In(5,10,15,20-tetraphenylporphyrin)(C$_2$H$_5$)** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 8.3.1. | Fe(C$_5$H$_5$)$_2$ | Benzene | | | 2.1 × 10$^9$ (calc) | LP/ABS/SST; $\tau_0$ = 70 μs; ET; [Q] ≤ 2.2 × 10$^{-5}$ mol/L | 86F247 |
| | *Organic Quenchers* | | | | | | |
| 8.3.2. | 2,4,7-Trinitro-9-fluorenone | Benzene | | | 3.1 × 10$^8$ (calc) | LP/ABS/SST; $\tau_0$ = 70 μs; [Q] ≤ 4 × 10$^{-5}$ mol/L | 86F247 |
| **8.4.** | **In(5,10,15,20-tetraphenylporphyrin)(OH)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 8.4.1. | 1,4-Benzoquinone | (C$_2$H$_5$)$_2$O | | | 1.2 × 10$^9$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | 1,3-Xylene | | | 4.6 × 10$^8$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | 1,4-Xylene | | | 6.1 × 10$^7$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | 3-Chloro-toluene | | | 1.2 × 10$^9$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | Benzene | | | 5.3 × 10$^8$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | CH$_2$Cl$_2$ | | | 5.8 × 10$^8$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | Chlorobenzene | | | 7.7 × 10$^8$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | Cumene | | | 6.5 × 10$^8$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | Dodecane | | | 1.6 × 10$^8$ | FP/ABS/SST | 81F368 |
| | 1,4-Benzoquinone | Ethyl acetate | | | 6.3 × 10$^8$ | FP/ABS/SST | 81F368 |

TABLE 8. Quenching of excited indium complexes—Continued

| No. | | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|---|
| **8.4.** | | **In(5,10,15,20-tetraphenylporphyrin)(OH)**—Continued | | | | | | |
| | | 1,4-Benzoquinone | Ethylbenzene | | | $6.9 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Fluorobenzene | | | $8.0 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Heptane | | | $1.6 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Hexane | | | $1.5 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Isoamyl acetate | | | $5.2 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Mesitylene | | | $2.7 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Methyl ethyl ketone | | | $9.1 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Nonane | | | $1.9 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Octane | | | $1.5 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Propyl acetate | | | $6.3 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Tetradecane | | | $1.6 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Toluene | | | $4.4 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Tridecane | | | $1.6 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | Undecane | | | $1.6 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | t-Butyl-benzene | | | $1.2 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Benzoquinone | py | | | $3 \times 10^7$ | FP/ABS/SST | 81F368 |
| | 8.4.2. | 1,4-Naphthoquinone | 1,2-Xylene | | | $5.9 \times 10^5$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | 1,3-Xylene | | | $6.6 \times 10^5$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | 1,4-Xylene | | | $5.6 \times 10^5$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Benzene | | | $1.9 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Decane | | | $5.1 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Ethylbenzene | | | $1.2 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Hexane | | | $6.7 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Mesitylene | | | $4.1 \times 10^5$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Tetradecane | | | $4.1 \times 10^6$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | Toluene | | | $8.9 \times 10^5$ | FP/ABS/SST | 81F368 |
| | | 1,4-Naphthoquinone | t-Butyl-benzene | | | $1.2 \times 10^6$ | FP/ABS/SST | 81F368 |

TABLE 8. Quenching of excited indium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ $/L\ mol^{-1}\ s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **8.5.** | **In(5,10,15,20-tetraphenylporphyrin)(TEOA)$_2$$^+$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 8.5.1. | MV$^{2-}$ | MeOH | 0.5 mol/L TEOA | | $3.4 \times 10^8$ | LP/ABS/SST; $\tau_0 = 48\ \mu s$; OT; $[Q] \leq 0.006\ mol/L$ | 85A013 |

TABLE 9. Quenching of excited iridium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **9.1.** | **cis-Ir(5,6-Me$_2$phen)$_2$Cl$_2$$^+$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 9.1.1. | Aniline | AN | 0.1 mol/L TEAP | ~22 | $7.7 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.2. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L TEAP | ~22 | $8.1 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.3. | 1,4-Bis(N-phenylamino)benzene | AN | 0.1 mol/L TEAP | ~22 | $9.4 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.4. | tert-Butylamine | AN | 0.1 mol/L TEAP | ~22 | $2.0 \times 10^6$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.5. | 4,4'-Diaminobiphenyl | AN | 0.1 mol/L TEAP | ~22 | $9.1 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.6. | Dibenzylamine | AN | 0.1 mol/L TEAP | ~22 | $4.6 \times 10^7$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.7. | Dibutylamine | AN | 0.1 mol/L TEAP | ~22 | $7.0 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.8. | Dicyclohexylamine | AN | 0.1 mol/L TEAP | ~22 | $8.9 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.9. | Diethylamine | AN | 0.1 mol/L TEAP | ~22 | $4.1 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.10. | N,N-Diethylaniline | AN | 0.1 mol/L TEAP | ~22 | $9.1 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.11. | 1,2-Dimethoxybenzene | AN | 0.1 mol/L TEAP | ~22 | $4.8 \times 10^7$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.12. | 1,4-Dimethoxybenzene | AN | 0.1 mol/L TEAP | ~22 | $2.4 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.13. | N,N-Dimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.14. | N,N-Dimethylbenzylamine | AN | 0.1 mol/L TEAP | ~22 | $4.1 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.15. | Diphenylamine | AN | 0.1 mol/L TEAP | ~22 | $6.8 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.16. | Dipropylamine | AN | 0.1 mol/L TEAP | ~22 | $6.4 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.17. | N-Methylaniline | AN | 0.1 mol/L TEAP | ~22 | $5.8 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.18. | Tributylamine | AN | 0.1 mol/L TEAP | ~22 | $2.3 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.19. | Triethylamine | AN | 0.1 mol/L TEAP | ~22 | $1.4 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.49$ μs (SL/LUM/SPC); RT | 78E518 |

TABLE 9. Quenching of excited iridium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **9.1.** | ***cis*-Ir(5,6-Me$_2$phen)$_2$Cl$_2$$^+$—Continued** | | | | | | |
| 9.1.20. | 1,2,3-Trimethoxybenzene | AN | 0.1 mol/L TEAP | ~22 | $6.4 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 0.49 μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.21. | 1,2,4-Trimethoxybenzene | AN | 0.1 mol/L TEAP | ~22 | $5.5 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.49 μs (SL/LUM/SPC); RT | 78E518 |
| 9.1.22. | Triphenylamine | AN | 0.1 mol/L TEAP | ~22 | $6.5 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.49 μs (SL/LUM/SPC); RT | 78E518 |
| **9.2.** | **Ir(bpy)$_2$($C^3$,$N'$-Hbpy)$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 9.2.1. | Br$^-$ | H$_2$O | pH 1.5 | | $2.4 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 0.70 μs; EX; [Q] = 0.003-0.25 mol/L | 85F140 |
| 9.2.2. | Co$^{2+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | ~23 | $6.1 \times 10^6$ | SS/LUM, LP/LUM/SST $\tau_0$ = 12 μs; RT, ET?; [Q] ≤ 0.012 mol/L; p$K_a^*$ = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$ | 79F173 |
| 9.2.3. | Co(NH$_3$)$_5$F$^{2+}$ | H$_2$O | pH 1.4; μ = 0.1 | ~20 | $1.8 \times 10^7$ | SS/LUM; $\tau_0$ = 13 μs (LP/LUM/SST); OT | 86A057 |
| 9.2.4. | Eu$^{2+}$ | H$_2$O | 0.5 mol/L HNO$_3$ | ~23 | $\sim 2 \times 10^8$ | SS/LUM, LP/LUM/SST $\tau_0$ = 12 μs; RT?; p$K_a^*$ = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$ | 79F173 |
| 9.2.5. | Fe$^{3+}$ | H$_2$O | pH 0.6 (HClO$_4$) | ~20 | $1.7 \times 10^7$ | SS/LUM and LP/LUM/SST; CR | 86A057 |
| | Fe$^{3+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | ~23 | $3.7 \times 10^7$ | SS/LUM, LP/LUM/SST $\tau_0$ = 12 μs; OT, ET?; [Q] ≤ 0.002 mol/L; p$K_a^*$ = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$ | 79F173 |
| 9.2.6. | Ni$^{2+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | ~23 | $2.8 \times 10^6$ | SS/LUM, LP/LUM/SST $\tau_0$ = 12 μs; RT, ET?; [Q] ≤ 0.024 mol/L; p$K_a^*$ = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$ | 79F173 |
| 9.2.7. | O$_2$ | MeOH | | | $3.4 \times 10^8$ | SS/LUM; $\tau_0$ = 2.4 μs (75F657); ET; S designated as Ir(bpy)$_3$$^{3+}$ | 777221 |
| 9.2.8. | Pt(CN)$_4$$^{2-}$ | H$_2$O | μ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | $2 \times 10^9$ | EMI; RT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |

TABLE 9. Quenching of excited iridium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **9.2.** | **Ir(bpy)$_2$($C^3$,$N'$-Hbpy)$^{3+}$**—Continued | | | | | | |
| 9.2.9. | Pt(C$_2$O$_4$)$_2$$^{2-}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 1 × 10$^9$ | EMI; RT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.10. | Pt(en)$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 6 × 10$^7$ | EMI; RT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.11. | Pt(NH$_3$)$_4$$^{2+}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 5 × 10$^7$ | EMI; RT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.12. | Pt(NH$_3$)$_4$Br$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 2 × 10$^8$ | EMI; OT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.13. | Pt(NH$_3$)$_5$Br$^{3+}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 4 × 10$^7$ | EMI; OT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.14. | Pt(NH$_3$)$_4$Cl$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 1 × 10$^8$ | EMI; OT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.15. | Pt(NH$_3$)$_5$Cl$^{3+}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 1 × 10$^7$ | EMI; OT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.16. | Pt(NO$_2$)$_4$$^{2-}$ | H$_2$O | $\mu$ = 0.01 (HClO$_4$ or H$_2$SO$_4$) | | 2 × 10$^9$ | EMI; RT; S designated as Ir(bpy)$_3$$^{3+}$ | 85A469 |
| 9.2.17. | S$_2$O$_8$$^{2-}$ | H$_2$O | pH 1.4; $\mu$ = 0.2 | ~20 | 7.8 × 10$^7$ | SS/LUM and LP/LUM/SST; $\tau_0$ = 13 $\mu$s; OT; [Q] = 0.002-0.05 mol/L | 86A057 |
| 9.2.18. | Tl$^{3+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | ~23 | 6 × 10$^4$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 12 $\mu$s; OT?; [Q] ≤ 0.18 mol/L; p$K_a$$^*$ = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$ | 79F173 |
| *Organic Quenchers* | | | | | | | |
| 9.2.19. | Biacetyl | H$_2$O | 0.5 mol/L HClO$_4$ | ~23 | 2.6 × 10$^8$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 12 $\mu$s; RT, ET?; [Q] ≤ 0.002 mol/L; p$K_a$$^*$ = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$ | 79F173 |
| 9.2.20. | MV$^{2+}$ | H$_2$O | 0.05 mol/L Mg(NO$_3$)$_2$; pH 1.4 | ~20 | 1.3 × 10$^6$ | SS/LUM and LP/LUM/SST; $\tau_0$ = 10 $\mu$s; OT; [Q] = 0.02-0.08 mol/L | 86A057 |
| **9.3.** | **Ir(bpy)$_2$($C^3$,$N'$-bpy)$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 9.3.1. | Co$^{2+}$ | H$_2$O | 0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7 | ~23 | 1.5 × 10$^7$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 10 $\mu$s; RT, ET?; [Q] ≤ 0.012 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$ | 79F173 |

TABLE 9. Quenching of excited iridium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **9.3.** | **Ir(bpy)$_2$($C^3$,$N'$-bpy)$^{2+}$—Continued** | | | | | | |
| 9.3.2. | Cr(CN)$_5$$^{3-}$ | H$_2$O | 0.05 mol/L NaHCO$_3$; pH 8.6 | ~23 | 8.9 × 10$^9$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 10 μs; ET; [Q] ≤ 0.001 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$ | 79F173 |
| 9.3.3. | Fe(OH)$^{2+}$ | H$_2$O | 0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7 | ~23 | 3.1 × 10$^8$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 10 μs; OT, ET?; [Q] ≤ 0.002 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$ | 79F173 |
| 9.3.4. | Ni$^{2+}$ | H$_2$O | 0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7 | ~23 | 4.2 × 10$^6$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 10 μs; RT, ET?; [Q] ≤ 0.024 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$ | 79F173 |
| 9.3.5. | Tl(OH)$^{2+}$ | H$_2$O | 0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7 | ~23 | 1.6 × 10$^7$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 10 μs; OT?; [Q] ≤ 0.025 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$ | 79F173 |
| *Organic Quenchers* | | | | | | | |
| 9.3.6. | Biacetyl | H$_2$O | 0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7 | ~23 | 2.8 × 10$^8$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 10 μs; RT, ET?; [Q] ≤ 0.002 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$ | 79F173 |
| 9.3.7. | 2,3-Diacetoxynorbornadiene | AN | | 25 | <1 × 10$^5$ | LIF and SS/QYP; $\tau_0$ = 10 μs; see Mech. [6] | 86A158 |
| 9.3.8. | 2,3-Diacetoxyquadricyclane | AN | | 25 | 1.0 × 10$^7$ | LIF and SS/QYP; $\tau_0$ = 10 μs; RT; see Mech. [6] | 86A158 |
| 9.3.9. | Norbornadiene | AN | | 25 | 1.4 × 10$^8$ | LIF and SS/QYP; $\tau_0$ = 10 μs; RT; see Mech. [6] | 86A158 |
| 9.3.10. | Quadricyclane | AN | | 25 | 3.3 × 10$^9$ | LIF and SS/QYP; $\tau_0$ = 10 μs; RT; see Mech. [6] | 86A158 |
| **9.4.** | **Ir(8-hydroxyquinolinato)$_3$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 9.4.1. | Cr(CN)$_6$$^{3-}$ | DMF | | 25 | 5.5 × 10$^7$ | SS/LUM; $\tau_0$ = 2.5 μs (LP/LUM/SST); ET; see Mech. [6] | 86E555 |
| *Organic Quenchers* | | | | | | | |
| 9.4.2. | 1-Chloro-4-nitrobenzene | AN | | 25 | 1.7 × 10$^9$ | LP/LUM/SST; OT | 86E555 |
| 9.4.3. | MV$^{2+}$ | AN | 0.01 mol/L TEAP | 25 | 1.6 × 10$^{10}$ | LP/LUM/SST; OT | 86E555 |
| 9.4.4. | Nitrobenzene | AN | | 25 | 1.7 × 10$^8$ | LP/LUM/SST; OT | 86E555 |

TABLE 9. Quenching of excited iridium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **9.5. Ir(phen)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 9.5.1. | O$_2$ | MeOH | | | $2.8 \times 10^8$ | SS/LUM; $\tau_0 = 2.6$ μs (75F657); ET | 777221 |
| **9.6. Ir$_2$(μ-pyrazolyl)$_2$(1,5-cyclooctadiene)$_2$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 9.6.1. | N-Benzyl-3-carbamyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $5.5 \times 10^9$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.2. | 1,2-Dichloroethane | Hexane | | | $7.3 \times 10^5$ | LP/LUM; $\tau_c = 0.25$ μs (84E152); OT | 84F117 |
| 9.6.3. | Dichloromethane | Hexane | | | $5.8 \times 10^5$ | LP/LUM; $\tau_c = 0.25$ μs (84E152); OT | 84F117 |
| 9.6.4. | N,4-Dimethyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $6.6 \times 10^8$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.5. | N-Ethyl-4-(tert-butyl)-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $6.5 \times 10^8$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.6. | N-Ethyl-4-carbamyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $1.5 \times 10^{10}$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.7. | N-Ethyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $2.5 \times 10^9$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.8. | N-Methyl-4-acetoxy-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $1.3 \times 10^{10}$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.9. | N-Methyl-3-carbamyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $6.2 \times 10^9$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.10. | N-Methyl-4-cyano-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $2.0 \times 10^{10}$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.11. | N-Methyl-2-methoxy-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $8.1 \times 10^8$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.12. | MV$^{2+}$ | AN | μ = 0.1 (TBAF) | ~22 | $1.6 \times 10^{10}$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT; same $k_q$ from same lab in 84E152 | 85E779 |
| 9.6.13. | N,2,3,6-Tetramethyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $2.9 \times 10^8$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.14. | N,2,4,6-Tetramethyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $2.2 \times 10^7$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.15. | N,2,6-Trimethyl-4-methoxy-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $1.1 \times 10^6$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |
| 9.6.16. | N,2,6-Trimethyl-py$^+$ | AN | μ = 0.1 (TBAF) | ~22 | $5.8 \times 10^8$ (corr) | LP/LUM; $\tau_c = 0.25$ μs; OT | 85E779 |

TABLE 10. Quenching of excited iron complexes

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **10.1.** $Fe(bpy)_3^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 10.1.1. $Fe^{3+}$ | | $H_2O$ | $\mu = 0.5$ $(H_2SO_4)$ | 25 | $\leq 1 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.81$ ns; [Q] = 0.1 mol/L | 80E040 |
| **10.2.** $Fe(terpy)_2^{2-}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 10.2.1. $Fe^{3+}$ | | $H_2O$ | $\mu = 0.5$ $(H_2SO_4)$ | 25 | $\leq 4 \times 10^6$ | LP/LUM/SST; $\tau_0 = 2.5$ ns; [Q] = 0.1 mol/L | 80E040 |

TABLE 11. Quenching of excited magnesium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **11.1.** | **Mg(etioporphyrin I)(pyridine)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 11.1.1. | *cis*-4-Nitrostilbene | Benzene | 0.005 mol/L py | | $2 \times 10^8$ | FP/ABS/SST; EX | 707320 |
| **11.2.** | **Mg(etioporphyrin I) [singlet]** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 11.2.1. | Nitrobenzene | AN | | | $1.4 \times 10^{10}$ | SS/LUM; $\tau_0 = 11$ ns (assumed); EX | 68A001 |
| | Nitrobenzene | Benzene | | | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 11$ ns (assumed); EX | 68A001 |
| | Nitrobenzene | EtOH | | | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 11$ ns (assumed); EX | 68A001 |
| | Nitrobenzene | MeCH | | | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 11$ ns (assumed); EX; [Q] $\leq 0.20$ mol/L | 68A001 |
| | Nitrobenzene | Piperidine | | | $5.7 \times 10^9$ | SS/LUM; $\tau_0 = 11$ ns (assumed); EX; [Q] $\leq 0.10$ mol/L | 68A001 |
| 11.2.2. | *cis*-4-Nitrostilbene | Benzene | | | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0 = 12$ ns (LP/LUM/SST); EX; nonlinear S-V plot at high [Q] | 707320 |
| **11.3.** | **Mg(etioporphyrin I) [triplet]** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 11.3.1. | 1-Methoxy-4-nitrobenzene | Benzene | | 25 | $7 \times 10^8$ | FP/ABS/SST; EX; [Q] = (1-50) $\times$ 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q]'s | 747293 |
| 11.3.2. | Nitrobenzene | Benzene | | 25 | $1.8 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) $\times$ 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q]'s | 747293 |
| 11.3.3. | *cis*-4-Nitrostilbene | Benzene | | | $1.7 \times 10^9$ | FP/ABS/SST; EX | 707320 |
| 11.3.4. | 4-Nitrotoluene | Benzene | | 25 | $1.4 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) $\times$ 10$^{-5}$ mol/L; $\tau$ increases at higher [Q]'s | 747293 |
| **11.4.** | **Mg(2,3,7,8,12,13,17,18-octaethylporphyrin)** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 11.4.1. | Mg(OEP) | 1-PrOH | | 25 | $1.1 \times 10^8$ | LP/ABS/SST; CD; also TT, see Mech. [10] | 83A102 |
| | Mg(OEP) | 2-PrOH | | 25 | $8 \times 10^7$ | LP/ABS/SST; CD; also TT, see Mech. [10] | 83A102 |

TABLE 11. Quenching of excited magnesium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| 11.4. | Mg(2,3,7,8,12,13,17,18-octaethylporphyrin)—Continued | | | | | | |
| | Mg(OEP) | DMSO | | 25 | $2.1 \times 10^8$ | LP/ABS/SST; CD; also TT, see Mech. [10] | 83A102 |
| | Mg(OEP) | EtOH | | 25 | $1.1 \times 10^8$ | LP/ABS/SST; CD; also TT, see Mech. [10] | 83A102 |
| | Mg(OEP) | MeOH | | 25 | $1.6 \times 10^8$ | LP/ABS/SST; CD; [Q] = $(4-45) \times 10^{-6}$ mol/L; also TT, see Mech. [10] | 83A102 |
| 11.5. | Mg(phthalocyanine) [singlet] | | | | | | |
| | Organic Quenchers | | | | | | |
| 11.5.1. | 1,4-Benzoquinone | Dioxane | | | $2.7 \times 10^{10}$ | SS/LUM; $\tau_0 = 6.5$ ns (573002); OT; [Q] ≤ 0.1 mol/L; same $k_q$ from same lab in 67A003 | 65A001 |
| 11.5.2. | 1,3-Dinitrobenzene | Dioxane | | | $4.3 \times 10^9$ | SS/LUM; $\tau_0 = 6.5$ ns (573002); OT; [Q] ≤ 0.2 mol/L; same $k_q$ from same lab in 67A003 | 65A001 |
| 11.5.3. | Nitrobenzene | Dioxane | | | $1.0 \times 10^9$ | SS/LUM; $\tau_0 = 6.5$ ns (573002); OT; [Q] ≤ 1 mol/L; same $k_q$ from same lab in 67A003 | 65A001 |
| 11.5.4. | Trinitrobenzene | Dioxane | | | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0 = 6.5$ ns (573002); OT; [Q] ≤ 0.15 mol/L; same $k_q$ from same lab in 67A003 | 65A001 |
| 11.6. | Mg(phthalocyanine) [triplet] | | | | | | |
| | Inorganic Quenchers | | | | | | |
| 11.6.1. | Ag(TPP) | DMF | | | $1.7 \times 10^8$ | FP/ABS/SST; ET | 76E693 |
| | Ag(TPP) | Toluene | | | $1.9 \times 10^8$ | FP/ABS/SST; ET | 76E693 |
| 11.6.2. | Co(bpy)$_3^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $1.7 \times 10^7$ | LP/ABS/AVE; ET?; [Q] < 0.001 mol/L | 84A122 |
| 11.6.3. | Co(bpy)$_3^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $2.8 \times 10^8$ | LP/ABS/AVE; OT; $f =$ 0.58; [Q] < $2 \times 10^{-4}$ mol/L | 84A122 |
| 11.6.4. | Co(phen)$_3^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $3.6 \times 10^7$ | LP/ABS/AVE; ET?; [Q] < 0.001 mol/L | 84A122 |
| 11.6.5. | Co(phen)$_3^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $4.0 \times 10^8$ | LP/ABS/AVE; OT; $f =$ 0.60; [Q] < $2 \times 10^{-4}$ mol/L | 84A122 |

TABLE 11. Quenching of excited magnesium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **11.6.** | **Mg(phthalocyanine) [triplet]**—Continued | | | | | | |
| 11.6.6. | Co(terpy)$_2$$^{2+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $1.3 \times 10^8$ | LP/ABS/AVE; ET?; [Q] < 0.001 mol/L | 84A122 |
| 11.6.7. | Co(terpy)$_2$$^{3+}$ | DMA/H$_2$O (2.3/1) | | ~15 | $3.8 \times 10^8$ | LP/ABS/AVE; OT; $f$ = 0.57; [Q] < 2 × 10$^{-4}$ mol/L | 84A122 |
| 11.6.8. | Ni(etioporphyrin I) | 1-PrOH | | | $1.3 \times 10^9$ | FP/ABS/SST; ET | 74E520 |
| 11.6.9. | Pd(etioporphyrin I) | 1-PrOH | | | $<1 \times 10^8$ | FP/ABS/SST; ET | 74E520 |
| *Organic Quenchers* | | | | | | | |
| 11.6.10. | 1,4-Benzoquinone | Dioxane | | | $4.0 \times 10^7$ | FP/ABS/SST; $\tau_0$ = 0.1 ms; OT; same $k_q$ from same lab in 67A003 | 65A001 |
| 11.6.11. | MV$^{2+}$ | DMF/H$_2$O (9/1) | | | $7.6 \times 10^7$ | LP/ABS/AVE; $\tau_0$ = 0.33 ms; OT; $f$ = 0.71 | 84A272 |
| 11.6.12. | Nitrobenzene | Dioxane | | | $1.7 \times 10^6$ | FP/ABS/SST; $\tau_0$ = 0.1 ms; OT; same $k_q$ from same lab in 67A003 | 65A001 |
| **11.7.** | **Mg[tetrakis(4-tert-butyl)phthalocyanine]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 11.7.1. | 1,4-Naphthoquinone | Toluene | | | $6 \times 10^6$ (calc) | FP/ABS/SST; $\tau_0$ = 0.56 ms; EX; biexponential decay, see Mech. [2] | 82E636 |
| 11.7.2. | OrgQue13 | Toluene | | | $3.4 \times 10^6$ | FP/ABS/SST; $\tau_0$ = 0.38 ms; OT; [Q] = 0.002-0.02 mol/L | 84E308 |
| 11.7.3. | OrgQue14 | Toluene | | | $1.3 \times 10^6$ | FP/ABS/SST; $\tau_0$ = 0.38 ms; OT; [Q] = 0.002-0.02 mol/L; nonlinear S-V plot, see Mech. [1] | 84E308 |
| **11.8.** | **Mg[tetrakis(N-methylaza)phthalocyanine]$^{4+}$ [singlet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 11.8.1. | MV$^{2+}$ | H$_2$O | $\mu$ = 0 (extrap'd, NaCl) | | $4.5 \times 10^7$ | SS/LUM; $\tau_0$ = 8.2 ns; OT; [Q] = 0.001-0.2 mol/L | 81A188 |
| **11.9.** | **Mg[tetrakis(N-methylaza)phthalocyanine]$^{4+}$ [triplet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 11.9.1. | MV$^{2+}$ | H$_2$O | | | $<2 \times 10^3$ | FP/ABS/SST; $\tau_0$ = 0.28 ms; [Q] = 0.001-0.2 mol/L | 81A188 |

TABLE 11. Quenching of excited magnesium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **11.10. Mg(tetramethoxyphthalocyanine)** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 11.10.1. MV$^{2+}$ | | DMF/H$_2$O (9/1) | | | ~7 × 10$^7$ | LP/ABS/AVE; $\tau_0^{und}$ = ~0.24 ms; OT; S possibly a mixture of isomers | 86S089 |
| **11.11. Mg(5,10,15,20-tetraphenylporphyrin)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 11.11.1. Eu$^{3+}$ | | AN | | | 2.1 × 10$^6$ | FP/ABS/SST; OT; [Q] ≤ 0.0018 mol/L; some Eu$^{2+}$ present | 79A220 |
| *Organic Quenchers* | | | | | | | |
| 11.11.2. 1,4-Benzoquinone | | EtOH | | | 3.1 × 10$^9$ | LP/ABS/SST; OT; $f$ = 0.28; $\phi$ = 0.85 (82E428) | 83F182 |
| | 1,4-Benzoquinone | Toluene | | | 2 × 10$^8$ (calc) | FP/ABS/SST; $\tau_0$ = 0.30 ms; EX; same $k_q$ from same lab in 81E718; biexponential decay, see Mech. [2] | 82E636 |
| **11.12. Mg(5,10,15,20-tetraphenylporphyrin)(pyridine)** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 11.12.1. 1-Bromo-2-nitrobenzene | | Toluene | | | 2 × 10$^6$ (calc) | FP/ABS/SST; $\tau_0$ = 0.5 ns; EX; biexponential decay; see Mech. [2] | 83E101 |
| 11.12.2. 1-Chloro-2-nitrobenzene | | Toluene | | | 3 × 10$^7$ (calc) | FP/ABS/SST; $\tau_0$ = 0.5 ns; EX; biexponential decay; see Mech. [2] | 83E101 |
| 11.12.3. 1,2-Dinitrobenzene | | Toluene | | | <1 × 10$^8$ (calc) | FP/ABS/SST; $\tau_0$ = 0.5 ns; EX; biexponential decay; see Mech. [2] | 83E101 |
| 11.12.4. 1,4-Dinitrobenzene | | Toluene | | | 9 × 10$^7$ (calc) | FP/ABS/SST; $\tau_0$ = 0.5 ns; EX; biexponential decay; see Mech. [2] | 83E101 |
| 11.12.5. 2-Nitroaniline | | Toluene | | | 8 × 10$^6$ (calc) | FP/ABS/SST; $\tau_0$ = 0.5 ns; EX; biexponential decay; see Mech. [2]; see also 85A155 | 83E101 |
| 11.12.6. 3-Nitroaniline | | Toluene | | | 6 × 10$^6$ (calc) | FP/ABS/SST; $\tau_0$ = 0.5 ns; EX; biexponential decay; see Mech. [2] | 83E101 |

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TABLE 11. Quenching of excited magnesium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **11.12. Mg(5,10,15,20-tetraphenylporphyrin)(pyridine)**—Continued | | | | | | | |
| 11.12.7. | 1-Nitronaphthalene | Toluene | | | $<5 \times 10^8$ (calc) | FP/ABS/SST; $\tau_0 = 0.5$ ms; EX; biexponential decay, see Mech. [2] | 83E101 |
| 11.12.8. | 1,3,5-Trimethyl-2,4,6-trinitrobenzene | Toluene | | | $<5 \times 10^8$ (calc) | FP/ABS/SST; $\tau_0 = 0.5$ ms; EX; biexponential decay, see Mech. [2] | 83E101 |

TABLE 12. Quenching of excited molybdenum complexes

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **12.1. Mo$_6$Cl$_{14}$$^{2-}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 12.1.1. | PW$_{12}$O$_{40}$$^{3-}$ | H$_2$O | 2 mol/L HCl | 27 | $\sim 7 \times 10^8$ | SS/LUM; $\tau_0 = 20$ μs (81E076); OT; $\tau_0$ in 6 mol/L HCl and 6 mol/L LiCl | 83F069 |
| 12.1.2. | SiW$_{12}$O$_{40}$$^{4-}$ | H$_2$O | 2 mol/L HCl | 27 | $\sim 2 \times 10^8$ | SS/LUM; $\tau_0 = 20$ μs (81E076); OT; $\tau_0$ in 6 mol/L HCl and 6 mol/L LiCl | 83F069 |
| *Organic Quenchers* | | | | | | | |
| 12.1.3. | $N,N'$-Bis(2-sulfonatoethyl)-(vio$^{2+}$) zwitterion | H$_2$O | 2 mol/L HCl | 27 | $3.8 \times 10^6$ | SS/LUM; $\tau_0 = 20$ μs (81E076); OT; $\tau_0$ in 6 mol/L HCl and 6 mol/L LiCl | 83F069 |
| 12.1.4. | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | H$_2$O | 2 mol/L HCl | 27 | $\sim 3 \times 10^6$ | SS/LUM; $\tau_0 = 20$ μs (81E076); OT; $\tau_0$ in 6 mol/L HCl and 6 mol/L LiCl | 83F069 |
| 12.1.5. | Tetracyanoethene | AN | | 27 | $2.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.18$ ms (LP/LUM/SST); OT | 83F069 |

TABLE 13. Quenching of excited neodymium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **13.1. Nd$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 13.1.1. | H$_2$O | CCl$_4$/dTBP (4/1) | | 20 | $7.4 \times 10^6$ | LP/LUM/SST; $\tau_0 = 12$ μs; ET; [Q] $\leq$ 0.02 mol/L; S forms 1:3 complex with dTBP | 75E542 |
| | H$_2$O | CCl$_4$/TBP (4/1) | | 20 | $7.4 \times 10^6$ | LP/LUM/SST; $\tau_0 = 3$ μs; ET; [Q] $\leq$ 0.05 mol/L; S forms 1:3 complex with TBP | 75E542 |
| | H$_2$O | TBP | | 20 | $1.9 \times 10^6$ | LP/LUM/SST; $\tau_0 = 3$ μs; ET; [Q] $\leq$ 0.13 mol/L; S forms 1:3 complex with TBP | 75E542 |

TABLE 14. Quenching of excited osmium complexes

| No. | Quencher | Solvent | Solution Medium | $T$/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.1.** | **Os(5-Clphen)$_3$$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.1.1. | Co(bpy)$_3$$^{2+}$ | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; $\mu$ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | 5.5 × 10$^8$ | SS/LUM; $\tau_0$ = 78 ns (78E887); OT, ET | 85S022 |
| 14.1.2. | Eu$^{2+}$ | H$_2$O | pH 1.3; $\mu$ = 0.5 (NaCl) | 25 | 7.9 × 10$^6$ | LP/LUM/SST; $\tau_0$ = 78 ns; [Q] ≤ 0.005 mol/L | 80E040 |
| 14.1.3. | Fe$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | | 3.2 × 10$^9$ | FP/PCM/SST; $\tau_0$ = 78 ns (78E887); OT, ET?; [Q] ≤ 0.01 mol/L; same $k_q$ from same lab in 78A186; [Fe$^{2+}$] = [Fe$^{3+}$]; see Mech. [8] | 80E224 |
| 14.1.4. | Fe(bpy)$_3$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (NaCl) | 25 | 2.3 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 78 ns; ET; [Q] ≤ 0.005 mol/L | 80E040 |
| 14.1.5. | Fe(CN)$_6$$^{4-}$ | H$_2$O | $\mu$ = 0.001 (NaCl) | 25 | 1.7 × 10$^{10}$ | SS/LUM; $\tau_0$ = 66 ns (LP/LUM/AVE); RT; [Q] ≤ 0.005 mol/L; some SQ, see Mech. [11] | 81A250 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | $\mu$ = 0.1 (NaCl) | 25 | 3.2 × 10$^9$ | SS/LUM; $\tau_0$ = 66 ns (LP/LUM/AVE); RT; [Q] ≤ 0.006 mol/L; some SQ, see Mech. [11] | 81A250 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | $\mu$ = 1.0 (NaCl) | 25 | 2.8 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 78 ns; [Q] ≤ 0.005 mol/L | 80E040 |
| 14.1.6. | Fe(phen)$_3$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (NaCl) | 25 | 1.4 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 78 ns; ET, OT?; [Q] ≤ 0.005 mol/L | 80E040 |
| 14.1.7. | Ru(NH$_3$)$_6$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (NaCl) | 25 | 1.1 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 78 ns; [Q] ≤ 0.005 mol/L; same $k_q$ from same lab in 78E887 | 80E040 |
| 14.1.8. | Ru(terpy)$_2$$^{2+}$ | H$_2$O | $\mu$ = 1.0 (Na$_2$SO$_4$) | 25 | ≤1 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 78 ns; [Q] ≤ 0.005 mol/L; same $k_q$ from same lab in 78E887 | 80E040 |
| 14.1.9. | Ru(TPTZ)$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (NaCl) | 25 | 2.6 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 78 ns; OT; [Q] ≤ 0.005 mol/L | 80E040 |
| **14.2.** | **Os(5,6-Me$_2$phen)$_3$$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.2.1. | Co(bpy)$_3$$^{2+}$ | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; $\mu$ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | 1.5 × 10$^9$ | SS/LUM; $\tau_0$ = 63 ns (78E887); OT, ET | 85S022 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.2. Os(5,6-Me$_2$phen)$_3$$^{2+}$—Continued** | | | | | | | |
| 14.2.2. Cu$^{2+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $2.1 \times 10^8$ | SS/LUM; $\tau_0$ = 63 ns (C. Creutz, unpub. obs.); OT | 78A090 |
| **14.3. Os(3,4,7,8-Me$_4$phen)$_2$[cis-1,2-bis(diphenylphosphino)ethene]$^{2-}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.3.1. N-Benzyl-3-carbamyl-py$^+$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.9 \times 10^7$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.3.2. N,N'-Dibenzyl-vio$^{2+}$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.9 \times 10^9$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT | 85E347 |
| 14.3.3. N-Ethyl-3-carbamyl-py$^+$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.9 \times 10^6$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.3.4. N-Ethyl-4-carbomethoxy-py$^+$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $8.6 \times 10^8$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT | 85E347 |
| 14.3.5. N-Methyl-3-carbamyl-py$^+$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.2 \times 10^6$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.3.6. N-Methyl-4-carbamyl-py$^+$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.1 \times 10^8$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.3.7. N-Methyl-4-cyano-py$^+$ | | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.2 \times 10^9$ | SS/LUM; $\tau_0$ = 3.5 μs (LP/LUM/AVE); OT | 85E347 |
| **14.4. Os(bpy)$_3$$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.4.1. Co(CN)$_6$$^{3-}$ | | H$_2$O | 0.5 mol/L NaCl | ~20 | $1.3 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (SL/LUM/SPC); OT | 78F263 |
| 14.4.2. Co(NH$_3$)$_5$Br$^{2+}$ | | H$_2$O | 0.166 mol/L Na$_2$SO$_4$; 0.013 mol/L NaHSO$_4$; μ = 0.5 | 23-24 | $9 \times 10^8$ | SS/QYP, SS/LUM; $\tau_0$ = 19 ns (766014); OT; [Q] ≤ 0.008 mol/L; see Mech. [7] | 78A058 |
| 14.4.3. Co(NH$_3$)$_5$(CO$_3$)$^+$ | | H$_2$O | 0.166 mol/L Na$_2$SO$_4$; 0.013 mol/L NaHSO$_4$; μ = 0.5 | 23-24 | $\sim 1 \times 10^8$ | SS/QYP; $\tau_0$ = 19 ns (766014); OT; $f$ = ~1; see Mech. [7] | 78A058 |

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TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.4.** | **Os(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 14.4.4. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.166 mol/L Na$_2$SO$_4$; 0.013 mol/L NaHSO$_4$; $\mu$ = 0.5 | 23-24 | 6 × 10$^8$ | SS/QYP, SS/LUM; $\tau_0$ = 19 ns (766014); OT; [Q] ≤ 0.008 mol/L; see Mech. [7] | 73A058 |
| 14.4.5. | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.166 mol/L Na$_2$SO$_4$; 0.013 mol/L NaHSO$_4$; $\mu$ = 0.5 | 23-24 | ~2 × 10$^8$ | SS/QYP; $\tau_0$ = 19 ns (766014); OT; $f$ = ~1; [Q] ≤ 0.02 mol/L; see Mech. [7] | 73A058 |
| 14.4.6. | Co(NH$_3$)$_5$(N$_3$)$^{2+}$ | H$_2$O | 0.166 mol/L Na$_2$SO$_4$; 0.013 mol/L NaHSO$_4$; $\mu$ = 0.5 | 23-24 | 4 × 10$^8$ | SS/QYP; $\tau_0$ = 19 ns (766014); OT; $f$ = ~1; [Q] ≤ 0.008 mol/L; see Mech. [7] | 73A058 |
| 14.4.7. | Co(NH$_3$)$_5$(SO$_4$)$^{+}$ | H$_2$O | 0.166 mol/L Na$_2$SO$_4$; 0.013 mol/L NaHSO$_4$; $\mu$ = 0.5 | 23-24 | ~2 × 10$^3$ | SS/QYP; $\tau_0$ = 19 ns (766014); OT; $f$ = ~1; see Mech. [7] | 73A058 |
| 14.4.8. | Co(phen)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L NaCl | 25 | 5.7 × 10$^9$ | SS/LUM; $\tau_0$ = 19 ns (SL/LUM/SPC); OT; [Q] ≤ 0.004 mol/L | 766014 |
| 14.4.9. | Cr(CN)$_6$$^{3-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | 2.5 × 10$^9$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (SL/LUM/SPC); ET | 78F263 |
| 14.4.10. | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 2 × 10$^8$ | SS/LUM; $\tau_0$ = 19 ns (766014); OT | 78A090 |
| 14.4.11. | Fe$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | | 5.5 × 10$^9$ | FP/PCM/SST; $\tau_0$ = 19 ns (766014); OT, ET?; [Fe$^{2+}$] = [Fe$^{3+}$]; see Mech. [8] | 80E224 |
| 14.4.12. | Fe(CN)$_6$$^{3-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | 9.4 × 10$^9$ | SL/LUM/SPC; $\tau_0$$^{air}$ = 21 ns; OT | 78F263 |
| | Fe(CN)$_6$$^{3-}$ | H$_2$O | 0.5 mol/L NaCl | 25 | 1.3 × 10$^{10}$ | SS/LUM; $\tau_0$ = 19 ns (SL/LUM/SPC); OT; [Q] ≤ 0.01 mol/L | 766014 |
| 14.4.13. | Fe(CN)$_6$$^{1-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | 3.8 × 10$^8$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (SL/LUM/SPC); RT | 78F263 |
| 14.4.14. | Fe$^{III}$(cytochrome c) | H$_2$O | Pbuf; pH 7 | | >5 × 10$^9$ | LP/ABS/AVE; $\tau_0$ = 19 ns (80E040); OT; [Q] = (1-10) × 10$^{-5}$ mol/L; 10.6% of Q as Fe$^{II}$ | 84A306 |
| 14.4.15. | Mo(CN)$_8$$^{1-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | 2.8 × 10$^8$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (SL/LUM/SPC); RT | 78F263 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.4.** | **Os(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 14.4.16. | Ni(CN)$_4$$^{2-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | $9 \times 10^7$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (SL/LUM/SPC); OT | 78F263 |
| 14.4.17. | O$_2$ | H$_2$O | | 25 | $5.2 \times 10^9$ | SS/LUM; $\tau_0$ = 19 ns (SL/LUM/SPC); [Q] ≤ 0.0015 mol/L | 766014 |
| | O$_2$ | MeOH | | | $4.5 \times 10^9$ | SS/LUM; $\tau_0$ = 49 ns (75F657); ET | 777221 |
| 14.4.18. | PtBr$_4$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $3.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 20 ns; ET | 83E719 |
| 14.4.19. | PtBr$_6$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $2.5 \times 10^{10}$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (LP/LUM/SST); OT | 83A403 |
| 14.4.20. | Pt(C$_2$O$_4$)$_2$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $<3 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 20 ns | 83E719 |
| 14.4.21. | PtCl$_4$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $5.0 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 20 ns; ET | 83E719 |
| 14.4.22. | PtCl$_6$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $1.4 \times 10^{10}$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (LP/LUM/SST); OT | 83A403 |
| 14.4.23. | PtF$_6$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $2.3 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (LP/LUM/SST); OT | 83A403 |
| 14.4.24. | Pt(NH$_3$)$_4$Br$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.02 (HClO$_4$ or H$_2$SO$_4$) | | $3 \times 10^9$ | EMI; OT | 85A469 |
| 14.4.25. | Pt(NH$_3$)$_5$Br$^{3+}$ | H$_2$O | $\mu$ = 0.1 (HClO$_4$ or H$_2$SO$_4$) | | $4 \times 10^9$ | EMI; OT | 85A469 |
| 14.4.26. | Pt(NH$_3$)$_4$Cl$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.02 (HClO$_4$ or H$_2$SO$_4$) | | $2 \times 10^9$ | EMI; OT | 85A469 |
| 14.4.27. | Pt(NH$_3$)$_5$Cl$^{3+}$ | H$_2$O | $\mu$ = 0.1 (HClO$_4$ or H$_2$SO$_4$) | | $3 \times 10^9$ | EMI; OT | 85A469 |
| 14.4.28. | Pt(SCN)$_4$$^{2-}$ | H$_2$O | $\mu$ = 4 (HClO$_4$) | | $<3 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 20 ns | 83E719 |
| 14.4.29. | Pt(SCN)$_6$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$) | | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (LP/LUM/SST); OT | 83A403 |
| 14.4.30. | Ru(CN)$_6$$^{4-}$ | H$_2$O | 0.5 mol/L NaCl | ~20 | $1.3 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 21 ns (SL/LUM/SPC); RT | 78F263 |
| 14.4.31. | Ru(NH$_3$)$_6$$^{3+}$ | H$_2$O | 0.5 mol/L NaCl | 25 | $4.8 \times 10^9$ | SS/LUM, SL/LUM/SPC; $\tau_0$ = 19 ns (SL/LUM/SPC); OT; [Q] ≤ 0.02 mol/L | 766014 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.5.** $cis$-Os(bpy)$_2$(CH$_3$CN)$_2$$^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.5.1. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$ | 25 | $9 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.55$ μs; OT | 84N050 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$; 0.01 mol/L SLS | 25 | $2.7 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; OT | 84N050 |
| **14.6.** Os(bpy)[1,2-bis(dimethylarsino)benzene]$_2$$^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.6.1. | O$_2$ | AN | | | $1.2 \times 10^6$ | LP/LUM/SST; $\tau_0 = 1.6$ μs; ET; $p_Q = 2 \times 10^4$ Pa | 86S121 |
| *Organic Quenchers* | | | | | | | |
| 14.6.2. | 4,4'-Bis($N$,$N$-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.3 \times 10^6$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.6.3. | 4-Bromo-$N$,$N$-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.6 \times 10^6$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.6.4. | $N$,$N$-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.2 \times 10^6$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.6.5. | $N$-Ethyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.6.6. | $N$-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.6.7. | $N$-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.4 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.6.8. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.1 \times 10^6$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.6.9. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.4 \times 10^6$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.6.10. | Phenoxathiin | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.9 \times 10^6$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.6.11. | Triphenylamine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.8 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.6.12. | Tris(4-bromophenyl)amine | AN | | 23 | $1.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs; RT | 82S130 |
| | Tris(4-bromophenyl)amine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); RT | 85E347 |
| **14.7.** Os(bpy)[$cis$-1,2-bis(diphenylphosphino)ethene]$_2$$^{2+}$ | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.7.1. | $N$,$N$-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (LP/LUM/AVE); OT | 85E347 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.7.** | **Os(bpy)[cis-1,2-bis(diphenylphosphino)ethene]$_2$$^{2+}$—Continued** | | | | | | |
| 14.7.2. | N-Ethyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.4 \times 10^6$ | SS/LUM; $\tau_0 = 1.7$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.7.3. | N-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.5 \times 10^6$ | SS/LUM; $\tau_0 = 1.7$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.7.4. | N-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.7 \times 10^7$ | SS/LUM; $\tau_0 = 1.7$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.7.5. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.7 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ µs (LP/LUM/AVE); OT | 85E347 |
| **14.8.** | **Os(bpy)$_2$[bis(diphenylphosphino)methane]$^{2+}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.8.1. | 1,4-Bis(N,N-dimethylamino)benzene | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); RT | 85E347 |
| 14.8.2. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); RT | 85E347 |
| 14.8.3. | 4-Bromo-N,N-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $6.3 \times 10^7$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); RT | 85E347 |
| 14.8.4. | 2-Chlorophenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); RT | 85E347 |
| 14.8.5. | N,N'-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.8.6. | N-Ethyl-3-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.5 \times 10^6$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.8.7. | N-Ethyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $7.4 \times 10^6$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.8.8. | N-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.8.9. | N-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.8.10. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); OT | 85E347 |
| 14.8.11. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); RT | 85E347 |
| 14.8.12. | 2-(Trifluoromethyl)phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.30$ µs (LP/LUM/AVE); RT | 85E347 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_c$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.9.** | **cis-Os(bpy)$_2$(dimethylsulfoxide)$_2$$^{2+}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.9.1. | 4-Bromo-$N,N$-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $6.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.9.2. | $N,N'$-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.5 \times 10^8$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.9.3. | $N$-Ethyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.8 \times 10^6$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.9.4. | $N$-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.6 \times 10^6$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.9.5. | $N$-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $7.9 \times 10^7$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.9.6. | $N$-Methylphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $6.6 \times 10^9$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.9.7. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.4 \times 10^8$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.9.8. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.2 \times 10^9$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.9.9. | Phenoxathiin | AN | 0.1 mol/L LiClO$_4$ | ~23 | $6.2 \times 10^8$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.9.10. | Triphenylamine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.4 \times 10^9$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| **14.10.** | **Os(phen)$_3$$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.10.1. | Co(bpy)$_3$$^{2+}$ | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; $\mu = 0.5$; [Co$^{II}$]/[L] = 0.2 | 25 | $7.4 \times 10^8$ | SS/LUM; $\tau_0 = 84$ ns (78E887); OT, ET | 85S022 |
| 14.10.2. | Co(en)$_3$$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.0 \times 10^8$ | SS/LUM; $\tau_0^{air} = 75$ ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.3. | cis-Co(en)$_2$Cl$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $2.3 \times 10^9$ | SS/LUM; $\tau_0^{air} = 75$ ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.4. | trans-Co(en)$_2$Cl$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $2.7 \times 10^9$ | SS/LUM; $\tau_0^{air} = 75$ ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.5. | cis-Co(en)$_2$(H$_2$O)Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $9.6 \times 10^8$ | SS/LUM; $\tau_0^{air} = 75$ ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.6. | cis-Co(en)$_2$(NCS)$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.9 \times 10^7$ | SS/LUM; $\tau_0^{air} = 75$ ns (LP/LUM/AVE); OT | 84A255 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.10.** Os(phen)$_3$$^{2+}$—Continued | | | | | | | |
| 14.10.7. *trans*-Co(en)$_2$(NCS)$_2$$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.7 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.8. *cis*-Co(en)$_2$(NCS)Cl$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $2.1 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.9. *trans*-Co(en)$_2$(NCS)Cl$^+$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.6 \times 10^9$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.10. *cis*-Co(en)$_2$(NH$_3$)Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $9.3 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/SST); OT | 84A255 |
| 14.10.11. Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.0 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.12. Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $9.3 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.13. Co(NH$_3$)$_5$F$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $2.9 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.14. Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $3.7 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.15. Co(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $6.8 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.16. Co(NH$_3$)$_5$[OC(O)H]$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $4.1 \times 10^8$ | SS/LUM; $\tau_0$$^{air}$ = 75 ns (LP/LUM/AVE); OT | 84A255 |
| 14.10.17. Fe$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | | $4.0 \times 10^9$ | FP/PCM/SST; $\tau_0$ = 84 ns (78Z170); OT, ET?; [Q] $\leq$ 0.027 mol/L; [Fe$^{2+}$] = [Fe$^{3+}$], see Mech. [8] | 80E224 |
| 14.10.18. Fe$^{II}$(cytochrome c) | H$_2$O | Pbuf; pH 7 | | $>7 \times 10^8$ | LP/ABS/AVE; $\tau_0$ = 84 ns (80E040); OT; [Q] = (1–10) $\times$ 10$^{-5}$ mol/L; 10.6% of Q as Fe$^{II}$ | 84A306 |
| 14.10.19. HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$; 0.01 mol/L SLS | 25 | $<1.1 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.14 $\mu$s; OT | 84N050 |
| 14.10.20. O$_2$ | MeOH | | | $5.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.18 $\mu$s (75F657); ET | 777221 |
| *Organic Quenchers* | | | | | | | |
| 14.10.21. *N*-Benzyl-3-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.6 \times 10^7$ | SS/LUM; $\tau_0$ = 0.26 $\mu$s (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.10.** | **Os(phen)$_3$$^{2+}$—Continued** | | | | | | |
| 14.10.22. | 1,4-Bis(N,N-dimethylamino)benzene | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.10.23. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.10.24. | N-Ethyl-3-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.4 \times 10^6$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.10.25. | N-Ethyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.10.26. | N-Ethyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.10.27. | 4-Methoxy-N,N-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.10.28. | N-Methyl-3-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.8 \times 10^6$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.10.29. | N-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.10.30. | N-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.10.31. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.10.32. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $8.3 \times 10^6$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/AVE); RT | 85E347 |
| **14.11.** | **cis-Os(phen)$_2$(CH$_3$CN)$_2$$^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 14.11.1. | N-Benzyl-3-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.49$ μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.11.2. | 1,4-Bis(N,N-dimethylamino)benzene | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.49$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.11.3. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.49$ μs (LP/LUM/AVE); RT | 85E347 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.11.** *cis*-Os(phen)$_2$(CH$_3$CN)$_2$$^{2+}$—Continued | | | | | | | |
| 14.11.4. | 2-Chlorophenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | 1.3 × 10$^7$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); RT | 85E347 |
| 14.11.5. | *N,N*-Dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | 1.2 × 10$^5$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); RT | 85E347 |
| 14.11.6. | *N*-Ethyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | 4.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.11.7. | 4-Methoxy-*N,N*-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | 1.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); RT | 85E347 |
| 14.11.8. | 3-Methoxyphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | 5.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); RT | 85E347 |
| 14.11.9. | *N*-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | 1.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); OT | 85E347 |
| 14.11.10. | *N*-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | 2.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); OT | 85E347 |
| 14.11.11. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.49 μs (LP/LUM/AVE); OT | 85E347 |
| **14.12.** *cis*-Os(phen)$_2$(CO)Cl$^+$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.12.1. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$ | 25 | 6.9 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.22 μs; OT | 84N050 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$; 0.01 mol/L SLS | 25 | 4.5 × 10$^7$ | LP/LUM/SST; $\tau_0$ = 0.25 μs; OT | 84N050 |
| **14.13.** Os(phen)$_2$[4,7-(PhSO$_3$)$_2$phen] | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.13.1. | O$_2$ | MeOH | | | 6.8 × 10$^9$ | SS/LUM; $\tau_0$ = 93 ns (75F657); ET | 777221 |
| **14.14.** Os(phen)$_2$(4,7-Ph$_2$phen)$^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.14.1. | O$_2$ | MeOH | | | 4.6 × 10$^9$ | SS/LUM; $\tau_0$ = 0.21 μs (75F657); ET | 777221 |
| **14.15.** Os(phen)$_2$[*cis*-1,2-bis(diphenylphosphino)ethene]$^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.15.1. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$ | 25 | 3.3 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 1.0 μs; OT | 84N050 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.15.** | **Os(phen)$_2$[cis-1,2-bis(diphenylphosphino)ethene]$^{2+}$**—Continued | | | | | | |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$; 0.01 mol/L SLS | 25 | $3.3 \times 10^6$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.90 µs; OT | 84N050 |
| | *Organic Quenchers* | | | | | | |
| 14.15.2. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); RT | 85E347 |
| 14.15.3. | 4-Bromo-N,N-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.3 \times 10^8$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); RT | 85E347 |
| 14.15.4. | N,N'-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.3 \times 10^9$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT | 85E347 |
| 14.15.5. | N-Ethyl-3-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.6 \times 10^6$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.15.6. | N-Ethyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.7 \times 10^7$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.15.7. | N-Methyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.3 \times 10^7$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.15.8. | N-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.8 \times 10^8$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT | 85E347 |
| 14.15.9. | N-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $8.4 \times 10^8$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT | 85E347 |
| 14.15.10. | N-Methylphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.9 \times 10^9$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); RT | 85E347 |
| 14.15.11. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.8 \times 10^8$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); OT | 85E347 |
| 14.15.12. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.8 \times 10^9$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); RT | 85E347 |
| 14.15.13. | Triphenylamine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.6 \times 10^7$ | SS/LUM; $\tau_0$ = 1.8 µs (LP/LUM/AVE); RT | 85E347 |

TABLE 14. Quenching of excited osmium complexes—Continued

QUENCHING OF EXCITED METAL COMPLEXES IN FLUID SOLUTION

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| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.16.** | **Os(phen)$_2$[bis(diphenylphosphino)methane]$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 14.16.1. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$ | 25 | $6.9 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.55$ $\mu$s; OT; [Q] $\leq 0.007$ mol/L; $k_q = \sim 8 \times 10^8$ with SS/LUM | 84N050 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$; 0.01 mol/L SLS | 25 | $5.3 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s; OT; [Q] $\leq 0.014$ mol/L; $k_q = 6.4 \times 10^6$ with SS/LUM | 84N050 |
| *Organic Quenchers* | | | | | | | |
| 14.16.2. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $6.2 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.16.3. | 4-Bromo-N,N-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $1.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.16.4. | N,N'-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $9.1 \times 10^8$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.16.5. | N-Ethyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $6.8 \times 10^7$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.16.6. | N-Ethyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $5.8 \times 10^3$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.16.7. | N-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.16.8. | N-Methylphenothiazine | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $1.4 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.16.9. | MV$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $1.6 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); OT | 85E347 |
| 14.16.10. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $3.6 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.16.11. | Triphenylamine | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $2.1 \times 10^7$ | SS/LUM; $\tau_0 = 1.1$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| **14.17.** | **cis-Os(phen)$_2$(dimethylphenylphosphine)$_2$$^{2+}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.17.1. | 1,4-Bis(N,N-dimethylamino)benzene | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $6.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.39$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.17.2. | 4,4'-Bis(N,N-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | $\sim 23$ | $3.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.39$ $\mu$s (LP/LUM/AVE); RT | 85E347 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.17.** | ***cis*-Os(phen)$_2$(dimethylphenylphosphine)$_2$$^{2+}$—Continued** | | | | | | |
| 14.17.3. | $N,N'$-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.17.4. | $N,N$-Dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.1 \times 10^5$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.17.5. | $N$-Ethyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.17.6. | $N$-Ethyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $7.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.17.7. | 4-Methoxy-$N,N$-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $3.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.17.8. | $N$-Methyl-4-carbamyl-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound | 85E347 |
| 14.17.9. | $N$-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $7.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.17.10. | $N$-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.17.11. | $N$-Methylphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.17.12. | $MV^{2+}$ | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); OT | 85E347 |
| 14.17.13. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); RT | 85E347 |
| 14.17.14. | 4,$N,N$-Trimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.39$ μs (LP/LUM/AVE); RT | 85E347 |
| **14.18.** | **Os(terpy)$_2$$^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 14.18.1. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $8.7 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.14$ μs; OT; $f = $~1 | 85A077 |
| 14.18.2. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$ | 25 | $6.6 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.14$ μs; OT | 84N050 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.1 mol/L NaNO$_3$; 0.01 mol/L SLS | 25 | $1.0 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.18$ μs; OT | 84N050 |

TABLE 14. Quenching of excited osmium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **14.18. Os(terpy)$_2$$^{2+}$—Continued** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.18.3. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | 0.1 mol/L LiClO$_4$ | ~23 | $7.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.27$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.18.4. | 4,4′-Bis($N,N$-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.27$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.18.5. | 2-Chlorophenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.27$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.18.6. | 4-Methoxy-$N,N$-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $2.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.27$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.18.7. | 3-Methoxyphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.27$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.18.8. | $N$-Methylphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $9.6 \times 10^6$ | SS/LUM; $\tau_0 = 0.27$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| **14.19. Os(terpy)[$cis$-1,2-bis(diphenylphosphino)ethene]Cl$^+$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 14.19.1. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | 0.1 mol/L LiClO$_4$ | ~23 | $5.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.19.2. | 4,4′-Bis($N,N$-dimethylamino)biphenyl | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.19.3. | 2-Chlorophenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.6 \times 10^7$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.19.4. | 4-Methoxy-$N,N$-dimethylaniline | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.19.5. | 3-Methoxyphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $4.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.19.6. | $N$-Methylphenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |
| 14.19.7. | Phenothiazine | AN | 0.1 mol/L LiClO$_4$ | ~23 | $1.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.10$ $\mu$s (LP/LUM/AVE); RT | 85E347 |

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TABLE 15. Quenching of excited palladium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **15.1. Pd(etioporphyrin I)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 15.1.1. | Ag(TPP) | Toluene | | | $2.5 \times 10^9$ | FP/LUM/SST; ET | 76E693 |
| 15.1.2. | Ni(etioporphyrin I) | Toluene | | | $3.1 \times 10^9$ | SS/LUM, FP/ABS/SST; ET | 74E520 |
| 15.1.3. | Ni(TPP) | Toluene | | | $3.2 \times 10^9$ | SS/LUM, FP/ABS/SST; ET | 74E520 |
| 15.1.4. | Yb(etioporphyrin I)$^+$ | Toluene | | 20 | $1 \times 10^9$ | FP/ABS/SST; ET; [Q] $\leq$ $4.5 \times 10^{-5}$ mol/L | 85F493 |
| *Organic Quenchers* | | | | | | | |
| 15.1.5. | Naphthacene | Toluene | | | $5.3 \times 10^9$ | SS/LUM, FP/ABS/SST; ET; [Q] = $(2\text{-}7.5) \times 10^{-6}$ mol/L | 74E520 |
| 15.1.6. | Perylene | Toluene | | | $5.8 \times 10^9$ | SS/LUM, FP/ABS/SST; ET; [Q] = $(1\text{-}10) \times 10^{-6}$ mol/L | 74E520 |
| **15.2. Pd(mesoporphyrin IX dimethyl ester)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 15.2.1. | O$_2$ | Toluene | | | $3.8 \times 10^9$ | LP/ABS/SST; ET; [Q] = 0.0011 mol/L | 81E738 |
| **15.3. Pd(octaethylchlorin)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 15.3.1. | Yb(etioporphyrin I)$^+$ | Toluene | | | $4.2 \times 10^8$ | FP/ABS/SST; ET | 76E693 |
| **15.4. Pd(2,3,7,8,12,13,17,18-octaethylporphyrin)** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 15.4.1. | cis-α-Methylstilbene | Benzene | | | $2.0 \times 10^5$ | SS/LUM; $\tau_0$ = 0.50 ms (FP/LUM/SST); EX; $k_q$ = $9.7 \times 10^4$ with FP/LUM/SST | 78A101 |
| 15.4.2. | trans-α-Methylstilbene | Benzene | | | $6.8 \times 10^5$ | SS/LUM; $\tau_0$ = 0.50 ms (FP/LUM/SST); EX | 78A101 |
| 15.4.3. | MV$^{2+}$ | BuN | | | $1.5 \times 10^9$ | SS/LUM; $\tau_0$ = 0.36 ms (FP/LUM/SST); OT | 767009 |
| 15.4.4. | cis-Stilbene | Benzene | | | $1.4 \times 10^6$ | SS/LUM; $\tau_0$ = 0.50 ms (FP/LUM/SST); EX | 78A101 |
| | cis-Stilbene | Pentane | | | $3.3 \times 10^6$ | SS/LUM; $\tau_0$ = 0.56 ms (FP/LUM/SST); EX | 78A101 |
| 15.4.5. | trans-Stilbene | Benzene | | | $1.5 \times 10^6$ | SS/LUM; $\tau_0$ = 0.50 ms (FP/LUM/SST); EX; $k_q$ = $5.3 \times 10^5$ with FP/LUM/SST | 78A101 |

TABLE 15. Quenching of excited palladium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **15.4. Pd(2,3,7,8,12,13,17,18-octaethylporphyrin)**—Continued | | | | | | | |
| | trans-Stilbene | Pentane | | | $3.3 \times 10^6$ | SS/LUM; $\tau_0 = 0.56$ ms (FP/LUM/SST); EX | 78A101 |
| **15.5. Pd(tetrabenzoporphyrin)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 15.5.1. | Ni(etioporphyrin I) | DMF | | | $1.1 \times 10^9$ | SS/LUM, FP/ABS/SST; ET | 74E520 |
| **15.6. Pd[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 15.6.1. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | | | $1.4 \times 10^8$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT | 83A133 |
| 15.6.2. | Fe$^{3+}$ | H$_2$O | | | $6.9 \times 10^7$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT | 83A133 |
| 15.6.3. | S$_2$O$_8^{2-}$ | H$_2$O | | | $1.9 \times 10^8$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT | 83A133 |
| *Organic Quenchers* | | | | | | | |
| 15.6.4. | MV$^{2+}$ | H$_2$O | | | $3.5 \times 10^4$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT | 83A133 |
| **15.7. Pd[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 15.7.1. | N,N'-Dibenzyl-vio$^{2+}$ | H$_2$O | 0.05 mol/L NaCl | | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.20$ ms (FP/LUM/SST) | 81N147 |
| 15.7.2. | MV$^{2+}$ | H$_2$O | | | $4.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.20$ ms (FP/LUM/SST) | 81N147 |
| | MV$^{2+}$ | H$_2$O | | | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.14$ ms (LP/LUM/AVE); OT | 85E552 |
| | MV$^{2+}$ | H$_2$O | 0.05 mol/L NaCl | | $3.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.20$ ms (FP/LUM/SST) | 81N147 |
| | MV$^{2+}$ | H$_2$O | 0.05% PVA | | $5.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.14$ ms (LP/LUM/AVE); OT | 85E552 |
| | MV$^{2+}$ | H$_2$O | 0.5% PVA | | $2.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.15$ ms (LP/LUM/AVE); OT | 85E552 |
| **15.8. Pd(5,10,15,20-tetraphenylporphyrin)** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 15.8.1. | 1,4-Benzoquinone | EtOH | | | $2.6 \times 10^9$ | LP/ABS/SST, SS/LUM; OT; $f = 0.05$ | 83F182 |
| 15.8.2. | N,N-Dimethylaniline | py | | | $1 \times 10^5$ | SS/LUM and LIF; EX; nonlinear S-V plot, see Mech. [1] | 79E349 |
| 15.8.3. | 4-Methoxy-N,N-dimethylaniline | py | | | $2.2 \times 10^7$ | SS/LUM and LIF | 79E349 |

TABLE 15. Quenching of excited palladium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **15.8.** | **Pd(5,10,15,20-tetraphenylporphyrin)**—Continued | | | | | | |
| 15.8.4. | cis-Stilbene | Benzene | | | $1.8 \times 10^5$ | SS/LUM; $\tau_0 = 0.36$ ms (FP/LUM/SST); EX | 78A101 |
| 15.8.5. | trans-Stilbene | Benzene | | | $1.0 \times 10^5$ | SS/LUM; $\tau_0 = 0.36$ ms (FP/LUM/SST); EX | 78A101 |

TABLE 16. Quenching of excited platinum complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **16.1. Pt(CN)$_4$$^{2-}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 16.1.1. | Co(en)$_3$$^{3+}$ | H$_2$O | | 24.5 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.64$ μs (LP/LUM/SST); [Q] = 0.081 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| 16.1.2. | Cu$^{II}$-EDTA | H$_2$O | [Cu]/[L] = 1 | 24.5 | $3.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ μs (LP/LUM/SST); [Q] = 0.018 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| 16.1.3. | Eu$^{3+}$ | H$_2$O | | 24 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.45$ μs (LP/LUM/SST); [Q] = 0.0040-0.0060 mol/L; [S] = 0.092 mol/L, as Ba$^{2+}$ salt; forms oligomers | 82E553 |
| 16.1.4. | Fe(CN)$_6$$^{3-}$ | H$_2$O | | | $5.0 \times 10^7$ | SS/LUM; $\tau_0 = 0.66$ μs (LP/LUM/SST); [Q] = 0.0083 mol/L; [S] = 0.44 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| 16.1.5. | Fe$^{III}$-EDTA | H$_2$O | [Fe]/[L] = 1 | 24 | $1.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.45$ μs (LP/LUM/SST); [Q] = ~9 × 10$^{-4}$ mol/L; [S] = 0.092 mol/L, as Ba$^{2+}$ salt; forms oligomers | 82E553 |
| 16.1.6. | IO$_3$$^-$ | H$_2$O | | 24 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ μs (LP/LUM/SST); [Q] = 0.0091 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| 16.1.7. | NO$_2$$^-$ | H$_2$O | | 20.5 | $2.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ μs (LP/LUM/SST); ET; [Q] = 0.001-0.1 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| | NO$_2$$^-$ | H$_2$O | | 21 | $3.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.54$ μs (LP/LUM/SST); ET; [Q] = 0.014-0.055 mol/L; [S] = 0.096 mol/L, as Ba$^{2+}$ salt; forms oligomers | 82E553 |

TABLE 16. Quenching of excited platinum complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **16.1.** | **Pt(CN)$_4$$^{2-}$—Continued** | | | | | | |
| 16.1.8. | Ni(CN)$_4$$^{2-}$ | H$_2$O | | 22.5 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ µs (LP/LUM/SST); [Q] = 0.046 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| 16.1.9. | O$_2$ | H$_2$O | | | $3.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.64$ µs; ET; [Q] = (2.8-14) $\times$ 10$^{-4}$ mol/L; [S] = 0.33 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| 16.1.10. | S$_2$O$_8$$^{2-}$ | H$_2$O | | 24 | $2.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ µs (LP/LUM/SST); [Q] = 0.0092 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| *Organic Quenchers* | | | | | | | |
| 16.1.11. | MV$^{2+}$ | H$_2$O | | 23.5 | $5.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.54$ µs (LP/LUM/SST); [Q] = (5.7-11) $\times$ 10$^{-5}$ mol/L; [S] = 0.099 mol/L, as Ba$^{2+}$ salt; forms oligomers | 82E553 |
| | MV$^{2+}$ | H$_2$O | | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.64$ µs (LP/LUM/SST); [Q] = 0.0036 mol/L; [S] = 0.40 mol/L, as K$^+$ salt; forms oligomers | 82E553 |
| **16.2.** | **Pt$_2$[µ-diphosphito(2-)-$P$,$P'$]$_4$$^{4-}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 16.2.1. | Co(C$_5$H$_4$COOH)$_2$$^+$ | H$_2$O | | | $1.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 9.5$ µs; OT; [Q] = (5-50) $\times$ 10$^{-5}$ mol/L | 85A161 |
| 16.2.2. | O$_2$ | H$_2$O | | | $2.4 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 9.5$ µs; ET | 85A161 |
| 16.2.3. | Rh(bpy)$_3$$^{3+}$ | H$_2$O | | | $1.5 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 9.5$ µs; OT; [Q] = (1-50) $\times$ 10$^{-5}$ mol/L | 85A161 |
| 16.2.4. | Ru(bpy)$_3$$^{2+}$ | H$_2$O | | | $1.8 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 9.5$ µs; ET; [Q] = (1-20) $\times$ 10$^{-5}$ mol/L | 85A161 |
| 16.2.5. | S$_2$O$_8$$^{2-}$ | H$_2$O | | | $1.5 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 9.5$ µs; OT; [Q] = 0.001-0.01 mol/L | 85A161 |

TABLE 16. Quenching of excited platinum complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **16.2.** | **Pt$_2$[μ-diphosphito(2-)-P,P']$_4$$^{4-}$—Continued** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 16.2.6. | Anthracene | MeOH | | | $6.2 \times 10^9$ | SS/LUM; $\tau_0 = 9.4$ μs (LP/LUM/AVE); ET; [Q] = (1-10) × 10$^{-4}$ mol/L | 85A161 |
| 16.2.7. | Azulene | MeOH | | | $3.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 9.4$ μs; ET; [Q] = (5-50) × 10$^{-5}$ mol/L | 85A161 |
| 16.2.8. | Biphenyl | MeOH | | | $<1 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 9.4$ μs; [Q] = 0.001-0.01 mol/L | 85A161 |
| 16.2.9. | 1,4-Bis(N,N-dimethylamino)benzene | MeOH | | ~25 | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 7.1$ μs (LP/LUM); RT | 84E074 |
| | 1,4-Bis(N,N-dimethylamino)benzene | MeOH | | | $1.3 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 9.4$ μs; RT; [Q] = 0.001 mol/L | 85A161 |
| 16.2.10. | 4,4'-Bis(N,N-dimethylamino)biphenyl | MeOH | | ~25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0 = 7.1$ μs (LP/LUM); RT | 84E074 |
| | 4,4'-Bis(N,N-dimethylamino)biphenyl | MeOH | | | $6.7 \times 10^8$ | SS/LUM; $\tau_0 = 9.4$ μs (LP/LUM/AVE); RT; [Q] = (1-10) × 10$^{-4}$ mol/L | 85A161 |
| 16.2.11. | N,N'-Bis(2-sulfonatoethyl)-(vio$^{2+}$) zwitterion | H$_2$O | 0.1 mol/L NaClO$_4$ | 25 | $5.5 \times 10^9$ | EMI; $\tau_0 = 9.8$ μs; OT | 81A344 |
| 16.2.12. | N,N'-Bis(1-sulfonato-2-propyl)-(vio$^{2+}$) zwitterion | H$_2$O | | | $4.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 9.5$ μs; OT; [Q] = (2-50) × 10$^{-5}$ mol/L | 85A161 |
| 16.2.13. | Carbon tetrachloride | AN | | | $2 \times 10^9$ | SS/LUM; OT | 86F089 |
| 16.2.14. | Chloroform | AN | | | $6 \times 10^7$ | SS/LUM; OT | 86F089 |
| 16.2.15. | N,N-Dimethylaniline | MeOH | | ~25 | $1.2 \times 10^7$ | SS/LUM; $\tau_0 = 7.1$ μs (LP/LUM); RT | 84E074 |
| | N,N-Dimethylaniline | MeOH | | | $1.2 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 9.4$ μs; RT; [Q] = 0.005-0.07 mol/L | 85A161 |
| 16.2.16. | Diphenylamine | MeOH | | | $\leq 1 \times 10^6$ | SS/LUM; $\tau_0 = 9.4$ μs (LP/LUM/AVE); [Q] = 0.001-0.01 mol/L | 85A161 |
| 16.2.17. | Diphenylmethanol | AN | | ~22 | $1 \times 10^5$ | HA | 85E779 |
| 16.2.18. | N-Methylphenothiazine | MeOH | | | $8.0 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 9.4$ μs; RT; [Q] = (5-50) × 10$^{-5}$ mol/L | 85A161 |
| 16.2.19. | MV$^{2+}$ | H$_2$O | | | $1.7 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 9.5$ μs; OT; [Q] = (1-10) × 10$^{-4}$ mol/L | 85A161 |

TABLE 16. Quenching of excited platinum complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **16.2. Pt$_2$[μ-diphosphito(2-)-$P,P'$]$_4$$^{4-}$—Continued** | | | | | | | |
| 16.2.20. Naphthalene | MeOH | | | | $1.2 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 9.4$ μs; ET; [Q] = 0.001-0.03 mol/L | 85A161 |
| 16.2.21. 2-Propanol | AN | | ~22 | $1 \times 10^3$ | | HA | 85E779 |
| 16.2.22. Toluene | AN | | ~22 | $1 \times 10^4$ | | HA | 85E779 |
| 16.2.23. Triethylamine | MeOH | | | $<1 \times 10^6$ | | SS/LUM; $\tau_0 = 9.4$ μs (LP/LUM/AVE); [Q] = 0.01-0.08 mol/L | 85A161 |
| 16.2.24. 4,$N$,$N$-Trimethylaniline | MeOH | | ~25 | $3.9 \times 10^7$ | | SS/LUM; $\tau_0 = 7.1$ μs (LP/LUM); RT | 84E074 |
| 16.2.25. Triphenylamine | MeOH | | ~25 | $1.5 \times 10^6$ | | SS/LUM; $\tau_0 = 7.1$ μs (LP/LUM); RT | 84E074 |
| **16.3. Pt(8-hydroxyquinolinato)$_2$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 16.3.1. Co(acac)$_3$ | Acetone | | ~22 | $8.9 \times 10^8$ | | LP/LUM/SST; ET | 83E223 |
| 16.3.2. Co(DMG)$_2$(C$_2$H$_5$)(H$_2$O) | Acetone | | ~22 | $3.6 \times 10^9$ | | LP/LUM/SST; ET | 83E223 |
| 16.3.3. Cr(CN)$_6$$^{3-}$ | DMF | | 25 | $9.2 \times 10^7$ | | SS/LUM; $\tau_0 = 2.7$ μs (LP/LUM/SST); ET; see Mech. [6] | 86E555 |
| *Organic Quenchers* | | | | | | | |
| 16.3.4. 1,4-Benzoquinone | AN | | 25 | $2.1 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.5. 1-Bromo-4-nitrobenzene | AN | | 25 | $3.2 \times 10^8$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.6. 1-Chloro-4-nitrobenzene | AN | | 25 | $1.8 \times 10^8$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.7. 1,2-Dinitrobenzene | AN | | 25 | $1.1 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.8. 1,3-Dinitrobenzene | AN | | 25 | $7.4 \times 10^9$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.9. 1-Fluoro-4-nitrobenzene | AN | | 25 | $2.8 \times 10^7$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.10. MV$^{2-}$ | AN | 0.01 mol/L TEAP | 25 | $1.1 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.11. 3-Nitrobenzaldehyde | AN | | 25 | $1.1 \times 10^9$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.12. 4-Nitrobenzaldehyde | AN | | 25 | $1.2 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.13. Nitrobenzene | AN | | 25 | $5.5 \times 10^6$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.14. 3-Nitrobenzonitrile | AN | | 25 | $4.8 \times 10^9$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.15. 4-Nitrobenzonitrile | AN | | 25 | $1.0 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.16. 4-Nitrotoluene | AN | | 25 | $1.9 \times 10^6$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.17. 9,10-Phenanthrenequinone | AN | | 25 | $1.7 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |
| 16.3.18. Tetracyanoethene | AN | | 25 | $2.4 \times 10^{10}$ | | LP/LUM/SST; OT | 86E555 |

TABLE 16. Quenching of excited platinum complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **16.4.** | **Pt(5,10,15,20-tetraphenylporphyrin)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 16.4.1. | *cis*-Stilbene | Benzene | | | $6.7 \times 10^5$ | SS/LUM; $\tau_0 = 54$ μs (FP/LUM/SST); EX | 78A101 |
| 16.4.2. | *trans*-Stilbene | Benzene | | | $5.0 \times 10^5$ | SS/LUM; $\tau_0 = 54$ μs (FP/LUM/SST); EX | 78A101 |

QUENCHING OF EXCITED METAL COMPLEXES IN FLUID SOLUTION

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TABLE 17. Quenching of excited rhenium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **17.1.** | **$fac$-Re(CO)$_3$(5-Clphen)Cl** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.1.1. | Anthracene | CH$_2$Cl$_2$ | | 25 | >1.4 × 10$^9$ | SS/LUM; $\tau_0$ = <0.65 μs (SL/LUM/AVE); ET; [Q] ≤ 0.005 mol/L | 746021 |
| 17.1.2. | *trans*-Stilbene | CH$_2$Cl$_2$ | | 25 | >1.4 × 10$^8$ | SS/LUM; $\tau_0$ = <0.65 μs (SL/LUM/AVE); ET | 746021 |
| **17.2.** | **$fac$-Re(CO)$_3$(4,7-Ph$_2$phen)Cl** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.2.1. | Aniline | AN | 0.1 mol/L TBAP | 25 | 2.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.45 μs (SL/LUM/AVE); RT | 78E397 |
| 17.2.2. | 1,4-Bis($N$,$N$-dimethylamino)benzene | AN | 0.1 mol/L TBAP | 25 | 8.7 × 10$^9$ | SS/LUM; $\tau_0$ = 0.45 μs (SL/LUM/AVE); RT | 78E397 |
| 17.2.3. | $N$,$N'$-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L TBAP | 25 | 3.3 × 10$^9$ | SS/LUM; $\tau_0$ = 0.45 μs (SL/LUM/AVE); OT | 78E397 |
| 17.2.4. | 1,4-Dimethoxybenzene | AN | 0.1 mol/L TBAP | 25 | <2 × 10$^6$ | SS/LUM; $\tau_0$ = 0.45 μs (SL/LUM/AVE); RT | 78E397 |
| 17.2.5. | MV$^{2+}$ | AN | 0.1 mol/L TBAP | 25 | 3.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.45 μs (SL/LUM/AVE); OT | 78E397 |
| 17.2.6. | 4,$N$,$N$-Trimethylaniline | AN | 0.1 mol/L TBAP | 25 | 3.9 × 10$^9$ | SS/LUM; $\tau_0$ = 0.45 μs (SL/LUM/AVE); RT | 78E397 |
| **17.3.** | **$fac$-Re(CO)$_3$(4-acetylpyridine)$_2$I** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.3.1. | Triethylamine | CH$_2$Cl$_2$/C$_6$H$_6$ (1/1) | | 25 | ~1 × 10$^9$ | SS/LUM; $\tau_0$ = ~0.5 μs; RT; [Q] ≤ 0.007 mol/L | 80F316 |
| **17.4.** | **$fac$-Re(CO)$_3$(4-benzoylpyridine)$_2$Cl** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.4.1. | Triethylamine | CH$_2$Cl$_2$/C$_6$H$_6$ (1/1) | | 25 | ~1 × 10$^9$ | SS/LUM; $\tau_0$ = ~0.5 μs; RT; [Q] ≤ 0.007 mol/L | 80F316 |
| **17.5.** | **$fac$-Re(CO)$_3$(bpy)Br** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.5.1. | Triethanolamine | DMF | CO$_2$ satd | 25 | 3.4 × 10$^7$ | SS/LUM; RT (83S051) | 86F230 |
| **17.6.** | **$fac$-Re(CO)$_3$(phen)Cl** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.6.1. | Aniline | AN | 0.1 mol/L TBAP | 25 | 5.8 × 10$^7$ | SS/LUM; $\tau_0$ = 0.50 μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.2. | 1,4-Bis($N$,$N$-dimethylamino)benzene | AN | 0.1 mol/L TBAP | 25 | 5.7 × 10$^9$ | SS/LUM; $\tau_0$ = 0.50 μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.3. | 1,4-Bis($N$-phenylamino)benzene | AN | 0.1 mol/L TBAP | 25 | 3.7 × 10$^9$ | SS/LUM; $\tau_0$ = 0.50 μs (SL/LUM/AVE); RT | 78E397 |

TABLE 17. Quenching of excited rhenium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **17.6.** | ***fac*-Re(CO)$_3$(phen)Cl—Continued** | | | | | | |
| 17.6.4. | 4-Bromoaniline | AN | 0.1 mol/L TBAP | 25 | $5.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.5. | 1-Chloro-4-nitrobenzene | AN | 0.1 mol/L TBAP | 25 | $2.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.6. | $N,N'$-Dibenzyl-vio$^{2+}$ | AN | 0.1 mol/L TBAP | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT; [Q] $\leq$ 0.002 mol/L | 78E397 |
| 17.6.7. | 1,4-Dimethoxybenzene | AN | 0.1 mol/L TBAP | 25 | $<2 \times 10^6$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.8. | $N,N$-Dimethylaniline | AN | 0.1 mol/L TBAP | 25 | $9.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.9. | $N,N$-Dimethylbenzylamine | AN | 0.1 mol/L TBAP | 25 | $<2 \times 10^6$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.10. | 4,4'-Dinitrobiphenyl | AN | 0.1 mol/L TBAP | 25 | $1.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.11. | Diphenylamine | AN | 0.1 mol/L TBAP | 25 | $4.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.12. | DQ$^{2+}$ | AN | 0.1 mol/L TBAP | 25 | $3.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.13. | $N$-Methyl-4-carbomethoxy-py$^+$ | AN | 0.1 mol/L TBAP | 25 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.14. | $N$-Methyl-4-cyano-py$^+$ | AN | 0.1 mol/L TBAP | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.15. | $N$-Methylphenothiazine | AN | 0.1 mol/L TBAP | 25 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |
| 17.6.16. | MV$^{2+}$ | AN | 0.1 mol/L TBAP | 25 | $3.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT; [Q] $\leq$ 0.0024 mol/L | 78E397 |
| 17.6.17. | 3-Nitrobenzaldehyde | AN | 0.1 mol/L TBAP | 25 | $6.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.18. | 4-Nitrobenzaldehyde | AN | 0.1 mol/L TBAP | 25 | $2.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.19. | 4-Nitrotoluene | AN | 0.1 mol/L TBAP | 25 | $<2 \times 10^7$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.20. | Tetracyanoethene | AN | 0.1 mol/L TBAP | 25 | $7.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 78E397 |
| 17.6.21. | 4,$N,N$-Trimethylaniline | AN | 0.1 mol/L TBAP | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 78E397 |

TABLE 17. Quenching of excited rhenium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **17.6.** | ***fac*-Re(CO)$_3$(phen)Cl**—Continued | | | | | | |
| 17.6.22. | $N,N$-(Trimethylene)-phen$^{2+}$ | AN | 0.1 mol/L TBAP | 25 | $3.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); OT | 73E397 |
| 17.6.23. | Triphenylamine | AN | 0.1 mol/L TBAP | 25 | $3.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.50$ μs (SL/LUM/AVE); RT | 73E397 |
| **17.7.** | ***fac*-Re(CO)$_3$(4-phenylpyridine)$_2$Cl** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.7.1. | Naphthalene | CH$_2$Cl$_2$ | | 25 | $\sim 1 \times 10^9$ | SS/LUM; $\tau_0 = 1.5$ μs (SL/LUM/AVE) | 79E269 |
| 17.7.2. | *trans*-Stilbene | CH$_2$Cl$_2$ | | 25 | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 1.5$ μs (SL/LUM/AVE); ET | 79E269 |
| **17.8.** | **Re$_2$Cl$_8$$^{2-}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 17.8.1. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | $\mu = 0.1$ (TBAP) | 25 | $5.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.2. | 4,4′-Bis($N,N$-dimethylamino)biphenyl | AN | $\mu = 0.1$ (TBAP) | 25 | $2.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.3. | $N,N$-Bis(4-methoxyphenyl)amine | AN | $\mu = 0.1$ (TBAP) | 25 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.4. | $N,N$-Diethylaniline | AN | $\mu = 0.1$ (TBAP) | 25 | $2.2 \times 10^6$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.5. | $N,N$-Dimethylaniline | AN | $\mu = 0.1$ (TBAP) | 25 | $1.5 \times 10^6$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.6. | Diphenylamine | AN | $\mu = 0.1$ (TBAP) | 25 | $6.1 \times 10^6$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.7. | $N$-Methylphenothiazine | AN | $\mu = 0.1$ (TBAP) | 25 | $9.5 \times 10^6$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.8. | Phenothiazine | AN | $\mu = 0.1$ (TBAP) | 25 | $8.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |
| 17.8.9. | 4,$N,N$-Trimethylaniline | AN | $\mu = 0.1$ (TBAP) | 25 | $1.3 \times 10^7$ | SS/LUM; $\tau_0 = 0.14$ μs (767006); RT | 81A315 |

TABLE 18. Quenching of excited rhodium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ $/L\ mol^{-1}\ s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **18.1.** $Rh(ND_3)_6^{3+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.1.1. | $OD^-$ | $D_2O$ | | 9 | $1.1 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 89$ ns; PT | 85F123 |
| **18.2.** $Rh(ND_3)_5Cl^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.2.1. | $OH^-$ | $H_2O$ | | 5 | $8.1 \times 10^9$ | SS/LUM or LP/LUM/SST; PT | 82E073 |
| **18.3.** $Rh(NH_3)_6^{3+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.3.1. | $OH^-$ | $H_2O$ | | 9 | $1.6 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 40$ ns; PT | 85F123 |
| **18.4.** $Rh(NH_3)_5Br^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.4.1. | $OH^-$ | $H_2O$ | | 5 | $2.7 \times 10^{10}$ | SS/QYP, SS/LUM or LP/LUM/SST; $\tau_0 = 24$ ns; PT; see Mech. [5] | 82E073 |
| **18.5.** $Rh(NH_3)_5Cl^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.5.1. | $CO_3^{2-}$ | $H_2O$ | CAbuf; pH 10.1 | 4 | $8.3 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0^{und} = 30$ ns; PT; [Q] $\leq$ 0.005 mol/L | 80E074 |
| 18.5.2. | $OH^-$ | $H_2O$ | | 4 | $2.1 \times 10^{10}$ | SS/LUM or LP/LUM/SST; $\tau_0^{und} = 30$ ns; PT; [Q] $\leq$ 0.0025 mol/L | 80E074 |
| | $OH^-$ | $H_2O$ | | 25 | $9.8 \times 10^{10}$ | SS/QYP; $\tau_0 = 14$ ns (79E417); PT; $\tau_0$ at pH 3; see Mech. [5] | 84A141 |
| **18.6.** $Rh(NH_3)_5I^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.6.1. | $OH^-$ | $H_2O$ | | 25 | $1.9 \times 10^{10}$ | LP/LUM/SPC; $\tau_0 = 1.3$ ns; PT; $\tau_0$ at pH 3 | 84A141 |
| **18.7.** $Rh(4,7\text{-}Ph_2phen)_3^{3+}$ | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 18.7.1. | 1,2-Diaminobenzene | $AN/H_2O$ | | | $8.1 \times 10^9$ | LP/ABS/SST; $\tau_0 = 73$ μs; RT; $f = 0.64$ | 85F184 |
| 18.7.2. | 1,4-Diaminobenzene | $AN/H_2O$ | | | $6.3 \times 10^9$ | LP/ABS/SST; $\tau_0 = 73$ μs; RT; $f = 0.78$ | 85F184 |
| 18.7.3. | 1,4-Dimethoxybenzene | $AN/H_2O$ | | | $4.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 73$ μs; RT; $f = 0.48$ | 85F184 |

TABLE 18. Quenching of excited rhodium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **18.7.** | **Rh(4,7-Ph$_2$phen)$_3$$^{3+}$—Continued** | | | | | | |
| 18.7.4. | 3,3'-Dimethyl-4,4'-diaminobiphenyl | AN/H$_2$O | | | $8.4 \times 10^9$ | LP/ABS/SST; $\tau_0 = 73$ µs; RT; $f = 0.55$ | 85F184 |
| 18.7.5. | Diphenylamine | AN/H$_2$O | | | $9.7 \times 10^9$ | LP/ABS/SST; $\tau_0 = 73$ µs; RT; $f = 0.38$ | 85F184 |
| 18.7.6. | 1,3,5-Trimethoxybenzene | AN/H$_2$O | | | $4.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 73$ µs; RT; $f = 0.45$ | 85F184 |
| **18.8.** | **cis-Rh(4,7-Ph$_2$phen)$_2$Cl$_2$$^+$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 18.8.1. | 1,4-Dimethoxybenzene | AN | | | $4.4 \times 10^8$ | LP/ABS/SST; $\tau_0 = 1.0$ µs; RT; $f = 0.38$ | 85F184 |
| 18.8.2. | 1,2,4-Trimethoxybenzene | AN | | | $2.9 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.0$ µs; RT; $f = 0.34$ | 85F184 |
| 18.8.3. | 1,3,5-Trimethoxybenzene | AN | | | $<1 \times 10^8$ | LP/ABS/SST; $\tau_0 = 1.0$ µs; RT | 85F184 |
| **18.9.** | **cis-Rh(bpy)$_2$Cl$_2$$^+$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 18.9.1. | OH$^-$ | H$_2$O | | 11 | $<1 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0^{und} = 52$ ns | 80E074 |
| **18.10.** | **trans-Rh(cyclam)(CN)$_2$$^+$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 18.10.1. | Cr(CN)$_6$$^{3-}$ | H$_2$O | pH 5.9; µ = 0.5 | 22 | $9.4 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 8.0$ µs; ET?; [Q] $\leq$ 0.004 mol/L | 83E674 |
| 18.10.2. | OH$^-$ | H$_2$O | | 22 | $1.6 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 8.0$ µs; PT?; [Q] $\leq$ 5 × 10$^{-5}$ mol/L | 83E674 |
| **18.11.** | **Rh$_2$(1,3-diisocyanopropane)$_4$$^{2+}$ [singlet]** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 18.11.1. | Benzophenone | AN | | | $5.9 \times 10^8$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.2. | 1,4-Benzoquinone | AN | | | $4.0 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT | 83F105 |
| 18.11.3. | Butyl iodide | AN | | | $2.6 \times 10^8$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT | 83F105 |
| 18.11.4. | 1-Chloro-4-nitrobenzene | AN | | | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |

TABLE 18. Quenching of excited rhodium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **18.11. Rh$_2$(1,3-diisocyanopropane)$_4$$^{2+}$ [singlet]—Continued** | | | | | | | |
| 18.11.5. | 1,4-Dicyanobenzene | AN | | | $1.9 \times 10^9$ | SS/LUM; $\tau_0 = 1.3$ ns (78E003); OT | 83C021 |
| 18.11.6. | Diethyl fumarate | AN | | | $6.8 \times 10^9$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.7. | 1,3-Dinitrobenzene | AN | | | $1.5 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.8. | 1,4-Dinitrobenzene | AN | | | $1.8 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.9. | 1-Methoxy-2-nitrobenzene | AN | | | $7.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.3$ ns (78E003); OT | 83C021 |
| 18.11.10. | Methyl 4-nitrobenzoate | AN | | | $1.4 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.11. | 2-Nitroaniline | AN | | | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (78E003); OT | 83C021 |
| 18.11.12. | 4-Nitroaniline | AN | | | $8.3 \times 10^9$ | SS/LUM; $\tau_0 = 1.3$ ns (78E003); OT | 83C021 |
| 18.11.13. | 3-Nitrobenzaldehyde | AN | | | $1.3 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.14. | Nitrobenzene | AN | | | $1.3 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT; same $k_q$ from same lab in 83C021 | 83F105 |
| 18.11.15. | Tetrachloro-1,4-benzoquinone | AN | | | $1.6 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.3$ ns (80A270); OT | 83F105 |
| **18.12. Rh$_2$(1,3-diisocyanopropane)$_4$$^{2+}$ [triplet]** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 18.12.1. | Anthracene | AN | | 21 | $3.4 \times 10^6$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; ET | 80A270 |
| 18.12.2. | Azulene | AN | | 21 | $6.3 \times 10^6$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; ET | 80A270 |
| 18.12.3. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | | 21 | $8.7 \times 10^8$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; RT | 80A270 |
| 18.12.4. | 1,4-Diazabicyclo[2.2.2]octane | AN | | 21 | $3.3 \times 10^6$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; RT | 80A270 |

TABLE 18. Quenching of excited rhodium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **18.12. Rh$_2$(1,3-diisocyanopropane)$_4$$^{2+}$ [triplet]—Continued** | | | | | | | |
| 18.12.5. | 9,10-Dichloroanthracene | AN | | 21 | $7.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; ET | 80A270 |
| 18.12.6. | N,N-Dimethylaniline | AN | | 21 | $<1 \times 10^5$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; RT | 80A270 |
| 18.12.7. | N-Methyl-4-carbomethoxy-py$^+$ | AN | $\mu = 0.0068$ (TBAS) | 21 | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; OT | 80A270 |
| 18.12.8. | N-Methylnicotinamide | AN | $\mu = 0.0067$ (TBAS) | 21 | $6.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; OT | 80A270 |
| 18.12.9. | MV$^{2+}$ | AN | $\mu = 0.013$ (TBAS) | 21 | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; OT | 80A270 |
| 18.12.10. | Nicotinamide | AN | | 21 | $<1 \times 10^5$ | LP/LUM/SST; $\tau_0 = 8.5$ μs | 80A270 |
| 18.12.11. | trans-Stilbene | AN | | 21 | $\leq 4 \times 10^5$ | LP/LUM/SST; $\tau_0 = 8.5$ μs; ET | 80A270 |
| **18.13. Rh(phen)$_3$$^{3+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 18.13.1. | Fe$^{2-}$ | H$_2$O | $\mu = 1$ | | $4.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.25$ μs; RT; $f = 1$ | 84B055 |
| *Organic Quenchers* | | | | | | | |
| 18.13.2. | 1,4-Dimethoxybenzene | H$_2$O | | | $4.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.41$ μs; RT; $f = 0.34$ | 85F184 |
| 18.13.3. | 1,2,4-Trimethoxybenzene | H$_2$O | | | $4.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.41$ μs; RT; $f = 0.30$ | 85F184 |
| **18.14. cis-Rh(phen)$_2$Cl$_2$$^+$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 18.14.1. | 1,2,4-Trimethoxybenzene | AN | | | $4.1 \times 10^8$ | LP/ABS/SST; $\tau_0 = 0.70$ μs; RT; $f = 0.065$ | 85F184 |
| **18.15. Rh(5,10,15,20-tetraphenylporphyrin)Cl** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 18.15.1. | MV$^{2+}$ | EtOH | | | $3.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 38$ μs; OT; $f = 0.2$; [Q] $\leq 3 \times 10^{-4}$ mol/L | 86A325 |
| **18.16. Rh(5,10,15,20-tetraphenylporphyrin)[OC(O)CH$_3$]** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 18.16.1. | MV$^{2+}$ | H$_2$O/DMF (1/1) | | 20 | $1.3 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.14$ ms; OT; [Q] = 0.0045-0.053 mol/L; $k_q = 8.8 \times 10^6$ with SS/LUM | 82F217 |

TABLE 18. Quenching of excited rhodium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **18.17. Rh(5,10,15,20-tetraphenylporphyrin)(pyridine)Cl** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 18.17.1. MV$^{2+}$ | | EtOH | 0.025 mol/L py | | $3.1 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.37$ μs; OT; [Q] ≤ 0.0013 mol/L | 86A325 |

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TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.1. Ru(5-Brphen)$_3^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.1.1. | Co(AZAMEsar)$^{3+}$ | $H_2O$ | $\mu = 0.2$ (LiCl) | 25 | $2.0 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 1.0$ $\mu$s (766404); ET, OT | 84A238 |
| 19.1.2. | Co(diAMsar)$^{3+}$ | $H_2O$ | 0.16 mol/L LiCl, 0.05 mol/L EtMO; pH 7.5 | 25 | $1.5 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 1.0$ $\mu$s (766404); ET, OT | 84A238 |
| 19.1.3. | Co(diAMsarH$_2$)$^{5+}$ | $H_2O$ | 0.1 mol/L HCl, 0.1 mol/L LiCl | 25 | $5.9 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 1.0$ $\mu$s (766404); ET, OT | 84A238 |
| 19.1.4. | Co(sep)$^{3+}$ | $H_2O$ | 0.2 mol/L LiCl | 25 | $2.8 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ $\mu$s (766404); ET, OT | 84A238 |
| | Co(sep)$^{3+}$ | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $2.2 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ $\mu$s (766404); ET, OT | 84A238 |
| 19.1.5. | Cr$^{3+}$ | $H_2O$ | 0.04 mol/L H$_2$SO$_4$; $\mu = 1.0$ (MgCl$_2$) | 25 | $1.3 \times 10^7$ | SS/LUM; $\tau_0 = 1.0$ $\mu$s (LP/LUM/AVE); ET | 766404 |
| 19.1.6. | Cu$^{2+}$ | $H_2O$ | 0.25 mol/L H$_2$SO$_4$; $\mu = 0.8$-1 | 25 | $3.4 \times 10^7$ | SL/LUM/SPC; $\tau_0 = 0.94$ $\mu$s; $\Delta H^{\ddagger} = 11$ kJ/mol; $\Delta S^{\ddagger} = -64$ J/mol·K (20-80°C); OT | 80A308 |
| | Cu$^{2+}$ | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $4.2 \times 10^7$ | SS/LUM; $\tau_0 = 1.0$ $\mu$s (766404); OT; $f = 0.30$ | 78A090 |
| 19.1.7. | Eu$^{3+}$ | $H_2O$ | 0.025 mol/L HCl, [MgCl$_2$] + [Eu$^{3+}$] = 0.9 mol/L | 25 | $\leq 5 \times 10^4$ | SS/LUM; $\tau_0 = 1.0$ $\mu$s (LP/LUM/AVE); Q mainly as EuCl$^{2+}$ | 766404 |
| 19.1.8. | Fe$^{3+}$ | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 1.0$ $\mu$s (LP/LUM/AVE); OT | 766404 |
| 19.1.9. | HgCl$_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | $4.7 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.3$ $\mu$s; OT | 84A077 |
| | HgCl$_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.99 mol/L NaNO$_3$ | | $5.8 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.3$ $\mu$s; OT | 84A077 |
| | HgCl$_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | $2.9 \times 10^6$ | LP/LUM/SST; $\tau_0 = 2.2$ $\mu$s; OT | 84N034 |
| | HgCl$_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $1.1 \times 10^6$ | LP/LUM/SST; $\tau_0 = 2.2$ $\mu$s; OT | 84N034 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.1. $Ru(5\text{-}Brphen)_3^{2+}$—Continued** | | | | | | | |
| 19.1.10. | $HgCl_3^-$ | $H_2O$ | 0.01 mol/L $HNO_3$, [$NaNO_3$] + [$NaCl$] = 0.99 mol/L | | $1.8 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.3 μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| | $HgCl_3^-$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS | | $\sim5 \times 10^5$ | LP/LUM/SST; $\tau_0$ = 2.2 μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |
| 19.1.11. | $HgCl_4^{2-}$ | $H_2O$ | 0.01 mol/L $HNO_3$, [$NaNO_3$] + [$NaCl$] = 0.99 mol/L | | $2.5 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 1.3 μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| 19.1.12. | $O_2$ | $H_2O$ | | 25 | $4.0 \times 10^9$ | SS/LUM; $\tau_0$ = 1.0 μs (LP/LUM/AVE); OT? | 766404 |
| *Organic Quenchers* | | | | | | | |
| 19.1.13. | Ascorbate ion | $H_2O$ | pH 5; μ = 0.7 ($Na_2SO_4$) | 25 | $9.7 \times 10^8$ | SS/LUM; $\tau_0$ = 1.0 μs (766404); RT | 82A278 |
| **19.2. $Ru(4,4'\text{-}Bu_2bpy)_3^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.2.1. | $N$-(4-Aminophenyl)aniline | AN | μ = 2 × 10$^{-4}$ | | $3.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.11 μs; RT | 85A248 |
| 19.2.2. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | μ = 2 × 10$^{-4}$ | | $5.9 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.11 μs; RT | 85A248 |
| 19.2.3. | 1,4-Bis($N$-phenylamino)benzene | AN | μ = 2 × 10$^{-4}$ | | $1.9 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.11 μs; RT | 85A248 |
| 19.2.4. | $N,N$-Dimethylaniline | AN | μ = 2 × 10$^{-4}$ | | $1 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.11 μs; RT | 85A248 |
| 19.2.5. | $MV^{2+}$ | $H_2O$ | μ = 0.5 | 20 | $7.1 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.40 μs (SL/LUM/SPC); OT | 82S159 |
| 19.2.6. | Phenothiazine | AN | μ = 2 × 10$^{-4}$ | | $1.1 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.11 μs; RT | 85A248 |
| 19.2.7. | 4,$N,N$-Trimethylaniline | AN | μ = 2 × 10$^{-4}$ | | $4.0 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.11 μs; RT | 85A248 |
| **19.3. $Ru[4,4'\text{-}(COObz)_2bpy]_3^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.3.1. | $N,N$-Dimethylaniline | AN | 0.1 mol/L TEAP | 25 | $4.7 \times 10^9$ | SS/LUM; $\tau_0$ = 1.9 μs; RT | 77F920 |
| | $N,N$-Dimethylaniline | AN | | | $4.7 \times 10^9$ | EMI; $\tau_0$ = 1.9 μs (SL/LUM/SPC); RT | 776441 |
| 19.3.2. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $2.3 \times 10^6$ | SS/LUM; $\tau_0$ = 1.9 μs; OT | 77F920 |
| 19.3.3. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $7.1 \times 10^7$ | SS/LUM; $\tau_0$ = 1.9 μs; OT | 77F920 |
| 19.3.4. | Tetracyanoethene | AN | 0.1 mol/L TEAP | 25 | $4.0 \times 10^9$ | SS/LUM; $\tau_0$ = 1.9 μs; OT | 77F920 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.4. Ru[4,4'-(COOchl)$_2$bpy]$_3^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.4.1. | N,N-Dimethylaniline | AN | 0.1 mol/L TEAP | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0$ = 2.1 µs; RT; $\tau$ in BuN | 77F920 |
| | N,N-Dimethylaniline | AN/BuN (3/1) | | | $2.3 \times 10^9$ | EMI; $\tau_0$ = 2.1 µs (SL/LUM/SPC); RT | 776441 |
| 19.4.2. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $1.8 \times 10^6$ | SS/LUM; $\tau_0$ = 2.1 µs; OT; $\tau$ in BuN | 77F920 |
| 19.4.3. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $5.5 \times 10^7$ | SS/LUM; $\tau_0$ = 2.1 µs; OT; $\tau$ in BuN | 77F920 |
| 19.4.4. | $MV^{2+}$ | AN/BuN (3/1) | | | $1.7 \times 10^7$ | EMI; $\tau_0$ = 2.1 µs (SL/LUM/SPC); OT | 776441 |
| | $MV^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $1.7 \times 10^7$ | SS/LUM; $\tau_0$ = 2.1 µs; OT; $\tau$ in BuN | 77F920 |
| 19.4.5. | Tetracyanoethene | AN | 0.1 mol/L TEAP | 25 | $3.1 \times 10^9$ | SS/LUM; $\tau_0$ = 2.1 µs; OT; $\tau$ in BuN | 77F920 |
| 19.4.6. | Triphenylamine | AN | 0.1 mol/L TEAP | 25 | $3.5 \times 10^9$ | SS/LUM; $\tau_0$ = 2.1 µs; RT; $\tau$ in BuN | 77F920 |
| **19.5. Ru[4,4'-(COOcyc)$_2$bpy]$_3^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.5.1. | N,N-Dimethylaniline | AN | 0.1 mol/L TEAP | 25 | $4.5 \times 10^9$ | SS/LUM; $\tau_0$ = 2.2 µs; RT | 77F920 |
| | N,N-Dimethylaniline | AN | | | $4.5 \times 10^9$ | EMI; $\tau_0$ = 2.2 µs (SL/LUM/SPC); RT | 776441 |
| 19.5.2. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $1.9 \times 10^6$ | SS/LUM; $\tau_0$ = 2.2 µs; OT | 77F920 |
| 19.5.3. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $6.0 \times 10^7$ | SS/LUM; $\tau_0$ = 2.2 µs; OT | 77F920 |
| 19.5.4. | $MV^{2+}$ | AN | | | $1.7 \times 10^8$ | EMI; $\tau_0$ = 2.2 µs (SL/LUM/SPC); OT | 776441 |
| | $MV^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $1.7 \times 10^8$ | SS/LUM; $\tau_0$ = 2.2 µs; OT; $\tau$ in AN | 77F920 |
| 19.5.5. | Tetracyanoethene | AN | 0.1 mol/L TEAP | 25 | $8.8 \times 10^9$ | SS/LUM; $\tau_0$ = 2.2 µs; OT | 77F920 |
| 19.5.6. | Triphenylamine | AN | 0.1 mol/L TEAP | 25 | $1.5 \times 10^9$ | SS/LUM; $\tau_0$ = 2.2 µs; RT | 77F920 |
| **19.6. Ru[4,4'-(COOdec)$_2$bpy]$_3^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.6.1. | N,N-Dimethylaniline | AN | 0.1 mol/L TEAP | 25 | $4.3 \times 10^9$ | SS/LUM; $\tau_0$ = 2.2 µs; RT | 77F920 |
| | N,N-Dimethylaniline | AN | | | $4.3 \times 10^9$ | EMI; $\tau_0$ = 2.2 µs (SL/LUM/SPC); RT | 776441 |
| 19.6.2. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $2.0 \times 10^6$ | SS/LUM; $\tau_0$ = 2.2 µs; OT | 77F920 |
| 19.6.3. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $5.0 \times 10^7$ | SS/LUM; $\tau_0$ = 2.2 µs; OT | 77F920 |

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.6.** | **Ru[4,4'-(COOdec)$_2$bpy]$_3^{2+}$—Continued** | | | | | | |
| 19.6.4. | Tetracyanoethene | AN | 0.1 mol/L TEAP | 25 | $7.1 \times 10^9$ | SS/LUM; $\tau_0 = 2.2$ μs; OT | 77F920 |
| **19.7.** | **Ru[4,4'-(COOet)$_2$bpy]$_3^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.7.1. | OrgQue11 | AN? | | | $1.3 \times 10^6$ | RT | 86F005 |
| 19.7.2. | OrgQue12 | AN? | | | $1.4 \times 10^6$ | RT | 86F005 |
| **19.8.** | **Ru[4,4'-(COOnap)$_2$bpy]$_3^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.8.1. | $N,N$-Dimethylaniline | AN | 0.1 mol/L TEAP | 25 | $4.1 \times 10^9$ | SS/LUM; $\tau_0 = 2.2$ μs; RT | 77F920 |
| | $N,N$-Dimethylaniline | AN | | | $4.1 \times 10^9$ | EMI; $\tau_0 = 2.2$ μs (SL/LUM/SPC); RT | 776441 |
| 19.8.2. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $2.5 \times 10^6$ | SS/LUM; $\tau_0 = 2.2$ μs; OT | 77F920 |
| 19.8.3. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $6.0 \times 10^7$ | SS/LUM; $\tau_0 = 2.2$ μs; OT | 77F920 |
| 19.8.4. | MV$^{2+}$ | AN | | | $1.6 \times 10^8$ | EMI; $\tau_0 = 2.2$ μs (SL/LUM/SPC); OT | 776441 |
| | MV$^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $1.6 \times 10^8$ | SS/LUM; $\tau_0 = 2.2$ μs; OT; $\tau$ in AN | 77F920 |
| 19.8.5. | Tetracyanoethene | AN | 0.1 mol/L TEAP | 25 | $8.8 \times 10^9$ | SS/LUM; $\tau_0 = 2.2$ μs; OT | 77F920 |
| **19.9.** | **Ru[4,4'-(COOpr)$_2$bpy]$_3^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.9.1. | Benzophenone-2-diazonium cation | AN | | | $2.5 \times 10^{10}$ | SS/LUM; OT | 84F440 |
| 19.9.2. | $N,N$-Dimethylaniline | AN | 0.1 mol/L TEAP | 25 | $3.7 \times 10^9$ | SS/LUM; $\tau_0 = 2.4$ μs; RT | 77F920 |
| | $N,N$-Dimethylaniline | AN | | | $3.7 \times 10^9$ | EMI; $\tau_0 = 2.4$ μs (SL/LUM/SPC); RT | 776441 |
| 19.9.3. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | 25 | $8.1 \times 10^7$ | SS/LUM; $\tau_0 = 2.4$ μs; OT | 77F920 |
| 19.9.4. | MV$^{2+}$ | AN | | | $1.2 \times 10^8$ | EMI; $\tau_0 = 2.4$ μs (SL/LUM/SPC); OT | 776441 |
| | MV$^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $1.2 \times 10^8$ | SS/LUM; $\tau_0 = 2.4$ μs; OT; $\tau$ in AN | 77F920 |
| 19.9.5. | OrgQue9 | AN | 0.1 mol/L TBAP | | $4.2 \times 10^8$ | SS/LUM; OT | 84F159 |
| 19.9.6. | Triethylamine | AN | 0.1 mol/L TEAP | 25 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 2.4$ μs; RT | 77F920 |
| **19.10.** | **Ru(4,4'-Cl$_2$bpy)$_3^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.10.1. | MV$^{2+}$ | H$_2$O/AN (20/1) | $\mu = 0.5$ | 20 | $7.5 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.33$ μs (SL/LUM/SPC); OT | 82S159 |

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TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.11.** | **$Ru(5\text{-}Clphen)_3^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 19.11.1. | $Co(AMMEsarH)^{4+}$ | $H_2O$ | 0.1 mol/L HCl, 0.1 mol/L LiCl | 25 | $2.3 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 0.94$ μs (766404); ET, OT | 84A238 |
| 19.11.2. | $Co(bpy)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $2.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |
| 19.11.3. | $Co(bpy)_3^{2+}$ | $H_2O$ | 0.16 mol/L $Na_2SO_4$, Pbuf; pH 7.8; $\mu = 0.5$; $[Co^{II}]/[L] = 0.2$ | 25 | $1.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT, ET | 85S022 |
| | $Co(bpy)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $7.9 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT, ET | 85S022 |
| 19.11.4. | $Co(5\text{-}Clphen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $1.7 \times 10^3$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |
| 19.11.5. | $Co(5\text{-}Clphen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |
| 19.11.6. | $Co(diAMsar)^{3+}$ | $H_2O$ | 0.16 mol/L LiCl, 0.05 mol/L EtMC; pH 7.5 | 25 | $1.4 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 0.94$ μs (766404); ET, OT; $f = 0.30$ at pH 8.1 | 84A238 |
| 19.11.7. | $Co(en)_3^{3+}$ | $H_2O$ | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | $4.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (84A238); ET, OT; [Q] = (3-90) $\times 10^{-4}$ mol/L | 85F161 |
| 19.11.8. | $Co(4,7\text{-}Me_2phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $2.4 \times 10^6$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |
| 19.11.9. | $Co(4,7\text{-}Me_2phen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $1.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |
| 19.11.10. | $Co(NH_3)_6^{3+}$ | $H_2O$ | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | $3.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (84A238); ET, OT; [Q] = (3-90) $\times 10^{-4}$ mol/L | 85F161 |
| 19.11.11. | $Co(phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $6.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.11.** | **$Ru(5\text{-}Clphen)_3^{2+}$—Continued** | | | | | | |
| 19.11.12. | $Co(phen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $9.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT | 85S022 |
| 19.11.13. | $Co(sep)^{3+}$ | $H_2O$ | 0.2 mol/L LiCl | 25 | $2.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); ET, OT; $f = 0.35$ | 84A238 |
| | $Co(sep)^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); ET, OT | 84A238 |
| 19.11.14. | $Cr^{3+}$ | $H_2O$ | 0.04 mol/L $H_2SO_4$; μ = 1.0 ($MgCl_2$) | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.94$ μs (LP/LUM/AVE); ET | 766404 |
| 19.11.15. | $Cu^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $4.0 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT; $f = 0.31$ | 78A090 |
| 19.11.16. | $Eu^{2+}$ | $H_2O$ | 0.05 mol/L HCl; μ = 0.5 (NaCl) | 25 | $1.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); RT; [Q] = 0.01-0.09 mol/L | 78A087 |
| 19.11.17. | $Eu^{3+}$ | $H_2O$ | 0.025 mol/L HCl, $[MgCl_2] + [Eu^{3+}]$ = 0.9 mol/L | 25 | $\leq 5 \times 10^4$ | SS/LUM; $\tau_0 = 0.94$ μs (LP/LUM/AVE); Q mainly as $EuCl^{2+}$ | 766404 |
| 19.11.18. | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.94$ μs (LP/LUM/AVE); OT | 766404 |
| 19.11.19. | $Hg^{2+}$ | $H_2O$ | 0.05 mol/L $HNO_3$; μ = 0.063 ($NaNO_3$) | ~23 | $6.1 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 1.1$ μs; OT | 84A148 |
| | $Hg^{2+}$ | $H_2O$ | 0.05 mol/L $HNO_3$; μ = 0.5 ($NaNO_3$) | ~23 | $2.6 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.1$ μs; OT | 84A148 |
| 19.11.20. | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.09 mol/L $NaNO_3$ | | $3.9 \times 10^8$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 1.2 μs; OT | 84A077 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.99 mol/L $NaNO_3$ | | $5.8 \times 10^8$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 1.2 μs; OT | 84A077 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.01 mol/L SLS | | $2.5 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 2.1$ μs; OT | 84N034 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS | | $1.4 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 2.2$ μs; OT | 84N034 |
| 19.11.21. | $HgCl_3^-$ | $H_2O$ | 0.01 mol/L $HNO_3$, $[NaNO_3] + [NaCl]$ = 0.99 mol/L | | $2.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 1.2$ μs; OT; $k_q$ from $Cl^-$ titration at fixed $[Hg^{II}]_{tot}$ | 84A077 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.11. Ru(5-Clphen)$_3^{2+}$**—Continued | | | | | | | |
| | HgCl$_3^-$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $<9 \times 10^4$ | LP/LUM/AVE; $\tau_0 = 2.2$ μs; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |
| 19.11.22. | HgCl$_4^{2-}$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNC$_3$] + [NaCl] = 0.99 mol/L | | $1.1 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.2$ μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| 19.11.23. | O$_2$ | H$_2$O | | 25 | $3.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.94$ μs (LP/LUM/AVE); OT? | 766404 |
| 19.11.24. | Os(bpy)$_3^{2+}$ | H$_2$O | $\mu = 1.0$ (Na$_2$SO$_4$) | 25 | $2.5 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.94$ μs; ET, RT; [Q] $\leq$ 0.005 mol/L | 80E040 |
| 19.11.25. | Os(NH$_3$)$_6^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $\leq 9 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.11.26. | Os(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $\leq 2 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.11.27. | Os(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $\leq 5 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.11.28. | Os(NH$_3$)$_5$I$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $3.2 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.11.29. | Os(NH$_3$)$_5$(N$_2$)$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $5.2 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); RT; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.11.30. | Rh(bpy)$_3^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $4.1 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | Rh(bpy)$_3^{3+}$ | H$_2$O | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $2.8 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | Rh(bpy)$_3^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $2.1 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); OT | 82A145 |
| 19.11.31. | cis-Rh(bpy)$_2$(H$_2$O)$_2^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $2.9 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **19.11. Ru(5-Clphen)$_3$$^{2+}$—Continued** | | | | | | | |
| 19.11.32. | *cis*-Rh(bpy)$_2$(OH)$_2$$^+$ | H$_2$O | 0.5 mol/L NaOH; $\mu$ = 0.5 | 25 | 1.1 × 10$^7$ | SS/LUM or LP/LUM/SST; ET | 81N003 |
| 19.11.33. | Rh(4,4'-Me$_2$bpy)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1 × 10$^6$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.94 $\mu$s (766404); OT | 82A145 |
| 19.11.34. | Rh(5-Mephen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.6 × 10$^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.94 $\mu$s (766404); OT | 82A145 |
| 19.11.35. | Rh(phen)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu$ = 0.5 | 25 | 5.7 × 10$^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| 19.11.36. | Ti$^{3+}$ | H$_2$O | 1.5 mol/L HCl; $\mu$ = 3.0 (LiCl) | 25 | 6.2 × 10$^6$ | LP/LUM/SST; $\tau_0$ = 0.72 $\mu$s; ET; 20-60% Ti$^{3+}$ coordinated by Cl$^-$ | 79A183 |
| *Organic Quenchers* | | | | | | | |
| 19.11.37. | Ascorbate ion | H$_2$O | pH 5; $\mu$ = 0.7 (Na$_2$SO$_4$) | 25 | 1.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.94 $\mu$s (766404); RT | 82A278 |
| 19.11.38. | bpyH$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 1.7 × 10$^9$ | SS/LUM; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.11.39. | *N,N'*-Dibenzyl-vio$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.9 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| 19.11.40. | 4,4'-Dimethyl-bpyH$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 1.8 × 10$^9$ | SS/LUM; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.11.41. | DQ$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.9 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| | DQ$^{2+}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 3.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.94 $\mu$s; [Q] = (5-50) × 10$^{-4}$ mol/L | 83C017 |
| 19.11.42. | *N,N'*-Ethylene-4,4'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.5 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| 19.11.43. | MV$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.3 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| 19.11.44. | phenH$^+$ | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 2.3 × 10$^7$ | SS/LUM; $\tau_0$ = 0.94 $\mu$s (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.11.** | **$Ru(5\text{-}Clphen)_3^{2+}$**—Continued | | | | | | |
| | phenH$^+$ | $H_2O$ | $\mu = 0.5$ (HCl, NaCl) | 25 | $3 \times 10^7$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.11.45. | phenH$_2^{2+}$ | $H_2O$ | $\mu = 0.5$ (HCl, NaCl) | 25 | $6.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.94$ μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.11.46. | $N,N'$-(Tetramethylene)-bpy$^{2+}$ | $H_2O$ | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $4.2 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.94$ μs (766404); OT | 82A145 |
| **19.12.** | **$Ru[4\text{-}(Et_3P)bpy]_3^{5+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 19.12.1. | Co(bpy)$_3^{3+}$ | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu = 1.0$ | | $1.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.76$ μs (LP/LUM/SST); OT | 82F048 |
| 19.12.2. | Co[4-(NO$_2$)bpy]$_3^{3+}$ | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu = 1.0$ | | $6.6 \times 10^7$ | SS/LUM; $\tau_0 = 0.76$ μs (LP/LUM/SST); OT | 82F048 |
| 19.12.3. | Fe$^{3+}$ | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.76$ μs (LP/LUM/SST); OT | 82F048 |
| | *Organic Quenchers* | | | | | | |
| 19.12.4. | bpy | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu = 1.0$ | | $4 \times 10^6$ | SS/LUM; $\tau_0 = 0.76$ μs (LP/LUM/SST); OT | 82F048 |
| 19.12.5. | 4-Nitro-bpy | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu = 1.0$ | | $5.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.76$ μs (LP/LUM/SST); OT | 82F048 |
| 19.12.6. | 4-(Triethylphosphonio)-bpy cation | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu = 1.0$ | | $2.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.76$ μs (LP/LUM/SST); OT | 82F048 |
| **19.13.** | **$Ru(3,3'\text{-}Me_2bpy)_3^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 19.13.1. | Eu(crypt)$^{2+}$ | $H_2O$ | 1 mol/L KCl | ~22 | $1.3 \times 10^9$ | SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L | 86E195 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.13. Ru(3,3'-Me$_2$bpy)$_3^{2+}$**—Continued | | | | | | | |
| 19.13.2. | Eu(crypt)$^{3+}$ | $H_2O$ | 1 mol/L KCl | ~22 | $5.6 \times 10^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| **19.14. Ru(4,4'-Me$_2$bpy)$_3^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.14.1. | Co(AMcapten)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.3 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.13 | 85F222 |
| 19.14.2. | Co(AMMEsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $8.0 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.10 | 85F222 |
| 19.14.3. | Co(AZAcapten)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.5 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT | 85F222 |
| 19.14.4. | Co(AZAMEsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $9.0 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.14 | 85F222 |
| 19.14.5. | Co(bpy)$_3^{2+}$ | $H_2O$ | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; $\mu$ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.33 $\mu$s (766404); OT, ET | 85S022 |
| 19.14.6. | Co(CLHOsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $3.7 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.19 | 85F222 |
| 19.14.7. | Co(CLNOsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $5.8 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.18 | 85F222 |
| 19.14.8. | Co(CLsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $2.4 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.25 | 85F222 |
| 19.14.9. | Co(CMMEabsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $5 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET | 85F222 |
| 19.14.10. | $lel_3$-Co(diAMchar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.9 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.39 | 85F222 |
| 19.14.11. | Co(diAMsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.1 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.17 | 85F222 |
| 19.14.12. | $lel_3$-Co(diAZAchar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $2.5 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.11 | 85F222 |
| 19.14.13. | Co(diCLsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $4.6 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.18 | 85F222 |
| 19.14.14. | Co(diNOsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $7.7 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT; $f$ = 0.20 | 85F222 |
| 19.14.15. | Co(EFMEoxosar-H)$^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $7 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET | 85F222 |
| 19.14.16. | Co(MENOsar)$^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $3.8 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.35 $\mu$s; ET, OT | 85F222 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.14.** | **$Ru(4,4'-Me_2bpy)_3^{2+}$—Continued** | | | | | | |
| 19.14.17. | $Co(NH_3)_6^{3+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $9 \times 10^6$ | SS/LUM; $\tau_0^{air} = 0.24$ μs (LP/LUM/AVE); OT | 84A255 |
| 19.14.18. | $Co(sar)^{3+}$ | $H_2O$ | ACbuf; pH 5; μ = 0.1 (NaClO$_4$) | 20 | $5.9 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.35$ μs; ET, OT; $f = 0.056$ | 85F222 |
| 19.14.19. | $Co(sep)^{3+}$ | $H_2O$ | ACbuf; pH 5; μ = 0.1 (NaClO$_4$) | 20 | $2.4 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.35$ μs; ET, OT; $f = 0.10$ | 85F222 |
| | $Co(sep)^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $4.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); ET, OT | 84A238 |
| 19.14.20. | $Cr^{3+}$ | $H_2O$ | 0.04 mol/L $H_2SO_4$; μ = 1.0 (MgCl$_2$) | 25 | $1.0 \times 10^7$ | SS/LUM; $\tau_0 = 0.33$ μs (LP/LUM/AVE); ET | 766404 |
| 19.14.21. | $Cu^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $9.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT; $f = 0.94$ | 78A090 |
| 19.14.22. | $Eu^{2+}$ | $H_2O$ | 0.05 mol/L HCl; μ = 0.5 (NaCl) | 25 | $1.5 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.33$ μs (766404); RT; [Q] = 0.01-0.09 mol/L | 78A087 |
| 19.14.23. | $Eu^{3+}$ | $H_2O$ | 0.025 mol/L HCl, [MgCl$_2$] + [Eu$^{3+}$] = 0.9 mol/L | 25 | $\sim 5 \times 10^5$ | SS/LUM; $\tau_0 = 0.33$ μs (LP/LUM/AVE); OT; Q mainly as EuCl$^{2+}$ | 766404 |
| 19.14.24. | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (LP/LUM/AVE); OT | 766404 |
| | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | | $3.3 \times 10^9$ | FP/PCM/SST; $\tau_0 = 0.33$ μs (766404); OT, ET?; [Q] = 0.005 mol/L; [Fe$^{2+}$] = [Fe$^{3+}$]; see Mech. [8] | 80E224 |
| 19.14.25. | $Hg^{2+}$ | $H_2O$ | 0.05 mol/L HNO$_3$; μ = 0.063 (NaNO$_3$) | ~23 | $4.4 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.37$ μs; OT | 84A148 |
| | $Hg^{2+}$ | $H_2O$ | 0.05 mol/L HNO$_3$; μ = 0.5 (NaNO$_3$) | ~23 | $1.9 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.36$ μs; OT | 84A148 |
| 19.14.26. | $HgCl_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | $1.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.34$ μs; OT | 84A077 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.99 mol/L NaNO$_3$ | | $1.9 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.34$ μs; OT | 84A077 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | $1.9 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.56$ μs; OT | 84N034 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.14.** | **Ru(4,4'-Me$_2$bpy)$_3$$^{2+}$—Continued** | | | | | | |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $1.2 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.56$ μs; OT | 84N034 |
| 19.14.27. | HgCl$_3$$^-$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $5.1 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.34$ μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| | HgCl$_3$$^-$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $\sim 6 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 0.56$ μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |
| 19.14.28. | HgCl$_4$$^{2-}$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $7.2 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.34$ μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| 19.14.29. | O$_2$ | H$_2$O | | 25 | $4.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (LP/LUM/AVE); OT? | 766404 |
| 19.14.30. | Rh(bpy)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.1 \times 10^9$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | Rh(bpy)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $7.7 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| 19.14.31. | cis-Rh(bpy)$_2$(H$_2$O)$_2$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $7.8 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| 19.14.32. | cis-Rh(bpy)$_2$(OH)$_2$$^+$ | H$_2$O | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $1.8 \times 10^7$ | SS/LUM or LP/LUM/SST; ET | 81N003 |
| 19.14.33. | Rh(phen)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.4 \times 10^9$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| *Organic Quenchers* | | | | | | | |
| 19.14.34. | Ascorbate ion | H$_2$O | pH 5; $\mu = 0.7$ (Na$_2$SO$_4$) | 25 | $2 \times 10^6$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); RT | 82A278 |
| 19.14.35. | bpyH$^+$ | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | $6.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | bpyH$^+$ | H$_2$O | $\mu = 0.5$ (HBr, NaBr) | 25 | $8.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | bpyH$^+$ | H$_2$O | $\mu = 0.5$ (HNO$_3$, NaNO$_3$) | 25 | $8.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.14. Ru(4,4'-Me$_2$bpy)$_3$$^{2+}$**—Continued | | | | | | | |
| | bpyH$^+$ | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 3.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.14.36. | bpyH$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 2.6 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.14.37. | 4,4'-Dimethyl-bpyH$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 2.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | 4,4'-Dimethyl-bpyH$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 2.9 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.14.38. | DQ$^{2+}$ | H$_2$O | 0.1 mol/L LiCl | 25 | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L NaCl | 25 | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L KCl | 25 | 2.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L RbCl | 25 | 2.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L CsCl | 25 | 2.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L TMAC | 25 | 2.3 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L TEAC | 25 | 2.3 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L TPrAC | 25 | 2.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L TBAC | 25 | 2.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L TPeAC | 25 | 2.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |
| | DQ$^{2+}$ | H$_2$O | 0.1 mol/L TPrAB | 25 | 2.7 × 10$^9$ | SS/LUM; $\tau_0$ = 0.33 μs (766404); OT | 85S022 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.14.** | **$Ru(4,4'-Me_2bpy)_3^{2+}$—Continued** | | | | | | |
| | $DQ^{2+}$ | $H_2O$ | 0.1 mol/L TBAB | 25 | $2.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2-}$ | $H_2O$ | 0.5 mol/L HCl | 25 | $3.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2-}$ | $H_2O$ | 0.5 mol/L HBr | 25 | $4.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2-}$ | $H_2O$ | 0.5 mol/L LiCl | 25 | $3.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2+}$ | $H_2O$ | 0.5 mol/L NaCl | 25 | $3.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2+}$ | $H_2O$ | 0.5 mol/L KCl | 25 | $3.7 \times 10^0$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2+}$ | $H_2O$ | 0.5 mol/L RbCl | 25 | $3.8 \times 10^0$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2+}$ | $H_2O$ | 0.5 mol/L CsCl | 25 | $3.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2+}$ | $H_2O$ | 0.5 mol/L LiBr | 25 | $4.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); OT | 85S022 |
| | $DQ^{2+}$ | $H_2O$ | $\mu = 0.5$ (HF, NaF) | 25 | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |
| | $DQ^{2+}$ | $H_2O$ | $\mu = 0.5$ (HCl, NaCl) | 25 | $3.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |
| | $DQ^{2+}$ | $H_2O$ | $\mu = 0.5$ (HBr, NaBr) | 25 | $4.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |
| | $DQ^{2+}$ | $H_2O$ | $\mu = 0.5$ (HI, NaI) | 25 | $5.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |
| | $DQ^{2+}$ | $H_2O$ | $\mu = 0.5$ (HNO$_3$, NaNO$_3$) | 25 | $4.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |
| | $DQ^{2+}$ | $H_2O$ | pH <1; $\mu = 0.5$ (NaHSO$_4$, Na$_2$SO$_4$) | 25 | $2.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |
| | $DQ^{2+}$ | $H_2O$ | pH >2; $\mu = 0.5$ (NaHSO$_4$, Na$_2$SO$_4$) | 25 | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ μs (766404); [Q] = (5-50) × $10^{-4}$ mol/L | 83C017 |

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TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.14. $Ru(4,4'-Me_2bpy)_3^{2+}$—Continued** | | | | | | | |
| 19.14.39. | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu =$ 0.1 ($NaClO_4$) | 20 | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.35$ $\mu$s; OT | 85F222 |
| 19.14.40. | phenH$^+$ | $H_2O$ | $\mu = 0.5$ (HCl, NaCl) | 25 | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ $\mu$s (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | phenH$^+$ | $H_2O$ | $\mu = 0.5$ ($NaHSO_4$, $Na_2SO_4$) | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.33$ $\mu$s (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| **19.15. $Ru(3,4,7,8-Me_4phen)_3^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.15.1. | $Co(sep)^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $6.9 \times 10^8$ | SS/LUM; $\tau_0 = 1.4$ $\mu$s (766404); ET, OT | 84A238 |
| 19.15.2. | $Cu^{2+}$ | $H_2O$ | 0.25 mol/L $H_2SO_4$; $\mu = 0.8$-1 | 25 | $6.5 \times 10^7$ | SL/LUM/SPC; $\tau_0 = 1.5$ $\mu$s; $\Delta H^{\ddagger} = 19$ kJ/mol; $\Delta S^{\ddagger} = -32$ J/mol·K (20-80°C); OT | 80A308 |
| | $Cu^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $1.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.4$ $\mu$s (766404); OT; $f = 0.95$ | 78A090 |
| | $Cu^{2+}$ | $H_2O$ | 0.5 mol/L $Li_2SO_4$ | 25 | $8.8 \times 10^7$ | SS/LUM; $\tau_0 = 1.5$ $\mu$s (LP/LUM/AVE); OT | 78A090 |
| 19.15.3. | $CuCl^+$ | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L $Cu^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ ($CuCl_2$, $MgCl_2$); $\mu = 0.35$ | 25 | $2.3 \times 10^8$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 19.15.4. | $CuCl_2$ | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L $Cu^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ ($CuCl_2$, $MgCl_2$); $\mu = 0.35$ | 25 | $2.2 \times 10^9$ | SL/LUM/SPC; OT; $k_c$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **19.15.** | **Ru(3,4,7,8-Me$_4$phen)$_3^{2+}$**—Continued | | | | | | |
| 19.15.5. | Cu(H$_2$O)$_n^{2+}$ | H$_2$O | 0.0025 mol/L H$_2$SO$_4$ + 0.088 mol/L Cu$^{2+}$ (CuSO$_4$, CuCl$_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ (CuCl$_2$, MgCl$_2$); μ = 0.35 | 25 | 4.8 × 10$^7$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 19.15.6. | Eu(crypt)$^{3+}$ | H$_2$O | 1 mol/L KCl | ~22 | 3.4 × 10$^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| 19.15.7. | Fe$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 3.4 × 10$^9$ | SS/LUM; τ$_0$ = 1.4 μs (LP/LUM/AVE); OT | 766404 |
| 19.15.8. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | 3.0 × 10$^9$ | LP/LUM/AVE; τ$_0$ = 2.3 μs; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | 7.5 × 10$^7$ | LP/LUM/AVE; τ$_0$ = 1.9 μs; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | 6.1 × 10$^7$ | LP/LUM/AVE; τ$_0$ = 2.2 μs; OT; [Q] ≤ 0.02 mol/L | 84N034 |
| 19.15.9. | HgCl$_3^-$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | 2.6 × 10$^7$ | LP/LUM/AVE; τ$_0$ = 2.2 μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |
| 19.15.10. | O$_2$ | H$_2$O | | 25 | 5.8 × 10$^9$ | SS/LUM; τ$_0$ = 1.4 μs (LP/LUM/AVE); OT? | 766404 |
| 19.15.11. | Os(NH$_3$)$_6^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 7.9 × 10$^7$ | SS/LUM or LP/LUM/SST; τ$_0$ = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10$^{-4}$ mol/L | 82A145 |
| 19.15.12. | Os(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 4.2 × 10$^8$ | SS/LUM or LP/LUM/SST; τ$_0$ = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10$^{-4}$ mol/L | 82A145 |
| 19.15.13. | Os(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 1.4 × 10$^8$ | SS/LUM or LP/LUM/SST; τ$_0$ = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10$^{-4}$ mol/L | 82A145 |
| 19.15.14. | Os(NH$_3$)$_5$I$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 8.5 × 10$^8$ | SS/LUM or LP/LUM/SST; τ$_0$ = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10$^{-4}$ mol/L | 82A145 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3{}^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.15.  Ru(3,4,7,8-Me$_4$phen)$_3{}^{2+}$**—Continued | | | | | | | |
| 19.15.15.  Ti$^{3+}$ | | $H_2O$ | 1.5 mol/L HCl; $\mu$ = 3.0 (LiCl) | 25 | $3.7 \times 10^6$ | LP/LUM/SST; $\tau_0$ = 1.0 $\mu$s; $\tau_0$ extrap'd to [Q] = 0; intercept of S-V plot is not 1.0; 20-60% Ti$^{3+}$ coordinated by Cl$^-$ | 79A183 |
| *Organic Quenchers* | | | | | | | |
| 19.15.16.  Ascorbate ion | | $H_2O$ | pH 5; $\mu$ = 0.7 (Na$_2$SO$_4$) | 25 | $1.1 \times 10^7$ | SS/LUM; $\tau_0$ = 1.4 $\mu$s (766404); RT | 82A278 |
| 19.15.17.  bpyH$^+$ | | $H_2O$ | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | $3.5 \times 10^9$ | SS/LUM; $\tau_0$ = 1.4 $\mu$s (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| **19.16.  Ru(3,5,6,8-Me$_4$phen)$_3{}^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.16.1.  Co(sep)$^{3+}$ | | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $3.0 \times 10^8$ | SS/LUM; $\tau_0$ = 2.2 $\mu$s (766404); ET, OT | 84A238 |
| 19.16.2.  Fe$^{3+}$ | | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $2.5 \times 10^9$ | SS/LUM; $\tau_0$ = 2.1 $\mu$s (LP/LUM/AVE); OT | 766404 |
| 19.16.3.  O$_2$ | | $H_2O$ | | 25 | $3.6 \times 10^9$ | SS/LUM; $\tau_0$ = 2.2 $\mu$s (LP/LUM/AVE); OT? | 766404 |
| 19.16.4.  Os(NH$_3$)$_5$(H$_2$O)$^{3+}$ | | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $4.9 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 2.2 $\mu$s (766404); OT, ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.16.5.  Os(NH$_3$)$_5$I$^{2+}$ | | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | 25 | $6.6 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 2.2 $\mu$s (766404); OT, ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| *Organic Quenchers* | | | | | | | |
| 19.16.6.  Ascorbate ion | | $H_2O$ | pH 5; $\mu$ = 0.7 (Na$_2$SO$_4$) | 25 | $3.6 \times 10^7$ | SS/LUM; $\tau_0$ = 2.2 $\mu$s (766404); RT | 82A278 |
| **19.17.  Ru(4,7-Me$_2$phen)$_3{}^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.17.1.  Co(AMMEsarH)$^{4+}$ | | $H_2O$ | 0.1 mol/L HCl, 0.1 mol/L LiCl | 25 | $7.4 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0$ = 1.7 $\mu$s (766404); ET, OT | 84A238 |
| 19.17.2.  Co(AZAMEsar)$^{3+}$ | | $H_2O$ | $\mu$ = 0.2 (LiCl) | 25 | $8.4 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0$ = 1.7 $\mu$s (766404); ET, OT | 84A238 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.17.** | **Ru(4,7-Me$_2$phen)$_3^{2+}$**—Continued | | | | | | |
| 19.17.3. | Co(bpy)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 2.9 × 10$^7$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| | Co(bpy)$^{2+}$ | H$_2$O | 0.5 mol/L NaF, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 9.6 × 10$^7$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| | Co(bpy)$^{2+}$ | H$_2$O | 0.5 mol/L NaCl, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 1.5 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| | Co(bpy)$^{2+}$ | H$_2$O | 0.5 mol/L NaBr, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 1.8 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| | Co(bpy)$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 1.0 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| 19.17.4. | Co(bpy)$_3^+$ | AN | 0.1 mol/L TEAP | 25 | 3.8 × 10$^9$ | LP/LUM/AVE; $\tau_0$ = 1.1 μs; RT | 86A077 |
| 19.17.5. | Co(bpy)$_3^{2+}$ | AN | 0.1 mol/L TEAP | 25 | 1.9 × 10$^8$ | SS/LUM; $\tau_0$ = 1.1 μs (LP/LUM/AVE); OT, ET? | 86A077 |
| | Co(bpy)$_3^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | 1.0 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT, ET | 85S022 |
| | Co(bpy)$_3^{2+}$ | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; μ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | 1.6 × 10$^9$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT, ET | 85S022 |
| 19.17.6. | Co(5-Brphen)$^{2-}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 3.4 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| 19.17.7. | Co(5-Clphen)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 2.8 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |
| 19.17.8. | Co(5-Clphen)$_3^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | 1.4 × 10$^8$ | SS/LUM; $\tau_0$ = 1.7 μs (766404); OT | 85S022 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.17.** | **$Ru(4,7-Me_2phen)_3^{2+}$—Continued** | | | | | | |
| 19.17.9. | $Co(diAMsar)^{3+}$ | $H_2O$ | 0.16 mol/L LiCl, 0.05 mol/L EtMO; pH 7.5 | 25 | $5.8 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); ET, OT; $f = 0.90$ at pH 8.3 | 84A238 |
| 19.17.10. | $Co(diAMsarH_2)^{5+}$ | $H_2O$ | 0.1 mol/L HCl, 0.1 mol/L LiCl | 25 | $1.1 \times 10^9$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 1.7 μs (766404); ET, OT | 84A238 |
| 19.17.11. | $Co(en)_3^{3+}$ | $H_2O$ | ACbuf; pH 4.7; μ = 0.01 (NaCl) | 25 | $1.1 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (84A238); ET, OT; [Q] = (3-90) $\times$ $10^{-4}$ mol/L | 85F161 |
| 19.17.12. | $Co(4,4'-Me_2bpy)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $7.4 \times 10^7$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.13. | $Co(2,9-Me_2phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $5.4 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.14. | $Co(4,7-Me_2phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $4.3 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.15. | $Co(4,7-Me_2phen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.16. | $Co(5-Mephen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $2.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.17. | $Co(5,6-Me_2phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $3.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.18. | $Co(NH_3)_6^{3+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $2.3 \times 10^7$ | SS/LUM; $\tau_0^{air} = 0.52$ μs (LP/LUM/AVE); OT | 84A255 |
| | $Co(NH_3)_6^{3+}$ | $H_2O$ | ACbuf; pH 4.7; μ = 0.01 (NaCl) | 25 | $7.7 \times 10^7$ | SS/LUM; $\tau_0 = 1.7$ μs (84A238); ET, OT; [Q] = (3-90) $\times$ $10^{-4}$ mol/L | 85F161 |
| 19.17.19. | $Co(phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $1.6 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.20. | $Co(phen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $1.1 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); OT | 85S022 |
| 19.17.21. | $Co(sep)^{3+}$ | $H_2O$ | 0.2 mol/L LiCl | 25 | $9.5 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ μs (766404); ET, OT; $f = 0.64$ | 84A238 |

| No. | Quencher | Solvent | Solution Medium | T/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|------|------|----------|------|
| **19.17.** | **Ru(4,7-Me$_2$phen)$_3^{2+}$—Continued** | | | | | | |
| | Co(sep)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $7.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.7$ $\mu$s (766404); ET, OT | 84A238 |
| 19.17.22. | Cr$^{3+}$ | H$_2$O | 0.04 mol/L H$_2$SO$_4$; $\mu = 1.0$ (MgCl$_2$) | 25 | $1.3 \times 10^7$ | SS/LUM; $\tau_0 = 1.7$ $\mu$s (LP/LUM/AVE); ET; [Q] ≤ 0.006 mol/L | 766404 |
| 19.17.23. | Cu$^{2+}$ | D$_2$O | 0.25 mol/L H$_2$SO$_4$; $\mu = 0.8$-1 | 25 | $7.8 \times 10^7$ | SL/LUM/SPC; $\tau_0 = 2.3$ $\mu$s; $\Delta H^\ddagger = 20$ kJ/mol; $\Delta S^\ddagger = -26$ J/mol·K (20-80°C) OT | 80A308 |
| | Cu$^{2+}$ | H$_2$O | $\mu = 0.12$ (NaNO$_3$) | 25 | $8.6 \times 10^7$ (calc) | LP/LUM/SST; $\tau_0 = 1.6$ $\mu$s; OT | 85N199 |
| | Cu$^{2+}$ | H$_2$O | $\mu = 0.18$ (NaNO$_3$) | 25 | $7.7 \times 10^7$ (calc) | LP/LUM/SST; $\tau_0 = 1.7$ $\mu$s (83N004); OT | 85N199 |
| | Cu$^{2+}$ | H$_2$O | 0.25 mol/L H$_2$SO$_4$; $\mu = 0.8$-1 | 25 | $7.9 \times 10^7$ | SL/LUM/SPC; $\tau_0 = 1.6$ $\mu$s; $\Delta H^\ddagger = 18$ kJ/mol; $\Delta S^\ddagger = -34$ J/mol·K (20-80°C) OT | 80A308 |
| | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $8.6 \times 10^7$ | SS/LUM; $\tau_0 = 1.7$ $\mu$s (766404); OT; $f = 0.96$ | 78A090 |
| 19.17.24. | CuCl$^+$ | H$_2$O | 0.0025 mol/L H$_2$SO$_4$ + 0.088 mol/L Cu$^{2+}$ (CuSO$_4$, CuCl$_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ (CuCl$_2$, MgCl$_2$); $\mu = 0.35$ | 25 | $3.2 \times 10^8$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 19.17.25. | CuCl$_2$ | H$_2$O | 0.0025 mol/L H$_2$SO$_4$ + 0.088 mol/L Cu$^{2+}$ (CuSO$_4$, CuCl$_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ (CuCl$_2$, MgCl$_2$); $\mu = 0.35$ | 25 | $2.6 \times 10^9$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 19.17.26. | Cu(H$_2$O)$_n^{2+}$ | H$_2$O | 0.0025 mol/L H$_2$SO$_4$ + 0.088 mol/L Cu$^{2+}$ (CuSO$_4$, CuCl$_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ (CuCl$_2$, MgCl$_2$); $\mu = 0.35$ | 25 | $7.8 \times 10^7$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |

TABLE 19. Quenching of excited ruthenium complexes (except Ru(bpy)$_3$$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.17. Ru(4,7-Me$_2$phen)$_3$$^{2+}$—Continued** | | | | | | | |
| 19.17.27. Eu$^{2+}$ | | H$_2$O | 0.05 mol/L HCl; $\mu$ = 0.5 (NaCl) | 25 | $7.0 \times 10^6$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (766404); RT | 78A087 |
| 19.17.28. Eu$^{3+}$ | | H$_2$O | 0.025 mol/L HCl, [MgCl$_2$] + [Eu$^{3+}$] = 0.9 mol/L | 25 | $2.1 \times 10^6$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (LP/LUM/AVE); OT; [Q] $\leq$ 0.5 mol/L; Q mainly as EuCl$^{2+}$ | 766404 |
| | Eu$^{3+}$ | H$_2$O | 0.025 mol/L HCl; $\mu$ = 2.8 (MgCl$_2$) | 25 | $1.3 \times 10^6$ | SL/LUM/SPC; $\tau_0$ = 1.6 $\mu$s; $\Delta H^{\ddagger}$ = 25 kJ/mol; $\Delta S^{\ddagger}$ = −44 J/mol·K (20-80°C); OT; Q mainly as EuCl$^{2+}$ | 80A308 |
| 19.17.29. Fe$^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (LP/LUM/AVE); OT | 766404 |
| 19.17.30. Hg$^{2+}$ | | H$_2$O | 0.05 mol/L HNO$_3$; $\mu$ = 0.063 (NaNO$_3$) | ~23 | $9.5 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 1.9 $\mu$s; OT | 84A148 |
| | Hg$^{2+}$ | H$_2$O | 0.05 mol/L HNO$_3$; $\mu$ = 0.5 (NaNO$_3$) | ~23 | $3.8 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 1.6 $\mu$s; OT | 84A148 |
| 19.17.31. HgCl$_2$ | | H$_2$O | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | $2.8 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.9 $\mu$s; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.99 mol/L NaNO$_3$ | | $2.8 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.9 $\mu$s; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | $3.0 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 3.3 $\mu$s; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $2.4 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 3.4 $\mu$s; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.40 mol/L, 0.01 mol/L SLS | | $2.3 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 3.5 $\mu$s; OT | 84N034 |
| 19.17.32. HgCl$_3$$^-$ | | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $8.5 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.9 $\mu$s; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| | HgCl$_3$$^-$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $1.2 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 3.4 $\mu$s; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.17. Ru(4,7-Me$_2$phen)$_3^{2+}$—Continued** | | | | | | | |
| 19.17.33. HgCl$_4^{2-}$ | | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $1.0 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 1.9$ μs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| 19.17.34. O$_2$ | | H$_2$O | | 25 | $4.5 \times 10^9$ | SS/LUM; $\tau_0 \approx 1.7$ μs (LP/LUM/AVE); OT? | 766404 |
| 19.17.35. Os(bpy)$_3^{2+}$ | | H$_2$O | $\mu = 1.0$ (Na$_2$SO$_4$) | 25 | $2.5 \times 10^9$ | LP/LUM/SST; $\tau_0 = 1.7$ μs; ET; [Q] $\leq 0.005$ mol/L | 80E040 |
| 19.17.36. Os(NH$_3$)$_6^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $5.0 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT, ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.17.37. Os(NH$_3$)$_5$Cl$^{2+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $3.0 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT, ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.17.38. Os(NH$_3$)$_5$(H$_2$O)$^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $8.7 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT, ET?; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.17.39. Os(NH$_3$)$_5$(N$_2$)$^{2+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $\leq 3 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); RT; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 19.17.40. Rh(bpy)$_3^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.3 \times 10^9$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | Rh(bpy)$_3^{3+}$ | H$_2$O | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $9.9 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | Rh(bpy)$_3^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $9 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT | 82A145 |
| 19.17.41. cis-Rh(bpy)$_2$(H$_2$O)$_2^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.4 \times 10^9$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| 19.17.42. cis-Rh(bpy)$_2$(OH)$_2^+$ | | H$_2$O | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $2.5 \times 10^7$ | SS/LUM or LP/LUM/SST; ET | 81N003 |
| 19.17.43. Rh(4,4'-Me$_2$bpy)$_3^{3+}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.2 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT | 82A145 |
| 19.17.44. Rh(5-Mephen)$_3^{3+}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.3 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT | 82A145 |
| 19.17.45. Rh(5,6-Me$_2$phen)$_3^{3+}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.6 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.7$ μs (766404); OT | 82A145 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.17. Ru(4,7-Me$_2$phen)$_3^{2+}$—Continued** | | | | | | | |
| 19.17.46. Rh(phen)$_3^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.5 × 10$^9$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| 19.17.47. Ru(4,7-Me$_2$phen)$_3^{3+}$ | | AN | 0.1 mol/L TEAP | 25 | 2.5 × 10$^9$ | LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s; OT | 86A077 |
| 19.17.48. Ti$^{3+}$ | | H$_2$O | 1.5 mol/L HCl; $\mu$ = 3.0 (LiCl) | 25 | 3.8 × 10$^6$ | LP/LUM/SST; $\tau_0$ = 1.3 $\mu$s; ET; 20-60% Ti$^{3+}$ coordinated by Cl$^-$ | 79A183 |
| *Organic Quenchers* | | | | | | | |
| 19.17.49. bpyH$^+$ | | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 1.4 × 10$^9$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | bpyH$^+$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.17.50. N,N-Dibenzyl-vio$^{2+}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 2.4 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.7 $\mu$s (766404); OT; [Q] = (3.5-500) × 10$^{-5}$ mol/L | 82A145 |
| 19.17.51. N,N-Diethylaniline | | MeOH | | 25 | 8.6 × 10$^6$ | SL/LUM/SPC; $\tau_0$ = 0.85 $\mu$s; $\Delta G^{\ddagger}$ = 33 kJ/mol; RT | 83E623 |
| 19.17.52. N,N-Dimethylaniline | | MeOH | | 25 | 3.7 × 10$^6$ | SL/LUM/SPC; $\tau_0$ = 0.85 $\mu$s; $\Delta G^{\ddagger}$ = 36 kJ/mol; RT | 83E623 |
| 19.17.53. 4,4'-Dimethyl-bpyH$_2^{2+}$ | | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.17.54. DQ$^{2-}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 2.4 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.7 $\mu$s (766404); OT; [Q] = (3.5-500) × 10$^{-5}$ mol/L | 82A145 |
| | DQ$^{2-}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 4.1 × 10$^9$ | SS/LUM; $\tau_0$ = 1.7 $\mu$s (766404); [Q] = (5-50) × 10$^{-4}$ mol/L | 83C017 |
| 19.17.55. N,N'-Ethylene-4,4'-dimethyl-bpy$^{2+}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 2.1 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.7 $\mu$s (766404); OT; [Q] = (3.5-500) × 10$^{-5}$ mol/L | 82A145 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.17. Ru(4,7-Me$_2$phen)$_3^{2+}$**—Continued | | | | | | | |
| 19.17.56. MV$^{2+}$ | | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; μ = 0.5 | 25 | 1.8 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.7 μs (766404); OT; [Q] = (3.5-500) × 10$^{-5}$ mol/L | 82A145 |
| | MV$^{2+}$ | H$_2$O | 0.0067 mol/L Pbuf, ≤0.2 mol/L HSEtOH; pH 7 | 30 | 4.4 × 10$^8$ | SS/QYP; $\tau_0$ = 1.7 μs (766404); OT; [Q] ≤ 0.01 mol/L; $\tau_0$ at 25 °C; see Mech. [7] | 81A139 |
| 19.17.57. 4,N,N-Trimethylaniline | | MeOH | | 25 | 1.8 × 10$^8$ | SL/LUM/SPC; $\tau_0$ = 0.85 μs; $\Delta G^{\ddagger}$ = 26 kJ/mol; RT | 83E623 |
| **19.18. Ru(5-Mephen)$_3^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.18.1. Co(bpy)$_3^{2+}$ | | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; μ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | 1.2 × 10$^9$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); OT, ET | 85S022 |
| 19.18.2. Co(sep)$^{3+}$ | | H$_2$O | 0.2 mol/L LiCl | 25 | 7.3 × 10$^8$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); ET, OT | 84A238 |
| | Co(sep)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 5.5 × 10$^8$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); ET, OT | 84A238 |
| 19.18.3. Cr$^{3+}$ | | H$_2$O | 0.04 mol/L H$_2$SO$_4$; μ = 1.0 (MgCl$_2$) | 25. | 1.3 × 10$^7$ | SS/LUM; $\tau_0$ = 1.3 μs (LP/LUM/AVE); ET | 766404 |
| 19.18.4. Cu$^{2+}$ | | H$_2$O | μ = 0.12 (NaNO$_3$) | 25 | 4.9 × 10$^7$ (calc) | LP/LUM/SST; $\tau_0$ = 1.4 μs; OT | 85N199 |
| | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 6.0 × 10$^7$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); OT; $f$ = 0.74 | 78A090 |
| 19.18.5. Eu$^{3+}$ | | H$_2$O | 0.025 mol/L HCl, [MgCl$_2$] + [Eu$^{3+}$] = 0.9 mol/L | 25 | 4.2 × 10$^5$ | SS/LUM; $\tau_0$ = 1.3 μs (LP/LUM/AVE); OT; Q mainly as EuCl$^{2+}$ | 766404 |
| 19.18.6. Fe$^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 2.6 × 10$^9$ | SS/LUM; $\tau_0$ = 1.3 μs (LP/LUM/AVE); OT | 766404 |
| 19.18.7. Hg$^{2+}$ | | H$_2$O | 0.05 mol/L HNO$_3$; μ = 0.063 (NaNO$_3$) | ~23 | 8.4 × 10$^7$ | LP/LUM/AVE; $\tau_0$ = 1.5 μs; OT | 84A148 |
| | Hg$^{2+}$ | H$_2$O | 0.05 mol/L HNO$_3$; μ = 0.5 (NaNO$_3$) | ~23 | 3.3 × 10$^8$ | LP/LUM/AVE; $\tau_0$ = 1.5 μs; OT | 84A148 |

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TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.18.** | **Ru(5-Mephen)$_3$$^{2+}$—Continued** | | | | | | |
| 19.18.8. | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | $1.9 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.4 µs; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$; 0.99 mol/L NaNO$_3$ | | $2.6 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.4 µs; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | $1.3 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 2.3 µs; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $1.1 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 2.4 µs; OT | 84N034 |
| 19.18.9. | HgCl$_3$$^-$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $6.3 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.4 µs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| | HgCl$_3$$^-$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $\sim 3 \times 10^6$ | LP/LUM/AVE; $\tau_0$ = 2.4 µs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |
| 19.18.10. | HgCl$_4$$^{2-}$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $8.1 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 1.4 µs; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| 19.18.11. | O$_2$ | H$_2$O | | 25 | $5.0 \times 10^9$ | SS/LUM; $\tau_0$ = 1.3 µs (LP/LUM/AVE); OT? | 766404 |
| 19.18.12. | Rh(bpy)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; µ = 0.5 | 25 | $7 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.3 µs (766404); OT | 82A145 |
| 19.18.13. | Rh(4,4'-Me$_2$bpy)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; µ = 0.5 | 25 | $4.9 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.3 µs (766404); OT | 82A145 |
| 19.18.14. | Rh(5-Mephen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; µ = 0.5 | 25 | $1.0 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.3 µs (766404); OT | 82A145 |
| 19.18.15. | Rh(5,6-Me$_2$phen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; µ = 0.5 | 25 | $1.3 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 1.3 µs (766404); OT | 82A145 |
| *Organic Quenchers* | | | | | | | |
| 19.18.16. | Ascorbate ion | H$_2$O | pH 5; µ = 0.7 (Na$_2$SO$_4$) | 25 | $1.7 \times 10^8$ | SS/LUM; $\tau_0$ = 1.3 µs (766404); RT | 82A278 |
| 19.18.17. | bpyH$^+$ | H$_2$O | µ = 0.5 (HCl, NaCl) | 25 | $3.4 \times 10^7$ | SS/LUM; $\tau_0$ = 1.3 µs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.18. Ru(5-Mephen)$_3^{2+}$—Continued** | | | | | | | |
| 19.18.18. bpyH$_2^{2+}$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 3.2 × 10$^9$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.18.19. DQ$^{2+}$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 3.3 × 10$^9$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); [Q] = (5-50) × 10$^{-4}$ mol/L | 83C017 |
| 19.18.20. phenH$^+$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 1.8 × 10$^9$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.18.21. phenH$_2^{2+}$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 3.8 × 10$^9$ | SS/LUM; $\tau_0$ = 1.3 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| **19.19. Ru(5,6-Me$_2$phen)$_3^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.19.1. Co(en)$_3^{3+}$ | | H$_2$O | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | 9.1 × 10$^7$ | SS/LUM; $\tau_0$ = 1.8 μs (84A238); ET, OT; [Q] = (3-90) × 10$^{-4}$ mol/L | 85F161 |
| 19.19.2. Co(NH$_3$)$_6^{3+}$ | | H$_2$O | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | 5.3 × 10$^7$ | SS/LUM; $\tau_0$ = 1.8 μs (84A238); ET, OT; [Q] = (3-90) × 10$^{-4}$ mol/L | 85F161 |
| 19.19.3. Co(sep)$^{3+}$ | | H$_2$O | 0.2 mol/L LiCl | 25 | 7.2 × 10$^8$ | SS/LUM; $\tau_0$ = 1.8 μs (766404); ET, OT | 84A238 |
| Co(sep)$^{3+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 5.7 × 10$^8$ | SS/LUM; $\tau_0$ = 1.8 μs (766404); ET, OT | 84A238 |
| 19.19.4. Cr$^{3+}$ | | H$_2$O | 0.04 mol/L H$_2$SO$_4$; $\mu$ = 1.0 (MgCl$_2$) | 25 | 1.4 × 10$^7$ | SS/LUM; $\tau_0$ = 1.8 μs (LP/LUM/AVE); ET | 766404 |
| 19.19.5. Cu$^{2+}$ | | H$_2$O | $\mu$ = 0.12 (NaNO$_3$) | 25 | 5.2 × 10$^7$ (calc) | LP/LUM/SST; $\tau_0$ = 1.8 μs; OT | 85N199 |
| Cu$^{2+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 7.6 × 10$^7$ | SS/LUM; $\tau_0$ = 1.8 μs (766404); OT; $f$ = 0.79 | 78A090 |
| 19.19.6. Eu$^{3+}$ | | H$_2$O | 0.025 mol/L HCl, [MgCl$_2$] + [Eu$^{3+}$] = 0.9 mol/L | 25 | 7.5 × 10$^5$ | SS/LUM; $\tau_0$ = 1.8 μs (LP/LUM/AVE); OT; Q mainly as EuCl$^{2+}$ | 766404 |
| 19.19.7. Eu(crypt)$^{3+}$ | | H$_2$O | 1 mol/L KCl | ~22 | 6.0 × 10$^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.19.** | **$Ru(5,6-Me_2phen)_3^{2+}$—Continued** | | | | | | |
| 19.19.8. | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.6 \times 10^9$ | SS/LUM; $\tau_0 = 1.8$ μs (LP/LUM/AVE); OT | 766404 |
| 19.19.9. | $Hg^{2+}$ | $H_2O$ | 0.05 mol/L $HNO_3$; μ = 0.063 ($NaNO_3$) | ~23 | $8.3 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 1.9$ μs; OT | 84A148 |
| | $Hg^{2+}$ | $H_2O$ | 0.05 mol/L $HNO_3$; μ = 0.5 ($NaNO_3$) | ~23 | $3.6 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 2.0$ μs; OT | 84A148 |
| 19.19.10. | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.09 mol/L $NaNO_3$ | | $2.9 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 1.9$ μs; OT | 84A077 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.99 mol/L $NaNO_3$ | | $2.6 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 1.9$ μs; OT | 84A077 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.01 mol/L SLS | | $1.7 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 3.1$ μs; OT | 84N034 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS | | $1.3 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 3.2$ μs; OT | 84N034 |
| 19.19.11. | $HgCl_3^-$ | $H_2O$ | 0.01 mol/L $HNO_3$, $[NaNO_3] + [NaCl]$ = 0.99 mol/L | | $5.0 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 1.9$ μs; OT; $k_q$ from $Cl^-$ titration at fixed $[Hg^{II}]_{tot}$ | 84A077 |
| | $HgCl_3^-$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS | | $\sim4 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 3.2$ μs; OT; $k_q$ from $Cl^-$ titration at fixed $[Hg^{II}]_{tot}$ | 84N034 |
| 19.19.12. | $HgCl_4^{2-}$ | $H_2O$ | 0.01 mol/L $HNO_3$, $[NaNO_3] + [NaCl]$ = 0.99 mol/L | | $7.8 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.9$ μs; OT; $k_q$ from $Cl^-$ titration at fixed $[Hg^{II}]_{tot}$ | 84A077 |
| 19.19.13. | $O_2$ | $H_2O$ | | 25 | $4.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.8$ μs (LP/LUM/AVE); OT? | 766404 |
| 19.19.14. | $Os(NH_3)_6^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $\leq3 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.8$ μs (766404); OT, ET?; [Q] = (3-200) × $10^{-4}$ mol/L | 82A145 |
| 19.19.15. | $Os(NH_3)_5(H_2O)^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $\leq2 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 1.8$ μs (766404); OT, ET?; [Q] = (3-200) × $10^{-4}$ mol/L | 82A145 |

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| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.19. Ru(5,6-Me$_2$phen)$_3$$^{2+}$—**Continued | | | | | | | |
| 19.19.16. Os(NH$_3$)$_5$I$^{2+}$ | | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 6.6 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0 \approx 1.8$ μs (766404); OT, ET?; [Q] = (3-200) × 10$^{-4}$ mol/L | 82A145 |
| *Organic Quenchers* | | | | | | | |
| 19.19.17. Ascorbate ion | | H$_2$O | pH 5; $\mu = 0.7$ (Na$_2$SO$_4$) | 25 | 1.1 × 10$^8$ | SS/LUM; $\tau_0 = 1.8$ μs (766404); RT | 82A278 |
| 19.19.18. bpyH$^+$ | | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | 9.9 × 10$^7$ | SS/LUM; $\tau_0 = 1.8$ μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| bpyH$^+$ | | H$_2$O | $\mu = 0.5$ (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 6 × 10$^7$ | SS/LUM; $\tau_0 = 1.8$ μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.19.19. bpyH$_2$$^{2+}$ | | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | 3.6 × 10$^9$ | SS/LUM; $\tau_0 = 1.8$ μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.19.20. $N,N$-Diethylaniline | | MeOH | | 25 | 2.0 × 10$^8$ | SL/LUM/SPC; $\tau_0 = 1.4$ μs; $\Delta G^{\ddagger} = 26$ kJ/mol; RT | 83E623 |
| 19.19.21. DQ$^{2+}$ | | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | 3.2 × 10$^9$ | SS/LUM; $\tau_0 = 1.8$ μs (766404); [Q] = (5-50) × 10$^{-4}$ mol/L | 83C017 |
| 19.19.22. $4,N,N$-Trimethylaniline | | MeOH | | 25 | 3.3 × 10$^9$ | SL/LUM/SPC; $\tau_0 = 1.4$ μs; $\Delta G^{\ddagger} = 19$ kJ/mol; RT | 83E623 |
| **19.20. Ru[4,7-(PhSO$_3$)$_2$phen]$_3$$^{4-}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.20.1. O$_2$ | | MeOH | | | 1.9 × 10$^9$ | SS/LUM; $\tau_0 = 5.5$ μs (LP/LUM/AVE); ET | 777221 |
| **19.21. Ru(4,7-Ph$_2$phen)$_3$$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.21.1. Fe(CN)$_6$$^{3-}$ | | H$_2$O | | | 1.5 × 10$^{10}$ | SL/LUM/SPC; $\tau_0$$^{air}$ = 0.91 μs; [Q] ≤ 2 × 10$^{-4}$ mol/L; some SQ | 85R098 |
| Fe(CN)$_6$$^{4-}$ | | H$_2$O/Me$_2$SO$_4$ (9/1) | 0.0045 mol/L TRbuf; 0.045 mol/L NaCl; pH 7.2 | | 3.0 × 10$^9$ | SL/LUM/SPC; $\tau_0$$^{air}$ = 0.93 μs; [Q] ≤ 6 × 10$^{-4}$ mol/L; some SQ | 85R098 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.21.** | **$Ru(4,7\text{-}Ph_2phen)_3^{2+}$—Continued** | | | | | | |
| 19.21.2. | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.01 mol/L SLS | | $9.5 \times 10^5$ | LP/LUM/AVE; $\tau_0 = 5.8$ μs; OT | 84N034 |
| | $HgCl_2$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS | | $8.0 \times 10^5$ | LP/LUM/AVE; $\tau_0 = 5.8$ μs; OT | 84N034 |
| 19.21.3. | $O_2$ | MeOH | | | $2.5 \times 10^9$ | SS/LUM; $\tau_0 = 5.3$ μs (LP/LUM/AVE); ET | 777221 |
| *Organic Quenchers* | | | | | | | |
| 19.21.4. | $N,N'$-Dibutyl-vio$^{2+}$ | AN | $\mu = 0$ (calc'd) | | $1.6 \times 10^8$ | LP/LUM/SST; OT | 83N153 |
| 19.21.5. | $N,N'$-Diethyl-vio$^{2+}$ | AN | $\mu = 0$ (calc'd) | | $1.5 \times 10^8$ | LP/LUM/SST; OT | 83N153 |
| **19.22.** | **$Ru(5\text{-}Phphen)_3^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.22.1. | $Cu^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $5.7 \times 10^7$ | SS/LUM; $\tau_0 = 1.3$ μs (766404); OT; $f = 0.51$ | 78A090 |
| 19.22.2. | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.3$ μs (LP/LUM/AVE); OT | 766404 |
| 19.22.3. | $O_2$ | $H_2O$ | | 25 | $4.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.3$ μs (LP/LUM/AVE); OT? | 766404 |
| **19.23.** | **$Ru[4,4'\text{-}(SO_3)_2bpy]_3^{4-}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.23.1. | $Cu^{2+}$ | $D_2O$ | $\mu = 0.2$ ($NaClO_4$) | 25 | $1.6 \times 10^8$ | SL/LUM/SPC; $\tau_0 = 0.99$ μs; OT | 85E617 |
| | $Cu^{2+}$ | $H_2O$ | pH 5-6; $\mu = 0.2$ ($NaClO_4$) | 25 | $1.9 \times 10^8$ | SL/LUM/SPC; $\tau_0 = 0.48$ μs; OT; [Q] $\leq 0.025$ mol/L | 85E617 |
| | $Cu^{2+}$ | $H_2O$ | 0.25 mol/L $H_2SO_4$; $\mu = 0.95$ | 25 | $7.5 \times 10^7$ | SL/LUM/SPC; OT | 85E617 |
| *Organic Quenchers* | | | | | | | |
| 19.23.2. | $MV^{2+}$ | $H_2O$ | $\mu = 0$ (calc'd, $Na_2SO_4$) | 25 | $2.3 \times 10^{10}$ | SL/LUM/SPC; $\tau_0 = 0.48$ μs; OT | 85E617 |
| **19.24.** | **$Ru(2,2'\text{-}bipyrazine)_3^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.24.1. | $Cl^-$ | AN | | | $1.6 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.84$ μs; RT? | 86A134 |
| 19.24.2. | $Co(NH_3)_6^{3+}$ | $H_2O$ | $\mu = 1.0$ (KCl) | 20 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.92$ μs (LP/LUM/AVE); OT | 85E218 |
| 19.24.3. | $Co(NH_3)_5Cl^{2+}$ | $H_2O$ | $\mu = 1.0$ (KCl) | 20 | $5.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.92$ μs (LP/LUM/AVE); OT | 85E218 |

| No. | Quencher | Solvent | Solution Medium | T/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.24.** | **Ru(2,2'-bipyrazine)$_3^{2+}$—Continued** | | | | | | |
| 19.24.4. | Cu$^{2+}$ | H$_2$O | $\mu$ = 1.0 (KCl) | 20 | 5 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); OT | 85E218 |
| | Cu$^{2+}$ | H$_2$O | 2 mol/L H$_2$SO$_4$ | 20 | 5 × 10$^8$ | SS/LUM; $\tau_0$ = 50 ns (LP/LUM/AVE); ET; S* monoprotonated | 85E218 |
| | Cu$^{2+}$ | H$_2$SO$_4$ (98%) | | 20 | 3 × 10$^7$ | SS/LUM; $\tau_0$ = 0.52 $\mu$s (LP/LUM/AVE); S* hexaprotonated | 85E218 |
| 19.24.5. | Fe$^{2+}$ | H$_2$O | $\mu$ = 1.0 (KCl) | 20 | 6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); RT | 85E218 |
| | Fe$^{2+}$ | H$_2$O | 2 mol/L H$_2$SO$_4$ | 20 | 7 × 10$^8$ | SS/LUM; $\tau_0$ = 50 ns (LP/LUM/AVE); RT; S* monoprotonated | 85E218 |
| | Fe$^{2+}$ | H$_2$SO$_4$ (98%) | | 20 | 1.1 × 10$^8$ | SS/LUM; $\tau_0$ = 0.52 $\mu$s (LP/LUM/AVE); S* hexaprotonated | 85E218 |
| 19.24.6. | Fe$^{3+}$ | H$_2$O | $\mu$ = 1.0 (KCl) | 20 | 1.1 × 10$^{10}$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); OT | 85E218 |
| | Fe$^{3+}$ | H$_2$O | 2 mol/L H$_2$SO$_4$ | 20 | 1 × 10$^8$ | SS/LUM; $\tau_0$ = 50 ns (LP/LUM/AVE); OT; S* monoprotonated | 85E218 |
| | Fe$^{3+}$ | H$_2$SO$_4$ (98%) | | 20 | 1 × 10$^7$ | SS/LUM; $\tau_0$ = 0.52 $\mu$s (LP/LUM/AVE); S* hexaprotonated | 85E218 |
| 19.24.7. | Fe(CN)$_6^{3-}$ | H$_2$O | $\mu$ = 1.0 (KCl) | 20 | 5.6 × 10$^9$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); OT | 85E218 |
| | Fe(CN)$_6^{3-}$ | H$_2$O | 2 mol/L H$_2$SO$_4$ | 20 | 4.1 × 10$^{10}$ | SS/LUM; $\tau_0$ = 50 ns (LP/LUM/AVE); S* monoprotonated | 85E218 |
| 19.24.8. | Fe(CN)$_6^{4-}$ | H$_2$O | $\mu$ = 1.0 (KCl) | 20 | 1.0 × 10$^{10}$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); RT | 85E218 |
| | Fe(CN)$_6^{4-}$ | H$_2$O | 2 mol/L H$_2$SO$_4$ | 20 | 5.3 × 10$^9$ | SS/LUM; $\tau_0$ = 50 ns (LP/LUM/AVE); S* monoprotonated | 85E218 |
| 19.24.9. | I$^-$ | H$_2$O | $\mu$ = 1.0 (KCl) | 20 | 7.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); RT | 85E218 |
| *Organic Quenchers* | | | | | | | |
| 19.24.10. | Aniline | AN | $\mu$ = 0.1 (TBAP) | 22 | 5.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.74 $\mu$s (LP/LUM/AVE); RT | 85E218 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.24.** | **$Ru(2,2'$-bipyrazine$)_3^{2+}$—Continued** | | | | | | |
| 19.24.11. | 1,4-B.s($N$-phenylamino)benzene | AN | $\mu = 0.1$ (TBAP) | 22 | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.12. | 1,2-Dimethoxybenzene | AN | $\mu = 0.1$ (TBAP) | 22 | $1.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.13. | 1,4-Dimethoxybenzene | AN | $\mu = 0.1$ (TBAP) | 22 | $8.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.14. | $N,N$-Dimethylaniline | AN | $\mu = 0.1$ (TBAP) | 22 | $8.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.15. | Diphenylamine | AN | $\mu = 0.1$ (TBAP) | 22 | $5.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.16. | EDTA | $H_2O$ | 0.05 mol/L PHTHbuf; pH 5 | | $3.9 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.75$ μs; RT; [Q] = 0.002-0.02 mol/L | 85A431 |
| | EDTA | $H_2O$ | 0.1 mol/L PHTHbuf; pH 5 | | $3.9 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.75$ μs; RT; [Q] ≤ 0.01 mol/L | 83N178 |
| | EDTA | $H_2O$ | pH 8.7; $\mu = 1.0$ ($Na_2SO_4$) | | $6.9 \times 10^8$ | SS/LUM, LP/LUM/AVE; $\tau_0^{air} = 0.60$ μs; RT; $f = $ ~0.7 (85F311); [Q] = (1-1000) $\times 10^{-4}$ mol/L | 86A120 |
| | EDTA | $H_2O$ | pH 11.0; $\mu = 1.0$ ($Na_2SO_4$) | | $7.7 \times 10^8$ | SS/LUM, LP/LUM/AVE; $\tau_0^{air} = 0.60$ μs; RT; $f = $ ~0.7 (85F311); [Q] = (1-1000) $\times 10^{-4}$ mol/L | 86A120 |
| 19.24.17. | $MV^{2+}$ | $H_2O$ | 0.5 mol/L KCl | 25 | $8.6 \times 10^6$ | SS/LUM; $\tau_0 = 1.0$ μs (83E209); OT | 83F371 |
| 19.24.18. | Phenothiazine | AN | $\mu = 0.1$ (TBAP) | 22 | $7.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.19. | Triethanolamine | $H_2O$ | 0.5 mol/L KCl | 25 | $2.5 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (83E209); RT | 83F371 |
| 19.24.20. | 1,2,3-Trimethoxybenzene | AN | $\mu = 0.1$ (TBAP) | 22 | $6.5 \times 10^7$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.21. | 1,2,4-Trimethoxybenzene | AN | $\mu = 0.1$ (TBAP) | 22 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.22. | 1,3,5-Trimethoxybenzene | AN | $\mu = 0.1$ (TBAP) | 22 | $2.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.23. | 4,$N,N$-Trimethylaniline | AN | $\mu = 0.1$ (TBAP) | 22 | $8.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |
| 19.24.24. | Triphenylamine | AN | $\mu = 0.1$ (TBAP) | 22 | $6.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.74$ μs (LP/LUM/AVE); RT | 85E218 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------|----------|------|
| **19.25. $Ru(3,3'\text{-bipyridazine})_3^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.25.1. | $MV^{2+}$ | $H_2O$ | | 25 | $7.6 \times 10^7$ | EMI; $\tau_0 = 0.70$ μs | 83E209 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L KCl | 25 | $7.6 \times 10^7$ | SS/LUM; $\tau_0 = 0.70$ μs (83E209); OT | 83F371 |
| | $MV^{2+}$ | $H_2O$ | 0.05 mol/L PHTHbuf; pH 5 | | $4.8 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.58$ μs; OT; [Q] = 0.002-0.02 mol/L | 85A431 |
| 19.25.2. | Triethanolamine | $H_2O$ | | 25 | $1.3 \times 10^6$ | EMI; $\tau_0 = 0.70$ μs | 83E209 |
| | Triethanolamine | $H_2O$ | 0.5 mol/L KCl | 25 | $1.3 \times 10^6$ | SS/LUM; $\tau_0 = 0.70$ μs (83E209); RT | 83F371 |
| **19.26. $Ru(2,2'\text{-bipyrimidine})_3^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.26.1. | $O_2$ | AN | | | $5.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 67$ ns; $p_Q = (2, 10) \times 10^4$ Pa | 86B098 |
| | $O_2$ | $H_2O$ | | | $\sim 1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 83$ ns; $p_Q = (2, 10) \times 10^4$ Pa | 86B098 |
| | $O_2$ | MeOH | | | $4.5 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.10$ μs; $p_Q = (2, 10) \times 10^4$ Pa | 86B098 |
| *Organic Quenchers* | | | | | | | |
| 19.26.2. | Triethanolamine | $H_2O$ | 0.5 mol/L KCl | 25 | $3.6 \times 10^7$ | SS/LUM; $\tau_0 = 60$ ns (83E209); RT | 83F371 |
| **19.27. $Ru^{II}[1,2\text{-bis(phenylthio)ethane}]_2Cl(\mu\text{-vio})Ru^{II}(bpy)_2Cl^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.27.1. | $N$-Methyl-4-carbamyl-py$^+$ | AN/$CH_2Cl_2$ (1.5/1) | | −23 | $2.7 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.10$ μs; OT | 85F051 |
| **19.28. $Ru^{II}[1,2\text{-bis(phenylthio)ethane}]_2Cl(\mu\text{-vio})Ru^{III}(bpy)_2Cl^{3+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.28.1. | $N$-Methyl-4-carbamyl-py$^+$ | AN/$CH_2Cl_2$ (1.5/1) | | −23 | $2.4 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.10$ μs; OT; [Q] ≤ 0.018 mol/L | 85F051 |
| **19.29. $Ru(bpy)_2[(BUG)_2bpy]^{n+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.29.1. | $MV^{2+}$ | $H_2O$ | $\mu = 0.06$ (NaCl) | ~24 | $2.6 \times 10^8$ | LP/LUM/AVE, SS/LUM; $\tau_0 = 0.53$ μs; OT; [Q] = 0.005-0.020 mol/L | 85A387 |
| | $MV^{2+}$ | $H_2O$ | $\mu = 0.15$ (NaCl) | ~24 | $6.1 \times 10^8$ | LP/LUM/AVE, SS/LUM; $\tau_0 = 0.53$ μs; OT; [Q] = 0.005-0.020 mol/L | 85A387 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.29.** | **$Ru(bpy)_2[(BUG)_2bpy]^{n+}$—Continued** | | | | | | |
| | $MV^{2+}$ | $H_2O$ | $\mu = 0.30$ (NaCl) | ~24 | $8.8 \times 10^8$ | LP/LUM/AVE, SS/LUM; $\tau_0$ = 0.53 μs; OT; [Q] = 0.005-0.020 mol/L | 85A387 |
| | $MV^{2+}$ | $H_2O$ | $\mu = 0.60$ (NaCl) | ~24 | $1.2 \times 10^9$ | LP/LUM/AVE, SS/LUM; $\tau_0$ = 0.53 μs; OT; [Q] = 0.005-0.020 mol/L | 85A387 |
| **19.30.** | **$cis$-$Ru(bpy)_2(CN)_2$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 19.30.1. | $Co^{2+}$ | $H_2O$ | | ~21 | $6.4 \times 10^6$ | FP/LUM/SST; $\tau_0$ = 0.27 μs; ET; some SQ | 776220 |
| 19.30.2. | $Co(acac)_2$ | MeOH | | ~21 | $4.3 \times 10^7$ | SS/LUM; $\tau_0$ = 0.40 μs (FP/LUM/SST); ET | 776220 |
| 19.30.3. | $Co(acac)_3$ | MeOH | | ~21 | $8.2 \times 10^8$ | SS/LUM; $\tau_0$ = 0.40 μs (FP/LUM/SST) | 776220 |
| 19.30.4. | $Co(CN)_6^{3-}$ | $H_2O$ | | ~21 | $1.6 \times 10^6$ | SS/LUM; $\tau_0$ = 0.27 μs (FP/LUM/SST) | 776220 |
| 19.30.5. | $Co(C_2O_4)_3^{3-}$ | $H_2O$ | | ~21 | $3.0 \times 10^6$ | SS/LUM; $\tau_0$ = 0.27 μs (FP/LUM/SST); OT | 776220 |
| 19.30.6. | $Co(NH_3)_6^{3+}$ | $H_2O$ | | ~21 | $1.4 \times 10^6$ | SS/LUM; $\tau_0$ = 0.27 μs (FP/LUM/SST); OT | 776220 |
| 19.30.7. | $Co(NH_3)_5Cl^{2+}$ | $H_2O$ | | ~21 | $3.4 \times 10^6$ | SS/LUM; $\tau_0$ = 0.27 μs (FP/LUM/SST); OT | 776220 |
| 19.30.8. | $Cr^{3+}$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $1.4 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.9. | $Cr(acac)_3$ | MeOH | | ~21 | $4.4 \times 10^8$ | SS/LUM; $\tau_0$ = 0.40 μs (FP/LUM/SST); ET | 776220 |
| 19.30.10. | $Cr(CN)_6^{3-}$ | $H_2O$ | | ~21 | $3.0 \times 10^8$ | SS/LUM; $\tau_0$ = 0.27 μs (FP/LUM/SST); ET | 776220 |
| 19.30.11. | $Cr(C_2O_4)_3^{3-}$ | $H_2O$ | | ~21 | $1.9 \times 10^8$ | SS/LUM; $\tau_0$ = 0.27 μs (FP/LUM/SST); ET | 776220 |
| 19.30.12. | $trans$-$Cr(cyclam)(CN)_2^+$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $1.8 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.13. | $trans$-$Cr(diethylenetriamine)_2^{3+}$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $1.9 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.14. | $Cr(en)_3^{3+}$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $7.5 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.30.** | **$cis$-Ru(bpy)$_2$(CN)$_2$—Continued** | | | | | | |
| 19.30.15. | $trans$-Cr(en)$_2$Br$_2^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $1.1 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET; [Q] = 0.001-0.004 mol/L | 84E372 |
| 19.30.16. | $cis$-Cr(en)$_2$Cl$_2^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $5.1 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET | 84E372 |
| | $cis$-Cr(en)$_2$Cl$_2^+$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $2.1 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.17. | $trans$-Cr(en)$_2$Cl$_2^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $8.2 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET; [Q] = 0.001-0.009 mol/L | 84E372 |
| | $trans$-Cr(en)$_2$Cl$_2^+$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $3.6 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.18. | $trans$-Cr(en)$_2$F$_2^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $9.0 \times 10^7$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET; [Q] = 0.005-0.01 mol/L | 84E372 |
| 19.30.19. | $cis$-Cr(en)$_2$(NCS)$_2^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $1.2 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET | 84E372 |
| 19.30.20. | $trans$-Cr(en)$_2$(NCS)$_2^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $9.1 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET; [Q] = 0.001-0.006 mol/L | 84E372 |
| 19.30.21. | $cis$-Cr(en)$_2$(NCS)Cl$^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $7.0 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET | 84E372 |
| 19.30.22. | $trans$-Cr(en)$_2$(NCS)Cl$^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $8.0 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET; [Q] = 0.001-0.008 mol/L | 84E372 |
| 19.30.23. | $trans$-Cr(en)$_2$(ONO)Cl$^+$ | H$_2$O | 0.1 mol/L KCl | 11 | $5.3 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.30 $\mu$s; ET; [Q] = 0.002-0.009 mol/L | 84E372 |
| 19.30.24. | Cr(NH$_3$)$_6^{3+}$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $6.1 \times 10^7$ (corr) | LP/LUM/SST; ET; [Q] $\leq$ 0.020 mol/L | 86E096 |
| 19.30.25. | Cr(NH$_3$)$_5$Br$^{2+}$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $2.1 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.26. | Cr(NH$_3$)$_5$(CN)$^{2+}$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $1.1 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.27. | Cr(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $1.9 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.28. | Cr(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.001 mol/L CF$_3$SO$_3$H | 15 | $6.8 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |

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TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.30.** | **$cis$-Ru(bpy)$_2$(CN)$_2$—Continued** | | | | | | |
| 19.30.29. | $Cr(NH_3)_5(N_3)^{2+}$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $2.3 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.30. | $trans$-$Cr(NH_3)_2(NCS)_4^-$ | $H_2O$ | | ~21 | $1.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.27$ μs (FP/LUM/SST); ET | 776220 |
| 19.30.31. | $Cr(NH_3)_5(NCS)^{2+}$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $3.8 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.32. | $Cr[trans$-$(R)$- cyclohexanediamine]$_3^{3+}$ | $H_2O$ | 0.001 mol/L $CF_3SO_3H$ | 15 | $9.9 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 19.30.33. | $Cu^{2+}$ | $H_2O$ | | ~21 | $3.9 \times 10^8$ | FP/LUM/SST; $\tau_0 = 0.27$ μs; OT, ET; some SQ | 776220 |
| 19.30.34. | $Cu(acac)_2$ | MeOH | | ~21 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.40$ μs (FP/LUM/SST); OT, ET | 776220 |
| 19.30.35. | $Fe(CN)_6^{3-}$ | $H_2O$ | | ~21 | $6.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.27$ μs (FP/LUM/SST); OT | 776220 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | pH 7 | ~24 | $7.2 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.25$ μs; OT; $f = <0.1$; [Q] = 3 $\times$ 10$^{-4}$ mol/L | 80A133 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | 0.0018 mol/L polybrene; pH 7 | ~24 | $1.9 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.25$ μs; OT; $f = 0.9$; [Q] = 3 $\times$ 10$^{-4}$ mol/L | 80A133 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | 0.0023 mol/L polybrene; pH 7 | ~24 | $2.4 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.25$ μs; OT; $f = 0.9$; [Q] = 3 $\times$ 10$^{-4}$ mol/L | 80A133 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | 0.0030 mol/L polybrene; pH 7 | ~24 | $2.8 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.25$ μs; OT; $f = 0.9$; [Q] = 3 $\times$ 10$^{-4}$ mol/L | 80A133 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | 0.0045 - 0.063 mol/L polybrene; pH 7 | ~24 | $3.9 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.25$ μs; OT; $f = 0.9$; [Q] = 3 $\times$ 10$^{-4}$ mol/L | 80A133 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | 0.013 mol/L polybrene; pH 2.1-12.2 ($HClO_4$ or NaOH) | ~24 | $4.2 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.25$ μs; OT; $f = 0.9$; [Q] = 3 $\times$ 10$^{-4}$ mol/L | 80A133 |
| 19.30.36. | $Fe(CN)_6^{4-}$ | $H_2O$ | | ~21 | $6.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.27$ μs (FP/LUM/SST); ET, RT | 776220 |
| 19.30.37. | $I^-$ | $H_2O$ | | ~21 | $1.5 \times 10^5$ | SS/LUM; $\tau_0 = 0.27$ μs (FP/LUM/SST) | 776220 |
| 19.30.38. | $Ni^{2+}$ | $H_2O$ | | ~21 | $9 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.27$ μs; ET; some SQ | 776220 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.30.** | *cis*-Ru(bpy)$_2$(CN)$_2$—Continued | | | | | | |
| 19.30.39. | Ni(acac)$_2$ | MeOH | | ~21 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.40$ μs (FP/LUM/SST) | 776220 |
| 19.30.40. | NiCl$_4^{2-}$ | H$_2$O | | ~21 | $4.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.27$ μs (FP/LUM/SST) | 776220 |
| 19.30.41. | O$_2$ | H$_2$O | | ~21 | $4.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.26$ μs (LP/LUM/SST); ET | 737658 |
| | O$_2$ | MeOH | | | $5.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.40$ μs (LP/LUM/AVE); ET; $k_q = 4.5 \times 10^9$ L mol$^{-1}$ s$^{-1}$ at ~21 °C with SS/LUM and $\tau_0 = 0.42$ μs from same lab in 737658 | 777221 |
| 19.30.42. | PtCl$_4^{2-}$ | H$_2$O | | ~21 | $6.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.27$ μs (FP/LUM/SST); ET | 776220 |
| *Organic Quenchers* | | | | | | | |
| 19.30.43. | 9,10-Anthraquinone-2,6-disulfonate ion | H$_2$O | pH 4.2 (HAc) | | $7.1 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.2$ μs (assumed); OT; [Q] = (3-25) $\times 10^{-4}$ mol/L | 82N119 |
| | 9,10-Anthraquinone-2,6-disulfonate ion | H$_2$O | 2% w/w colloidal ZrO$_2$; pH 4.2 (HAc) | | $3.9 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.2$ μs (assumed); OT; [Q] = (3-25) $\times 10^{-4}$ mol/L; Q adsorbed | 82N119 |
| 19.30.44. | $N,N'$-Bis(poly-2,4-ionene)-(vio$^{2+}$) polycation | H$_2$O | pH 5-7 | | $2.5 \times 10^9$ | LP/LUM/AVE; OT; $f = 0.09$; [Q] = 0.001 mol/L | 85B030 |
| 19.30.45. | $N$-Methyl-$N'$-(poly-2,4-ionene)-(vio$^{2-}$) polycation | H$_2$O | pH 5-7 | | $2.8 \times 10^9$ | LP/LUM/AVE; OT; $f = 0.08$; [Q] = 0.001 mol/L | 85B030 |
| 19.30.46. | MV$^{2+}$ | AN | 0.1 mol/L TBAP | | $9.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.34$ μs (FP/LUM/SST); OT | 767009 |
| | MV$^{2+}$ | H$_2$O | $\mu = 0.024$ (NaCl) | ~23 | $5.3 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.19$ μs; OT; [Q] ≤ 0.008 mol/L | 79F442 |
| | MV$^{2+}$ | H$_2$O | $\mu = 0.52$ (NaCl) | ~23 | $5.3 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.20$ μs; OT; [Q] ≤ 0.024 mol/L | 79F442 |
| | MV$^{2+}$ | H$_2$O | pH 5-7 | | $4.1 \times 10^9$ | LP/LUM/AVE; OT; $f = 0.09$ | 85B030 |
| 19.30.47. | PolyVio10 | H$_2$O | pH 5-7 | | $1.1 \times 10^9$ | LP/LUM/AVE; OT; $f = 0.10$; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| 19.30.48. | PolyVio11 | H$_2$O | pH 5-7 | | $1.1 \times 10^9$ | LP/LUM/AVE; OT; $f = 0.13$; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L $mol^{-1}$ $s^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **19.30.** $cis$-$Ru(bpy)_2(CN)_2$—Continued | | | | | | | |
| 19.30.49. PolyVio12 | | $H_2O$ | pH 5-7 | | $2.2 \times 10^9$ | LP/LUM/AVE; OT; $f =$ 0.07; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| 19.30.50. PolyVio13 | | $H_2O$ | pH 5-7 | | $1.6 \times 10^9$ | LP/LUM/AVE; OT; $f =$ 0.11; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| **19.31.** $Ru(bpy)_2[4,4'-(COOH)_2bpy]^{2+}$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.31.1. $Cu^{2+}$ | | $H_2O$ | pH 1.5 | | $8.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.21$ μs (SL/LUM/SPC); OT | 85E075 |
| *Organic Quenchers* | | | | | | | |
| 19.31.2. $MV^{2+}$ | | $H_2O$ | 0.1 mol/L HCl; μ = 0.137 (NaCl) | ~23 | $6.1 \times 10^8$ | LP/LUM/SST; $\tau_0^{air} = 0.23$ μs; OT; [Q] ≤ 0.024 mol/L | 79F442 |
| $MV^{2+}$ | | $H_2O$ | 0.1 mol/L HCl; μ = 0.62 (NaCl) | ~23 | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.22$ μs; OT; [Q] ≤ 0.024 mol/L | 79F442 |
| **19.32.** $Ru(bpy)_2[4,4'-(COO)_2bpy]$ | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.32.1. $Cu^{2+}$ | | $H_2O$ | pH 4.3 | | $1.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.46$ μs (SL/LUM/SPC); OT; partial protonation of one $COO^-$ group in S* | 85E075 |
| *Organic Quenchers* | | | | | | | |
| 19.32.2. $MV^{2+}$ | | $H_2O$ | μ = 0.029 (NaCl) | ~23 | $2.5 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.40$ μs; OT; [Q] ≤ 0.01 mol/L | 79F442 |
| $MV^{2+}$ | | $H_2O$ | μ = 0.53 (NaCl) | ~23 | $1.9 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.39$ μs; OT; [Q] ≤ 0.024 mol/L | 79F442 |
| $MV^{2+}$ | | $H_2O$ | μ = 0 (calc'd, $Na_2SO_4$) | 25 | $1.9 \times 10^9$ | SL/LUM/SPC; $\tau_0 = 0.51$ μs; OT | 85E617 |
| **19.33.** $Ru(bpy)[4,4'-(COOchl)_2bpy]_2^{2+}$ | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.33.1. $N,N$-Dimethylaniline | | AN | 0.1 mol/L TEAP | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 2.1$ μs; RT; $\tau$ in BuN | 77F920 |
| $N,N$-Dimethylaniline | | AN/BuN (3/1) | | | $2.1 \times 10^9$ | EMI; $\tau_0 = 2.1$ μs (SL/LUM/SPC); RT | 776441 |
| 19.33.2. 1,2-Dinitrobenzene | | AN | 0.1 mol/L TEAP | 25 | $2.8 \times 10^6$ | SS/LUM; $\tau_0 = 2.1$ μs; OT; $\tau$ in BuN | 77F920 |
| 19.33.3. 1,4-Dinitrobenzene | | AN | 0.1 mol/L TEAP | 25 | $8.3 \times 10^7$ | SS/LUM; $\tau_0 = 2.1$ μs; OT; $\tau$ in BuN | 77F920 |

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L $mol^{-1}$ $s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.33. Ru(bpy)[4,4'-(COOchl)$_2$bpy]$_2^{2+}$**—Continued | | | | | | | |
| 19.33.4. MV$^{2+}$ | | AN/BuN (3/1) | | | $3.6 \times 10^7$ | EMI; $\tau_0$ = 2.1 μs (SL/LUM/SPC); OT | 776441 |
| | MV$^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $3.6 \times 10^7$ | SS/LUM; $\tau_0$ = 2.1 μs; OT; τ in BuN | 77F920 |
| 19.33.5. Tetracyanoethene | | AN | 0.1 mol/L TEAP | 25 | $4.6 \times 10^9$ | SS/LUM; $\tau_0$ = 2.1 μs; OT; τ in BuN | 77F920 |
| **19.34. Ru(bpy)$_2$[4,4'-(COOchl)$_2$bpy]$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.34.1. *N,N*-Dimethylaniline | | AN | 0.1 mol/L TEAP | 25 | $3.7 \times 10^8$ | SS/LUM; $\tau_0$ = 2.0 μs; RT; τ in BuN | 77F920 |
| | *N,N*-Dimethylaniline | AN/BuN (3/1) | | | $3.7 \times 10^8$ | EMI; $\tau_0$ = 2.0 μs (SL/LUM/SPC); RT | 776441 |
| 19.34.2. 1,2-Dinitrobenzene | | AN | 0.1 mol/L TEAP | 25 | $4.8 \times 10^6$ | SS/LUM; $\tau_0$ = 2.0 μs; OT; τ in BuN | 77F920 |
| 19.34.3. 1,4-Dinitrobenzene | | AN | 0.1 mol/L TEAP | 25 | $1.3 \times 10^8$ | SS/LUM; $\tau_0$ = 2.0 μs; OT; τ in BuN | 77F920 |
| 19.34.4. MV$^{2+}$ | | AN/BuN (3/1) | | | $3.5 \times 10^7$ | EMI; $\tau_0$ = 2.0 μs (SL/LUM/SPC); OT | 776441 |
| | MV$^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $3.5 \times 10^7$ | SS/LUM; $\tau_0$ = 2.0 μs; OT; τ in BuN | 77F920 |
| 19.34.5. Tetracyanoethene | | AN | 0.1 mol/L TEAP | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0$ = 2.0 μs; OT; τ in BuN | 77F920 |
| **19.35. Ru(bpy)$_2$[4,4'-(COOet)$_2$bpy]$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.35.1. H$_2$O | | EtOH | | 22 | $9.3 \times 10^4$ | LP/LUM/SST; $\tau_0$ = 1.0 μs; [Q] ≤ 1.8 mol/L; nonlinear S-V plot at higher [Q] | 80S001 |
| *Organic Quenchers* | | | | | | | |
| 19.35.2. *N,N'*-Dibenzyl-vio$^{2+}$ | | EtOH | | 22 | $3.6 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 μs; OT | 80S001 |
| | *N,N'*-Dibenzyl-vio$^{2+}$ | H$_2$O | | 22 | $2.3 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.37 μs; OT | 80S001 |
| 19.35.3. *N,N*-Dimethylaniline | | EtOH | | 22 | $3.7 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 μs; RT | 80S001 |
| 19.35.4. MV$^{2+}$ | | EtOH | | 22 | $2.9 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 μs; OT | 80S001 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.35. Ru(bpy)$_2$[4,4′-(COOet)$_2$bpy]$^{2+}$**—Continued | | | | | | | |
| | MV$^{2+}$ | H$_2$O | | 22 | 1.3 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.37 μs; OT; [Q] ≤ 0.02 mol/L | 80S001 |
| **19.36. Ru(bpy)$_2$(4,4′-Cl$_2$bpy)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.36.1. | Eu(crypt)$^{3+}$ | H$_2$O | 1 mol/L KCl | ~22 | 5.6 × 10$^6$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| **19.37. Ru(bpy)$_2$(Do$_2$Ca$_2$bpy)$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.37.1. | N-Butylphenothiazine | AN | | 25 | 5.9 × 10$^9$ | SS/LUM; $\tau_0$ = 0.57 μs; RT; [Q] = (1-10) × 10$^{-5}$ mol/L | 80N169 |
| 19.37.2. | Nitrilotriacetate ion | H$_2$O/MeOH (1/1) | | | 3 × 10$^8$ | SS/LUM; RT | 80N125 |
| **19.38. Ru(bpy)(3,3′-Me$_2$bpy)$_2$$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.38.1. | Eu(crypt)$^{3+}$ | H$_2$O | 1 mol/L KCl | ~22 | 7.1 × 10$^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| **19.39. Ru(bpy)$_2$(3,3′-Me$_2$bpy)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.39.1. | Eu(crypt)$^{3+}$ | H$_2$O | 1 mol/L KCl | ~22 | 3.3 × 10$^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| **19.40. Ru(bpy)$_2$(4,4′-Me$_2$bpy)$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.40.1. | MV$^{2+}$ | H$_2$O | μ = 0.023 (NaCl) | ~23 | 6.7 × 10$^8$ | LP/LUM/SST; $\tau_0^{air}$ = 0.33 μs; OT; [Q] ≤ 0.008 mol/L | 79F442 |
| | MV$^{2+}$ | H$_2$O | μ = 0.52 (NaCl) | ~23 | 2.0 × 10$^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.34 μs; OT; [Q] ≤ 0.024 mol/L | 79F442 |
| **19.41. Ru(bpy)(Me$_2$dibenzoH$_2$phen)$_2$$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.41.1. | Ru(Me$_2$dibenzoH$_2$phen)$_3$$^{2+}$ | AN | μ = 0.02 (KPF$_6$) | ~20 | 5.5 × 10$^7$ | LP/LUM/SST; $\tau_0^{air}$ = 0.24 μs; ET | 84E462 |
| **19.42. Ru(bpy)$_2$(Me$_2$dibenzoH$_2$phen)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.42.1. | Eu(crypt)$^{2+}$ | H$_2$O | 1 mol/L KCl | ~22 | 1.0 × 10$^9$ | SL/LUM/SST; RT; [Q] = 0.001-0.01 mol/L | 86E195 |
| 19.42.2. | Ru(Me$_2$dibenzoH$_2$phen)$_3$$^{2+}$ | AN | μ = 0.02 (KPF$_6$) | ~20 | 6.6 × 10$^7$ | LP/LUM/SST; $\tau_0^{air}$ = 0.20 μs; ET | 84E462 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.42.** | **Ru(bpy)$_2$(Me$_2$dibenzoH$_2$phen)$^{2+}$**—Continued | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.42.3. | $N$-(4-Aminophenyl)aniline | AN | $\mu = 2 \times 10^{-4}$ | | $7.1 \times 10^9$ | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| 19.42.4. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | $\mu = 2 \times 10^{-4}$ | | $1.3 \times 10^{10}$. | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| 19.42.5. | 1,4-Bis($N$-phenylamino)benzene | AN | $\mu = 2 \times 10^{-4}$ | | $6.6 \times 10^9$ | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| 19.42.6. | $N,N$-Dimethylaniline | AN | $\mu = 2 \times 10^{-4}$ | | $4.1 \times 10^7$ | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| 19.42.7. | MV$^{2+}$ | H$_2$O | $\mu = 0.5$ | | $9.6 \times 10^8$ | SL/LUM/SPC?; $\tau_0^{air} = 0.14$ $\mu$s; OT | 81E512 |
| 19.42.8. | Phenothiazine | AN | $\mu = 2 \times 10^{-4}$ | | $4.2 \times 10^9$ | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| 19.42.9. | 4,$N,N$-Trimethylaniline | AN | $\mu = 2 \times 10^{-4}$ | | $8.8 \times 10^8$ | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| 19.42.10. | Triphenylamine | AN | $\mu = 2 \times 10^{-4}$ | | $4.8 \times 10^6$ | LF/LUM/SST; $\tau_0^{air} = 0.20$ $\mu$s; RT | 85A248 |
| **19.43.** | **Ru(bpy)$_2$[5-(NH$_2$)phen]$^{2+}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.43.1. | PolyPTZ | CH$_2$Cl$_2$ | 0.1 mol/L TBAF | | $1.2 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.2$ $\mu$s; RT; [Q] based on phenothiazine units | 86A052 |
| **19.44.** | **Ru(bpy)$_2$[4-(NO$_2$)bpy]$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.44.1. | Eu(crypt)$^{2+}$ | H$_2$O | 1 mol/L KCl | ~22 | $2.3 \times 10^9$ | SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L | 86E195 |
| 19.44.2. | Eu(crypt)$^{3+}$ | H$_2$O | 1 mol/L KCl | ~22 | $2.1 \times 10^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| *Organic Quenchers* | | | | | | | |
| 19.44.3. | MV$^{2+}$ | H$_2$O/AN (20/1) | $\mu = 0.5$ | 20 | $1.1 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.32$ $\mu$s (SL/LUM/SPC); OT | 82S159 |
| **19.45.** | **Ru(bpy)[4,4'-(SO$_3$)$_2$bpy]$_2$$^{2-}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.45.1. | MV$^{2+}$ | H$_2$O | $\mu = 0$ (calc'd, Na$_2$SO$_4$) | 25 | $1.6 \times 10^{10}$ | SL/LUM/SPC; $\tau_0 = 0.46$ $\mu$s; OT | 85E617 |

TABLE 19. Quenching of excited ruthenium complexes (except Ru(bpy)$_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.46. Ru(bpy)$_2$(acetylacetonato)$^+$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.46.1. | 1,4-Benzoquinone | AN | | 25 | $2.3 \times 10^{10}$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.2. | α-Bromo-4-nitrotoluene | AN | | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.3. | 1,2-Dimethyl-3-nitrobenzene | AN | | 25 | $9.7 \times 10^6$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.4. | 1,2-Dinitrobenzene | AN | | 25 | $8.4 \times 10^9$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.5. | 1,3-Dinitrobenzene | AN | | 25 | $9.3 \times 10^9$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.6. | 1,4-Dinitrobenzene | AN | | 25 | $1.4 \times 10^{10}$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.7. | 1-Methoxy-4-nitrobenzene | AN | | 25 | $2.2 \times 10^7$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.8. | 4-Nitrobenzamide | AN | | 25 | $4.0 \times 10^9$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.9. | 3-Nitrotoluene | AN | | 25 | $4.4 \times 10^8$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| 19.46.10. | 4-Nitrotoluene | AN | | 25 | $1.6 \times 10^8$ | SS/LUM; $\tau_0 = 21$ ns (SL/LUM/AVE); OT | 84A504 |
| **19.47. Ru(bpy)$_2$(3,3'-biisoquinoline)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.47.1. | Eu(crypt)$^{2+}$ | H$_2$O | 1 mol/L KCl | ~22 | $1.2 \times 10^9$ | SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L | 86E195 |
| **19.48. Ru(bpy)(3,3'-biisoquinoline)$_2^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.48.1. | Eu(crypt)$^{2+}$ | H$_2$O | 1 mol/L KCl | ~22 | $1.3 \times 10^9$ | SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L | 86E195 |
| **19.49. Ru(bpy)$_2$(2,2'-bipyrimidine)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.49.1. | O$_2$ | AN | | | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 91$ ns; $p_Q = (2, 10) \times 10^4$ Pa | 86B098 |
| | O$_2$ | H$_2$O | | | $\leq 1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 13$ ns; $p_Q = (2, 10) \times 10^4$ Pa | 86B098 |
| | O$_2$ | MeOH | | | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 36$ ns; $p_Q = (2, 10) \times 10^4$ Pa | 86B098 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.50.** | **Ru(bpy)(2,2'-biquinoline)$_2^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.50.1. | Eu(crypt)$^{2+}$ | H$_2$O | 1 mol/L KCl | ~22 | $1.7 \times 10^9$ | SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L | 86E195 |
| 19.50.2. | Ru(2,2'-biquinoline)$_3^{2+}$ | AN | $\mu = 0.02$ (KPF$_6$) | ~20 | $3.4 \times 10^7$ | LP/LUM/SST; $\tau_0^{air} = 0.19$ $\mu$s; ET | 84E462 |
| **19.51.** | **Ru(bpy)$_2$(2,2'-biquinoline)$^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.51.1. | Ru(2,2'-biquinoline)$_3^{2+}$ | AN | $\mu = 0.02$ (KPF$_6$) | ~20 | $5.6 \times 10^7$ | LP/LUM/SST; $\tau_0^{air} = 0.18$ $\mu$s; ET | 84E462 |
| *Organic Quenchers* | | | | | | | |
| 19.51.2. | N-(4-Aminophenyl)aniline | AN | $\mu = 2 \times 10^{-4}$ | | $8.2 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| 19.51.3. | 1,4-Bis(N,N-dimethylamino)benzene | AN | $\mu = 2 \times 10^{-4}$ | | $1.4 \times 10^{10}$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| 19.51.4. | 1,4-Bis(N-phenylamino)benzene | AN | $\mu = 2 \times 10^{-4}$ | | $8.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| 19.51.5. | N,N-Dimethylaniline | AN | $\mu = 2 \times 10^{-4}$ | | $2.4 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| 19.51.6. | MV$^{2+}$ | H$_2$O/AN (20/1) | $\mu = 0.5$ | 20 | $4.0 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.15$ $\mu$s (SL/LUM/SPC); OT | 82S159 |
| 19.51.7. | Phenothiazine | AN | $\mu = 2 \times 10^{-4}$ | | $7.1 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| 19.51.8. | 4,N,N-Trimethylaniline | AN | $\mu = 2 \times 10^{-4}$ | | $2.1 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| 19.51.9. | Triphenylamine | AN | $\mu = 2 \times 10^{-4}$ | | $1 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ $\mu$s; RT | 85A248 |
| **19.52.** | **Ru(bpy)$_2$(en)$^{2+}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.52.1. | 1,4-Benzoquinone | AN | | 25 | $2.4 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.11$ $\mu$s (SL/LUM/AVE); OT | 84A504 |
| 19.52.2. | $\alpha$-Bromo-4-nitrotoluene | AN | | 25 | $3.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.11$ $\mu$s (SL/LUM/AVE); OT | 84A504 |
| 19.52.3. | 1,2-Dimethyl-3-nitrobenzene | AN | | 25 | $1.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.11$ $\mu$s (SL/LUM/AVE); OT | 84A504 |
| 19.52.4. | 1,3-Dimethyl-2-nitrobenzene | AN | | 25 | $6.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.11$ $\mu$s (SL/LUM/AVE); OT | 84A504 |
| 19.52.5. | 1,2-Dinitrobenzene | AN | | 25 | $1.1 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.11$ $\mu$s (SL/LUM/AVE); OT | 84A504 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.52. Ru(bpy)$_2$(en)$^{2+}$**—Continued | | | | | | | |
| 19.52.6. | 1,3-Dinitrobenzene | AN | | 25 | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT | 84A504 |
| 19.52.7. | 1,4-Dinitrobenzene | AN | | 25 | $1.6 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT | 84A504 |
| 19.52.8. | 1-Methoxy-4-nitrobenzene | AN | | 25 | $7.3 \times 10^{8}$ | SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT | 84A504 |
| 19.52.9. | 4-Nitrobenzamide | AN | | 25 | $5.4 \times 10^{9}$ | SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT | 84A504 |
| 19.52.10. | 3-Nitrotoluene | AN | | 25 | $1.6 \times 10^{9}$ | SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT | 84A504 |
| 19.52.11. | 4-Nitrotoluene | AN | | 25 | $1.2 \times 10^{9}$ | SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT | 84A504 |
| **19.53. Ru(bpy)[2-(thiazol-2-yl)pyridine]$_2$$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.53.1. | MV$^{2+}$ | H$_2$O | | | $5.8 \times 10^{8}$ | LP/LUM/SST; $\tau_0 = 0.30$ μs; OT; $f = \sim0.25$ | 83N214 |
| **19.54. Ru(bpy)$_2$[2-(thiazol-2-yl)pyridine]$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.54.1. | MV$^{2+}$ | H$_2$O | | | $6.3 \times 10^{8}$ | LP/LUM/SST; $\tau_0 = 0.32$ μs; OT; $f = \sim0.25$ | 83N214 |
| **19.55. cis-Ru(bpy)$_2$(vio)Cl$^{+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.55.1. | N-Methyl-4-carbamyl-py$^+$ | AN/CH$_2$Cl$_2$ (1.5/1) | | $-23$ | $3.6 \times 10^{8}$ | LP/LUM/AVE; $\tau_0 = 0.10$ μs; OT | 85F051 |
| **19.56. Ru(2,7-dimethyl-1,4,5,8-tetraazaphenanthrene)$_3$$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.56.1. | 1,4-Dihydroxybenzene | H$_2$O | | 20 | $5.2 \times 10^{9}$ | LP/LUM/SST; $\tau_0 = 90$ ns; RT | 85S015 |
| **19.57. Ru[4-methyl-2-(2-pyridyl)pyrimidine]$_3$$^{2+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.57.1. | MV$^{2+}$ | H$_2$O | | 25 | $3.9 \times 10^{8}$ | EMI; $\tau_0 = 0.19$ μs | 83E209 |
| | MV$^{2+}$ | H$_2$O | 0.5 mol/L KCl | 25 | $3.9 \times 10^{8}$ | SS/LUM; $\tau_0 = 0.17$ μs (83E209); OT | 83F371 |
| | MV$^{2+}$ | H$_2$O | 0.05 mol/L PHTHbuf; pH 5 | | $2.9 \times 10^{9}$ | SS/LUM; $\tau_0 = 0.19$ μs (83E209); OT; [Q] = 0.002-0.02 mol/L | 85A431 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58.** | **Ru(phen)$_3$$^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 19.58.1. | Ag$^+$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 7.5 × 10$^4$ | SS/LUM; $\tau_0$ = 1.1 $\mu$s (LP/LUM/AVE); [Q] = 0.6-1.3 mol/L | 766319 |
| 19.58.2. | ClO$_4$$^-$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | <3 × 10$^5$ | SS/LUM; $\tau_0$ = 1.1 $\mu$s (LP/LUM/AVE); [Q] = 0.04 mol/L | 766319 |
| 19.58.3. | Co$^{2+}$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 2 × 10$^5$ | SS/LUM; $\tau_0$ = 1.1 $\mu$s (LP/LUM/AVE); [Q] = 0.05-0.06 mol/L | 766319 |
| 19.58.4. | Co(acac)$_2$ | MeOH | | ~21 | 1.2 × 10$^8$ | SS/LUM; $\tau_0$ = 0.31 $\mu$s (LP/LUM/AVE); ET; [Q] = 0.001-0.008 mol/L | 766319 |
| 19.58.5. | Co(acac)$_3$ | MeOH | | ~21 | 8.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.31 $\mu$s (LP/LUM/AVE); OT; [Q] = 0.001-0.005 mol/L | 766319 |
| 19.58.6. | Co(AMMEsarH)$^{4+}$ | H$_2$O | 0.1 mol/L HCl, 0.1 mol/L LiCl | 25 | 5.2 × 10$^8$ | SS/LUM or LP/LUM/AVE; $\tau_0$ = 0.92 $\mu$s (766404); ET, OT | 84A238 |
| 19.58.7. | Co(AZAMEsar)$^{3+}$ | H$_2$O | $\mu$ = 0.2 (LiCl) | 25 | 4.0 × 10$^8$ | SS/LUM or LP/LUM/AVE; $\tau_0$ = 0.92 $\mu$s (766404); ET, OT | 84A238 |
| 19.58.8. | Co(bpy)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 3.4 × 10$^7$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (766404); OT | 85S022 |
| 19.58.9. | Co(bpy)$_3$$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | 6.3 × 10$^7$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (766404); OT, ET | 85S022 |
| | Co(bpy)$_3$$^{2+}$ | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; $\mu$ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | 9.7 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (766404); OT, ET | 85S022 |
| 19.58.10. | Co(5-Clphen)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 1.9 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (766404); OT | 85S022 |
| 19.58.11. | Co(5-Clphen)$_3$$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | 1.2 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (766404); OT | 85S022 |

TABLE 19. Quenching of excited ruthenium complexes (except Ru(bpy)$_3$$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58.** | **Ru(phen)$_3$$^{2+}$—Continued** | | | | | | |
| 19.58.12. | Co(CN)$_6$$^{3-}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $2.7 \times 10^7$ | SS/LUM; $\tau_0 = 1.1$ μs (LP/LUM/AVE); ET; [Q] = 0.21 mol/L | 766319 |
| 19.58.13. | Co(C$_2$O$_4$)$_3$$^{3-}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $3.5 \times 10^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0 = 1.1$ μs (LP/LUM/AVE); [Q] $\leq 1.2 \times 10^{-4}$ mol/L; some SQ | 766319 |
| 19.58.14. | Co(diAMsar)$^{3+}$ | H$_2$O | 0.16 mol/L LiCl, 0.05 mol/L EtMO pH 7.5 | 25 | $3.4 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 0.92$ μs (766404); ET, OT; $f = 0.65$ at pH 8.3 | 84A238 |
| 19.58.15. | Co(diAMsarH$_2$)$^{5+}$ | H$_2$O | 0.1 mol/L HCl, 0.1 mol/L LiCl | 25 | $8.6 \times 10^8$ | SS/LUM or LP/LUM/AVE; $\tau_0 = 0.92$ μs (766404); ET, OT; $f = 1.0$ | 84A238 |
| 19.58.16. | Co(DMG)$_2$(C$_2$H$_5$)(H$_2$O) | H$_2$O | | ~22 | $2.1 \times 10^9$ | LP/LUM/SST; ET? | 83E223 |
| 19.58.17. | Co(en)$_3$$^{3+}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $<1 \times 10^6$ | SS/LUM; $\tau_0 = 1.1$ μs (LP/LUM/AVE); [Q] = 0.003-0.007 mol/L | 766319 |
| | Co(en)$_3$$^{3+}$ | H$_2$O | ACbuf; pH 4.7; $\mu = 0.01$ (NaCl) | 25 | $6.5 \times 10^7$ | SS/LUM; $\tau_0 = 0.92$ μs (84A238); ET, OT; [Q] = (3-90) $\times 10^{-4}$ mol/L | 85F161 |
| 19.58.18. | Co(4,7-Me$_2$phen)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $2.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.92$ μs (766404); OT | 85S022 |
| 19.58.19. | Co(4,7-Me$_2$phen)$_3$$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | $1.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.92$ μs (766404); OT | 85S022 |
| 19.58.20. | Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $\sim 3 \times 10^6$ | SS/LUM; $\tau_0 = 1.1$ μs (LP/LUM/AVE); OT; [Q] = 0.002-0.005 mol/L | 766319 |
| | Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.2 \times 10^7$ | SS/LUM; $\tau_0$$^{air} = 0.51$ μs (LP/LUM/AVE); OT | 84A255 |
| | Co(NH$_3$)$_6$$^{3+}$ | H$_2$O | ACbuf; pH 4.7; $\mu = 0.01$ (NaCl) | 25 | $4.6 \times 10^7$ | SS/LUM; $\tau_0 = 0.92$ μs (84A238); ET, OT; [Q] = (3-90) $\times 10^{-4}$ mol/L | 85F161 |
| 19.58.21. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 1.1$ μs (LP/LUM/AVE); OT; [Q] = 0.001-0.004 mol/L | 766319 |
| 19.58.22. | Co(phen)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $9 \times 10^7$ | SS/LUM; $\tau_0 = 0.92$ μs (766404); OT | 85S022 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **19.58. Ru(phen)$_3$$^{2+}$—Continued** | | | | | | | |
| 19.58.23. | Co(phen)$_3$$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | 7.7 × 10$^7$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); OT | 85S022 |
| 19.58.24. | Co(sep)$^{3+}$ | H$_2$O | 0.2 mol/L LiCl | 25 | 7.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); ET, OT; $f$ = 0.53 | 84A238 |
| | Co(sep)$^{3+}$ | H$_2$O | 0.1 mol/L TEOA; pH 8.1; $\mu$ = 0.2 (LiCl) | 25 | 6.3 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); ET, OT | 84A238 |
| | Co(sep)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 5.5 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); ET, OT | 84A238 |
| 19.58.25. | Cr$^{3+}$ | H$_2$O | 0.04 mol/L H$_2$SO$_4$; $\mu$ = 1.0 (MgCl$_2$) | 25 | 1.4 × 10$^7$ | SS/LUM; $\tau_0$ = 0.92 μs (LP/LUM/AVE); ET | 766404 |
| 19.58.26. | Cr(acac)$_3$ | MeOH | | ~21 | 5.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.31 μs (LP/LUM/AVE); ET; [Q] = 0.001-0.004 mol/L | 766319 |
| 19.58.27. | Cr(CN)$_6$$^{3-}$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 2.3 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 1.1 μs (LP/LUM/AVE); ET; [Q] ≤ 1.7 × 10$^{-4}$ mol/L; some SQ | 766319 |
| 19.58.28. | Cr(C$_2$O$_4$)$_3$$^{3-}$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 2.3 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 1.1 μs (LP/LUM/AVE); ET; [Q] ≤ 2.5 × 10$^{-4}$ mol/L; some SQ | 766319 |
| 19.58.29. | Cu$^{2-}$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 9 × 10$^6$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 1.1 μs (LP/LUM/AVE); OT; [Q] = 0.03-0.06 mol/L; some SQ | 766319 |
| | Cu$^{2-}$ | H$_2$O | $\mu$ = 0.12 (NaNO$_3$) | 25 | 4.6 × 10$^7$ (calc) | LP/LUM/SST; $\tau_0$ = 0.92 μs (83N004); OT | 85N199 |
| | Cu$^{2+}$ | H$_2$O | 0.25 mol/L H$_2$SO$_4$; $\mu$ = 0.8-1 | 25 | 6.4 × 10$^7$ | SL/LUM/SPC; $\tau_0$ = 1.1 μs; $\Delta H^{\ddagger}$ = 13 kJ/mol; $\Delta S^{\ddagger}$ = −51 J/mol·K (20-80°C); OT | 80A308 |
| | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 7.5 × 10$^7$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); OT; $f$ = 0.54 | 78A090 |
| 19.58.30. | Cu(acac)$_2$ | MeOH | | ~21 | 1.6 × 10$^9$ | SS/LUM; $\tau_0$ = 0.31 μs (LP/LUM/AVE); OT; [Q] = (3-12) × 10$^{-4}$ mol/L | 766319 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L $mol^{-1}$ $s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58. $Ru(phen)_3^{2+}$**—Continued | | | | | | | |
| 19.58.31. $CuCl^+$ | | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L $Cu^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L $Cl^-$ ($CuCl_2$, $MgCl_2$); $\mu$ = 0.35 | 25 | $2.2 \times 10^8$ | SL/LUM/SPC; OT; $k_q$ from $k_{abs}$ at various $[Cu^{II}]$ and $[Cl^-]$ using known association constants | 81A031 |
| 19.58.32. $CuCl_2$ | | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L $Cu^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L $Cl^-$ ($CuCl_2$, $MgCl_2$); $\mu$ = 0.35 | 25 | $2.1 \times 10^9$ | SL/LUM/SPC; OT; $k_q$ from $k_{abs}$ at various $[Cu^{II}]$ and $[Cl^-]$ using known association constants | 81A031 |
| 19.58.33. $Cu(H_2O)_n^{2+}$ | | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L $Cu^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L $Cl^-$ ($CuCl_2$, $MgCl_2$); $\mu$ = 0.35 | 25 | $6.1 \times 10^7$ | SL/LUM/SPC; OT; $k_q$ from $k_{abs}$ at various $[Cu^{II}]$ and $[Cl^-]$ using known association constants | 81A031 |
| 19.58.34. $Eu^{2+}$ | | $H_2O$ | 0.05 mol/L HCl; $\mu$ = 0.5 (NaCl) | 25 | $4.9 \times 10^7$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (766404); RT; [Q] = 0.01-0.09 mol/L | 78A087 |
| 19.58.35. $Eu^{3+}$ | | $H_2O$ | 0.025 mol/L HCl; $\mu$ = 2.8 ($MgCl_2$) | 25 | $3.6 \times 10^5$ | SL/LUM/SPC; $\tau_0$ = 1.1 $\mu$s; $\Delta H^\ddagger$ = 32 kJ/mol; $\Delta S^\ddagger$ = $-30$ J/mol·K (20-80°C); OT; Q mainly as $EuCl^{2+}$ | 80A308 |
| 19.58.36. $Fe^{3+}$ | | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.8 \times 10^9$ | SS/LUM; $\tau_0$ = 0.92 $\mu$s (LP/LUM/AVE); OT | 766404 |
| | $Fe^{3+}$ | $H_2O$ | 1 mol/L $HClO_4$ | | $2.5 \times 10^9$ | SS/LUM; $\tau_0$ = 0.81 $\mu$s (FP/LUM/SST); OT | 767009 |
| 19.58.37. $Fe(CN)_6^{3-}$ | | $H_2O$ | $\mu$ = 0 (calc'd) | ~21 | $4.4 \times 10^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s (LP/LUM/AVE); [Q] $\leq$ 5 $\times$ $10^{-5}$ mol/L; some SQ | 766319 |

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58.  Ru(phen)$_3^{2+}$**—Continued | | | | | | | |
| 19.58.38. Fe(CN)$_3^{4-}$ | | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 7.3 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s (LP/LUM/AVE); ET?; [Q] $\leq$ 5 × 10$^{-5}$ mol/L; some SQ | 766319 |
| | Fe(CN)$_3^{4-}$ | H$_2$O | | | 3.4 × 10$^{10}$ | SL/LUM/SPC; $\tau_0^{air}$ = 0.42 $\mu$s; [Q] $\leq$ 2 × 10$^{-4}$ mol/L; some SQ | 85R098 |
| | Fe(CN)$_3^{4-}$ | H$_2$O | 0.005 mol/L TRbuf; 0.05 mol/L NaCl; pH 7.2 | | 8.4 × 10$^9$ | SL/LUM/SPC; $\tau_0^{air}$ = 0.52 $\mu$s; [Q] $\leq$ 4 × 10$^{-4}$ mol/L; some SQ | 85R098 |
| 19.58.39. Fe$^{III}$(cytochrome c) | | H$_2$O | Pbuf; pH 7 | | >8 × 10$^7$ | LP/ABS/AVE; $\tau_0$ = 0.92 $\mu$s (80E040); OT; [Q] = (1-10) × 10$^{-5}$ mol/L; 10.6% of Q as Fe$^{II}$ | 84A306 |
| 19.58.40. Hg$^{2+}$ | | H$_2$O | 0.05 mol/L HNO$_3$; $\mu$ = 0.063 (NaNO$_3$) | ~23 | 9.0 × 10$^7$ | LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s; OT | 84A148 |
| | Hg$^{2+}$ | H$_2$O | 0.05 mol/L HNO$_3$; $\mu$ = 0.5 (NaNO$_3$) | ~23 | 3.1 × 10$^8$ | LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s; OT | 84A148 |
| 19.58.41. HgCl$_2$ | | H$_2$O | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | 1.3 × 10$^9$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s; OT; [Q] = (2-40) × 10$^{-4}$ mol/L | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.99 mol/L NaNO$_3$ | | 1.9 × 10$^9$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | 1.2 × 10$^7$ | LP/LUM/AVE; $\tau_0$ = 1.8 $\mu$s; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | 7.2 × 10$^6$ | LP/LUM/AVE; $\tau_0$ = 1.8 $\mu$s; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.40 mol/L, 0.01 mol/L SLS | | 7.1 × 10$^6$ | LP/LUM/AVE; $\tau_0$ = 2.0 $\mu$s; OT | 84N034 |
| 19.58.42. HgCl$_3^-$ | | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | 5.5 × 10$^9$ | LP/LUM/AVE; $\tau_0$ = 1.1 $\mu$s; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |

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TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3{}^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58.** | **$Ru(phen)_3{}^{2+}$**—Continued | | | | | | |
| | $HgCl_3{}^-$ | $H_2O$ | 0.01 mol/L $HNO_3$, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS | | $\sim4 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 1.8$ µs; OT; $k_q$ from Cl$^-$ titration at fixed $[Hg^{II}]_{tot}$ | 84N034 |
| 19.58.43. | $HgCl_4{}^{2-}$ | $H_2O$ | 0.01 mol/L $HNO_3$, $[NaNO_3]$ + $[NaCl]$ = 0.99 mol/L | | $3.2 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 1.1$ µs; OT; $k_q$ from Cl$^-$ titration at fixed $[Hg^{II}]_{tot}$ | 84A077 |
| 19.58.44. | $I^-$ | $H_2O$ | $\mu = 0$ (calc'd) | $\sim21$ | $1 \times 10^6$ | SS/LUM; $\tau_0 = 1.1$ µs (LP/LUM/AVE); $[Q]$ = 0.14-0.16 mol/L | 766319 |
| 19.58.45. | $NO_3{}^-$ | $H_2O$ | $\mu = 0$ (calc'd) | $\sim21$ | $<1 \times 10^5$ | SS/LUM; $\tau_0 = 1.1$ µs (LP/LUM/AVE); $[Q]$ = 0.1 mol/L | 766319 |
| 19.58.46. | $Ni^{2+}$ | $H_2O$ | $\mu = 0$ (calc'd) | $\sim21$ | $6.6 \times 10^5$ | SS/LUM; $\tau_0 = 1.1$ µs (LP/LUM/AVE); $[Q]$ = 0.05-0.06 mol/L | 766319 |
| 19.58.47. | $Ni(acac)_2$ | MeOH | | $\sim21$ | $4.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.31$ µs (LP/LUM/AVE); ET; $[Q]$ = 0.002-0.007 mol/L | 766319 |
| 19.58.48. | $O_2$ | $H_2O$ | | $\sim21$ | $4.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.0$ µs (LP/LUM/SST); ET | 737658 |
| | $O_2$ | $H_2O$ | | 25 | $4.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.92$ µs (LP/LUM/AVE); OT? | 766404 |
| | $O_2$ | MeOH | | $\sim21$ | $3.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.31$ µs (LP/LUM/SST); ET; same $k_q$ from same lab in 777221 | 737658 |
| 19.58.49. | $PtCl_4{}^{2-}$ | $H_2O$ | $\mu = 0$ (calc'd) | $\sim21$ | $1.7 \times 10^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0 = 1.1$ µs (LP/LUM/AVE); ET; $[Q]$ ≤ $2.2 \times 10^{-4}$ mol/L; some SQ | 766319 |
| 19.58.50. | $PtCl_6{}^{2-}$ | $H_2O$ | $\mu = 0$ (calc'd) | $\sim21$ | $\sim2 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.1$ µs (LP/LUM/AVE); OT, ET?; $[Q]$ = (1-3) $\times 10^{-4}$ mol/L | 766319 |
| 19.58.51. | $Rh(bpy)_3{}^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$; $\mu = 0.5$ | 25 | $9.9 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | $Rh(bpy)_3{}^{3+}$ | $H_2O$ | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $7.1 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | $Rh(bpy)_3{}^{3+}$ | $H_2O$ | 0.17 mol/L $Na_2SO_4$; $\mu = 0.5$ | 25 | $6 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.92$ µs (766404); OT | 82A145 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58. Ru(phen)$_3$$^{2+}$—Continued** | | | | | | | |
| 19.58.52. | cis-Rh(bpy)$_2$(H$_2$O)$_2$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $6.5 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| 19.58.53. | cis-Rh(bpy)$_2$(OH)$_2$$^+$ | H$_2$O | 0.5 mol/L NaOH; $\mu = 0.5$ | 25 | $1.2 \times 10^7$ | SS/LUM or LP/LUM/SST; ET | 81N003 |
| 19.58.54. | Rh(4,4'-Me$_2$bpy)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $2 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.92$ $\mu$s (766404); OT | 82A145 |
| 19.58.55. | Rh(5-Mephen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $9.8 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.92$ $\mu$s (766404); OT | 82A145 |
| 19.58.56. | Rh(5,6-Me$_2$phen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $9.5 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.92$ $\mu$s (766404); OT | 82A145 |
| 19.58.57. | Rh(phen)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $1.2 \times 10^9$ | SS/LUM or LP/LUM/SST· OT | 81N003 |
| 19.58.58. | S$_2$O$_3$$^{2-}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$(?) | 20(?) | $5.6 \times 10^8$ | SS/LUM; OT | 80F128 |
| 19.58.59. | Ti$^{3+}$ | H$_2$O | 1.5 mol/L HCl; $\mu = 3.0$ (LiCl) | 25 | $6.2 \times 10^6$ | LP/LUM/SST; $\tau_0 = 0.7?$ $\mu$s; ET; 20-60% Ti$^{3+}$ coordinated by Cl$^-$ | 79A183 |
| *Organic Quenchers* | | | | | | | |
| 19.58.60. | Ascorbate ion | H$_2$O | pH 5; $\mu = 0.7$ (Na$_2$SO$_4$) | 25 | $2.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.92$ $\mu$s (766404); RT | 82A278 |
| 19.58.61. | N,N-Bis(2-hydroxyethyl)-vio$^{2+}$ | H$_2$O | | | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.9$ $\mu$s; CT; [Q] = (2-10) $\times$ 10$^{-4}$ mol/L | 78A269 |
| 19.58.62. | bpyH$^+$ | H$_2$O | $\mu = 0.5$ (NaHSO$_4$, Na$_2$SO$_4$) | 25 | $1 \times 10^7$ | SS/LUM; $\tau_0 = 0.92$ $\mu$s (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | bpyH$^+$ | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | $2.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.92$ $\mu$s (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.58.63. | bpyH$_2$$^{2+}$ | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | $2.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.92$ $\mu$s (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.58.64. | N,N-Dibenzyl-vio$^{2+}$ | H$_2$O | | | $3.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.9$ $\mu$s; CT; [Q] = (2-10) $\times$ 10$^{-4}$ mol/L | 78A269 |
| 19.58.65. | N,N-Dibutyl-vio$^{2+}$ | AN | $\mu = 0$ (calc'd) | | $2.7 \times 10^8$ | LP/LUM/SST; OT | 83N153 |
| 19.58.66. | N,N-Diethyl-vio$^{2+}$ | AN | $\mu = 0$ (calc'd) | | $2.4 \times 10^8$ | LP/LUM/SST; OT | 83N153 |
| 19.58.67. | N,N-Dihexyl-vio$^{2+}$ | AN | $\mu = 0$ (calc'd) | | $2.8 \times 10^8$ | LP/LUM/SST; OT | 83N153 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.58. Ru(phen)$_3^{2+}$**—Continued | | | | | | | |
| 19.58.68. 4,4'-Dimethyl-bpyH$_2^{2+}$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 2.7 × 10$^9$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.58.69. DQ$^{2+}$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 3.3 × 10$^9$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); [Q] = (5-50) × 10$^{-4}$ mol/L | 83C017 |
| 19.58.70. MV$^{2+}$ | | AN | 0.1 mol/L TBAP | | 2.9 × 10$^9$ | SS/LUM; $\tau_0$ = 0.50 μs (FP/LUM/SST); OT | 767009 |
| | MV$^{2+}$ | H$_2$O | | | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.9 μs; OT; [Q] = (2-10) × 10$^{-4}$ mol/L | 78A269 |
| 19.58.71. phenH$^+$ | | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | 4.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | phenH$^+$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 7.8 × 10$^8$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.58.72. phenH$_2^{2+}$ | | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | 2.8 × 10$^9$ | SS/LUM; $\tau_0$ = 0.92 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 19.58.73. N,N'-(Trimethylene)-bpy$^{2+}$ | | H$_2$O | | | 2.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.9 μs; OT; [Q] = (2-10) × 10$^{-4}$ mol/L | 78A269 |
| **19.59. Ru(phen)$_2$(5-Brphen)$^{2+}$** *Inorganic Quenchers* | | | | | | | |
| 19.59.1. O$_2$ | | MeOH | | | 2.3 × 10$^9$ | SS/LUM; $\tau_0$ = 0.99 μs (LP/LUM/AVE); ET | 777221 |
| **19.60. cis-Ru(phen)$_2$(CN)$_2$** *Inorganic Quenchers* | | | | | | | |
| 19.60.1. Co$^{2+}$ | | H$_2$O | | ~21 | 1.0 × 10$^7$ | FP/LUM/SST; $\tau_0$ = 0.71 μs; ET; some SQ | 776220 |
| 19.60.2. Co(acac)$_2$ | | MeOH | | ~21 | 3.1 × 10$^7$ | SS/LUM; $\tau_0$ = 1.6 μs (FP/LUM/SST); ET | 776220 |
| 19.60.3. Co(acac)$_3$ | | MeOH | | ~21 | 5.8 × 10$^8$ | SS/LUM; $\tau_0$ = 1.6 μs (FP/LUM/SST) | 776220 |
| 19.60.4. Co(CN)$_6^{3-}$ | | H$_2$O | | ~21 | 2.8 × 10$^6$ | SS/LUM; $\tau_0$ = 0.71 μs (FP/LUM/SST) | 776220 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ $/L\ mol^{-1}\ s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.60.** | **$cis$-Ru(phen)$_2$(CN)$_2$—Continued** | | | | | | |
| 19.60.5. | $Co(C_2O_4)_3^{3-}$ | $H_2O$ | | ~21 | $3.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); OT | 776220 |
| 19.60.6. | $Co(NH_3)_6^{3+}$ | $H_2O$ | | ~21 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); OT | 776220 |
| 19.60.7. | $Co(NH_3)_5Cl^{2+}$ | $H_2O$ | | ~21 | $3.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); OT | 776220 |
| 19.60.8. | $Cr(acac)_3$ | MeOH | | ~21 | $5.6 \times 10^8$ | SS/LUM; $\tau_0 = 1.6$ μs (FP/LUM/SST); ET | 776220 |
| 19.60.9. | $Cr(CN)_6^{3-}$ | $H_2O$ | | ~21 | $4.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); ET | 776220 |
| 19.60.10. | $Cr(C_2O_4)_3^{3-}$ | $H_2O$ | | ~21 | $2.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); ET | 776220 |
| 19.60.11. | $trans$-Cr(en)$_2$Cl$_2^+$ | $H_2O$/DMF (3/1) | $7.5 \times 10^{-4}$ mol/L HCl | 20 | $3.6 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/AVE); $\Delta H^{\ddagger} = 7.7$ kJ/mol; ET | 81E237 |
| 19.60.12. | $trans$-Cr(en)$_2$F$_2^+$ | $H_2O$/DMF (3/1) | $7.5 \times 10^{-4}$ mol/L HCl | 20 | $3.0 \times 10^7$ | SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/AVE); $\Delta H^{\ddagger} = 0.96$ kJ/mol; ET | 81E237 |
| 19.60.13. | $trans$-Cr(en)$_2$(NCS)$_2^+$ | $H_2O$/DMF (3/1) | $7.5 \times 10^{-4}$ mol/L HCl | 20 | $5.3 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/AVE); $\Delta H^{\ddagger} = 9.4$ kJ/mol; ET | 81E237 |
| 19.60.14. | $trans$-Cr(en)$_2$(NCS)Cl$^+$ | $H_2O$/DMF (3/1) | $7.5 \times 10^{-4}$ mol/L HCl | 20 | $4.1 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/AVE); ET | 81E237 |
| 19.60.15. | $trans$-Cr(en)$_2$(ONO)Cl$^+$ | $H_2O$/DMF (3/1) | $7.5 \times 10^{-4}$ mol/L HCl | 20 | $1.9 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/AVE); ET | 81E237 |
| 19.60.16. | $trans$-Cr(NH$_3$)$_2$(NCS)$_4^-$ | $H_2O$ | | ~21 | $3.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); ET | 776220 |
| 19.60.17. | $Cu^{2+}$ | $H_2O$ | | ~21 | $4.8 \times 10^8$ | FP/LUM/SST; $\tau_0 = 0.71$ μs; OT, ET; same $k_q$ from same lab in 74E502; some SQ | 776220 |
| 19.60.18. | $Cu(acac)_2$ | MeOH | | ~21 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 1.6$ μs (FP/LUM/SST); OT, ET | 776220 |
| 19.60.19. | $Fe(CN)_6^{3-}$ | $H_2O$ | | ~21 | $6.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); OT | 776220 |
| 19.60.20. | $Fe(CN)_6^{4-}$ | $H_2O$ | | ~21 | $5.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); ET, RT | 776220 |
| 19.60.21. | $I^-$ | $H_2O$ | | ~21 | $4 \times 10^5$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST) | 776220 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.60.** *cis*-**Ru(phen)$_2$(CN)$_2$**—Continued | | | | | | | |
| 19.60.22. Ni$^{2-}$ | | H$_2$O | | ~21 | $2.0 \times 10^7$ | FP/LUM/SST; $\tau_0 = 0.71$ μs; ET; [Q] ≤ 0.14 mol/L; some SQ | 776220 |
| 19.60.23. Ni(acac)$_2$ | | MeOH | | ~21 | $6.0 \times 10^7$ | SS/LUM; $\tau_0 = 1.6$ μs (FP/LUM/SST) | 776220 |
| 19.60.24. NiCl$_4^{2-}$ | | H$_2$O | | ~21 | $5.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST) | 776220 |
| 19.60.25. O$_2$ | | H$_2$O | | ~21 | $5.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (LP/LUM/SST); ET | 737658 |
| O$_2$ | | MeOH | | | $5.4 \times 10^9$ | SS/LUM; $\tau_0 = 1.6$ μs (LP/LUM/AVE); ET; $k_q = 5.0 \times 10^9$ L mol$^{-1}$ s$^{-1}$ at ~21 °C with SS/LUM and $\tau_0 = 1.7$ μs from same lab in 737658 | 777221 |
| 19.60.26. PtCl$_4^{2-}$ | | H$_2$O | | ~21 | $1.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.71$ μs (FP/LUM/SST); ET | 776220 |
| **19.61.** **Ru(phen)$_2$(5-Clphen)$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.61.1. O$_2$ | | MeOH | | | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.95$ μs (LP/LUM/AVE); ET | 777221 |
| **19.62.** **Ru(phen)$_2$[4,7-(PhSO$_3$)$_2$phen]** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.62.1. O$_2$ | | H$_2$O | | 25 | $3.0 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 3.5$ μs; $p_Q = 2 \times 10^4$ Pa | 85E012 |
| O$_2$ | | H$_2$O | variable [β-CD] | 25 | $1.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 2.7$ μs; $p_Q = 2 \times 10^4$ Pa; $\tau_0$ and $k_q$ from β-CD titration at constant $p_Q$; S as 1:1 complex with β-CD | 85E012 |
| O$_2$ | | H$_2$O | variable [β-CD] | 25 | $1.2 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 3.6$ μs; $p_Q = 2 \times 10^4$ Pa; $\tau_0$ and $k_q$ from β-CD titration at constant $p_Q$; S as 1:2 complex with β-CD | 85E012 |
| O$_2$ | | MeOH | | | $1.8 \times 10^9$ | SS/LUM; $\tau_0 = 4.0$ μs (LP/LUM/AVE); ET | 777221 |
| *Organic Quenchers* | | | | | | | |
| 19.62.2. Ascorbate ion | | H$_2$O | pH 5; μ = 0.7 (Na$_2$SO$_4$) | 25 | $2.9 \times 10^7$ | SS/LUM; $\tau_0 = 2.5$ μs; RT; $\tau$ estimated | 82A278 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.63.** | **$Ru(phen)_2(4,7-Ph_2phen)^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.63.1. | $Cu^{2+}$ | $H_2O$ | $\mu$ = 0.12 (NaNO$_3$) | 25 | $2.0 \times 10^7$ (calc) | LP/LUM/SST; $\tau_0$ = 3.2 μs (83N004); OT | 85N199 |
| 19.63.2. | $O_2$ | $H_2O$ | | 25 | $3.7 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 3.1 μs; $p_Q$ = 2 × 10$^4$ Pa | 85E012 |
| | $O_2$ | $H_2O$ | variable [β-CD] | 25 | $1.3 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 2.8 μs; $p_Q$ = 2 × 10$^4$ Pa; $\tau_0$ and $k_q$ from β-CD titration at constant $p_Q$; S as 1:1 complex with β-CD | 85E012 |
| | $O_2$ | $H_2O$ | variable [β-CD] | 25 | $1.3 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 3.8 μs; $p_Q$ = 2 × 10$^4$ Pa; $\tau_0$ and $k_q$ from β-CD titration at constant $p_Q$; S as 1:2 complex with β-CD | 85E012 |
| | $O_2$ | MeOH | | | $2.6 \times 10^9$ | SS/LUM; $\tau_0$ = 2.6 μs (LP/LUM/AVE); ET | 777221 |
| **19.64.** | **$Ru(phen)_2(5-Phphen)^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.64.1. | $O_2$ | $H_2O$ | | 25 | $4.2 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.0 μs; $p_Q$ = 2 × 10$^4$ Pa | 85E012 |
| | $O_2$ | $H_2O$ | variable [β-CD] | 25 | $1.6 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 1.7 μs; $p_Q$ = 2 × 10$^4$ Pa; $\tau_0$ and $k_q$ from β-CD titration at constant $p_Q$; S as 1:1 complex with β-CD | 85E012 |
| **19.65.** | **$Ru[2-(phenylazo)pyridine]_3^{2+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.65.1. | $Ce^{4+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 22 | $3.6 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.42 μs (LP/LUM/AVE); OT | 84E347 |
| 19.65.2. | $Fe^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 22 | $3.6 \times 10^{10}$ | SS/LUM; $\tau_0^{air}$ = 0.42 μs (LP/LUM/AVE); RT | 84E347 |
| 19.65.3. | $Fe(CN)_6^{4-}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 22 | $1.8 \times 10^{10}$ | SS/LUM; $\tau_0^{air}$ = 0.42 μs (LP/LUM/AVE); RT | 84E347 |
| **19.66.** | **$Ru(phthalocyanine)(DMF)_2$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.66.1. | $Co(NH_3)_6^{3+}$ | AN/$H_2O$ (2.3/1) | 0.1 mol/L TEAP | | $4.7 \times 10^9$ (corr) | LP/ABS/SST | 83E262 |

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.66.** | **Ru(phthalocyanine)(DMF)$_2$**—Continued | | | | | | |
| 19.66.2. | $Co(NH_3)_5Cl^{2+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | $4.7 \times 10^9$ (corr) | LP/ABS/SST | 83E262 |
| 19.66.3. | $Co(NH_3)_5(H_2O)^{3+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | $2.6 \times 10^9$ (corr) | LP/ABS/SST | 83E262 |
| 19.66.4. | $Fe^{3-}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | $7.0 \times 10^9$ (corr) | LP/ABS/SST | 83E262 |
| 19.66.5. | $Fe(CN)_6^{3-}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | $2.0 \times 10^9$ (corr) | LP/ABS/SST | 83E262 |
| 19.66.6. | $Ru(NH_3)_6^{3+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | $5.5 \times 10^9$ (corr) | LP/ABS/SST; [Q] ≤ 0.02 mol/L | 83E262 |
| *Organic Quenchers* | | | | | | | |
| 19.66.7. | $N,N$-Bis(2-hydroxyethyl)-vio$^{2+}$ | AN | 0.1 mol/L TEAP | | $2.7 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.8. | $N,N$-Dibenzoyl-vio$^{2+}$ | AN | 0.1 mol/L TEAP | | $1.7 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.9. | $N,N$-Diethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $7.6 \times 10^8$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.10. | $N,N$-Diethyl-4,4'-dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $3.8 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT; [Q] ≤ 0.025 mol/L | 83E262 |
| 19.66.11. | $N,N$-Dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $2.5 \times 10^8$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.12. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $2.6 \times 10^8$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.13. | 1,3-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $3.6 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.14. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $5.9 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT; [Q] ≤ 0.015 mol/L | 83E262 |
| 19.66.15. | $N,N$-Dipropyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $6 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.16. | $N,N$-Ethylene-4,4'-dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $1.6 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.17. | 1-Iodo-4-nitrobenzene | AN | 0.1 mol/L TEAP | | $6.8 \times 10^8$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.18. | Methyl 3-nitrobenzoate | AN | 0.1 mol/L TEAP | | $6 \times 10^6$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| 19.66.19. | Methyl 4-nitrobenzoate | AN | 0.1 mol/L TEAP | | $8 \times 10^6$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.66. Ru(phthalocyanine)(DMF)$_2$**—Continued | | | | | | | |
| 19.66.20. MV$^{2+}$ | AN | 0.1 mol/L TEAP | | 2.8 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT; [Q] ≤ 0.025 mol/L | 83E262 |
| 19.66.21. 2-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | | 1 × 10$^7$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.66.22. 3-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | | 1.2 × 10$^8$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.66.23. 4-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | | 1.1 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.66.24. 4-Nitroso-$N,N$-dimethylaniline | AN | 0.1 mol/L TEAP | | 5.0 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| **19.67. Ru(phthalocyanine)(pyridine)$_2$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 19.67.1. Co(NH$_3$)$_6^{3+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | 1.6 × 10$^9$ (corr) | LP/ABS/SST; OT | 83E262 |
| 19.67.2. Co(NH$_3$)$_5$Cl$^{2+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | 1.0 × 10$^9$ (corr) | LP/ABS/SST; OT | 83E262 |
| 19.67.3. Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | 1.2 × 10$^9$ (corr) | LP/ABS/SST; OT | 83E262 |
| 19.67.4. Fe$^{3+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | 7.4 × 10$^9$ (corr) | LP/ABS/SST; OT | 83E262 |
| 19.67.5. Fe(CN)$_6^{3-}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | 1.4 × 10$^9$ (corr) | LP/ABS/SST; OT | 83E262 |
| 19.67.6. Ru(NH$_3$)$_6^{3+}$ | AN/H$_2$O (2.3/1) | 0.1 mol/L TEAP | | 7.7 × 10$^8$ (corr) | LP/ABS/SST; OT | 83E262 |
| *Organic Quenchers* | | | | | | | |
| 19.67.7. $N,N'$-Bis(2-hydroxyethyl)-vio$^{2+}$ | AN | 0.1 mol/L TEAP | | 2.4 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.67.8. $N,N'$-Dibenzoyl-vio$^{2+}$ | AN | 0.1 mol/L TEAP | | 2.0 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.67.9. $N,N'$-Dibutyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | 3.9 × 10$^8$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.67.10. $N,N'$-Diethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | 2.5 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.67.11. $N,N'$-Diethyl-4,4'-dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | 2.8 × 10$^9$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |
| 19.67.12. $N,N'$-Dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | 1.0 × 10$^8$ (corr) | LP/ABS/SST; $\tau_0$ = 0.17 μs; OT | 83E262 |

TABLE 19. Quenching of excited ruthenium complexes (except Ru(bpy)$_3$$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.67.** | **Ru(phthalocyanine)(pyridine)$_2$**—Continued | | | | | | |
| 19.67.13. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $8.7 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | 1,2-Dinitrobenzene | CH$_2$Cl$_2$ | | | $8.7 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT; [Q] $\leq 0.25$ mol/L | 82C018 |
| 19.67.14. | 1,3-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $3.8 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | 1,3-Dinitrobenzene | CH$_2$Cl$_2$ | | | $3.8 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |
| 19.67.15. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $2.2 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | 1,4-Dinitrobenzene | CH$_2$Cl$_2$ | | | $2.2 \times 10^9$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |
| 19.67.16. | $N,N'$-Dipropyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $1.2 \times 10^8$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| 19.67.17. | $N,N'$-Ethylene-4,4'-dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | | $1.3 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| 19.67.18. | 1-Iodo-4-nitrobenzene | AN | 0.1 mol/L TEAP | | $1 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | 1-Iodo-4-nitrobenzene | CH$_2$Cl$_2$ | | | $1.0 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |
| 19.67.19. | Methyl 3-nitrobenzoate | AN | 0.1 mol/L TEAP | | $6.8 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | Methyl 3-nitrobenzoate | CH$_2$Cl$_2$ | | | $6.8 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |
| 19.67.20. | Methyl 4-nitrobenzoate | AN | 0.1 mol/L TEAP | | $8.6 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | Methyl 4-nitrobenzoate | CH$_2$Cl$_2$ | | | $8.6 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |
| 19.67.21. | MV$^{2+}$ | AN | 0.1 mol/L TEAP | | $2.0 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| 19.67.22. | 2-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | | $1.5 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | 2-Nitrobenzaldehyde | CH$_2$Cl$_2$ | | | $1.5 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |
| 19.67.23. | 3-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | | $1.3 \times 10^7$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ $\mu$s; OT | 83E262 |
| | 3-Nitrobenzaldehyde | CH$_2$Cl$_2$ | | | $1.3 \times 10^7$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ $\mu$s; OT | 82C018 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.67.** | **Ru(phthalocyanine)(pyridine)$_2$**—Continued | | | | | | |
| 19.67.24. | 4-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | | $2.6 \times 10^8$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| | 4-Nitrobenzaldehyde | CH$_2$Cl$_2$ | | | $2.6 \times 10^8$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ μs; OT; [Q] $\leq$ 0.15 mol/L | 82C018 |
| 19.67.25. | 4-Nitroso-$N$,$N$-dimethylaniline | AN | 0.1 mol/L TEAP | | $1.2 \times 10^9$ (corr) | LP/ABS/SST; $\tau_0 = 0.17$ μs; OT | 83E262 |
| | 4-Nitroso-$N$,$N$-dimethylaniline | CH$_2$Cl$_2$ | | | $1.2 \times 10^9$ (corr) | LP/LUM/SST; $\tau_0 = \sim 0.2$ μs; OT; [Q] $\leq$ 0.025 mol/L | 82C018 |
| **19.68.** | **Ru(terpy)(bpy)(NH$_3$)$^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 19.68.1. | Fe$^{3+}$ | H$_2$O | 1 mol/L HClO$_4$ | | $3.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.43$ μs (F?/LUM/SST); OT | 767009 |
| **19.69.** | **Ru(1,4,5,8-tetraazaphenanthrene)$_3$$^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.69.1. | Cysteine | H$_2$O | pH 9 | | $2.2 \times 10^9$ | RT | 85F572 |
| 19.69.2. | 1,4-Dihydroxybenzene | H$_2$O | | 20 | $4.9 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.20$ μs; RT; $k_q = 4.5 \times 10^9$ L mol$^{-1}$ s$^{-1}$ at pH 5 from same lab in 85F572 | 85S015 |
| 19.69.3. | Triethanolamine | H$_2$O | pH 9 | | $3 \times 10^8$ | RT | 85F572 |
| **19.70.** | **Ru(5,10,15,20-tetraphenylporphyrin)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.70.1. | 1,4-Benzoquinone | EtOH | | | $3.0 \times 10^9$ | LP/ABS/SST, SS/LUM; OT; $f = 0.07$ | 83F182 |
| **19.71.** | **Ru(5,10,15,20-tetraphenylporphyrin)(CO)** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 19.71.1. | 4,4'-Bis($N$,$N$-dimethylamino)biphenyl | DMSO | | $\sim 23$ | $2.0 \times 10^7$ | SS/LUM; $\tau_0 = 36$ μs (LP/LUM/SST); RT | 81C001 |
| 19.71.2. | $N$-Ethylphenazinium cation | DMSO | | $\sim 23$ | $2.5 \times 10^9$ | SS/LUM; $\tau_0 = 36$ μs (LP/LUM/SST); OT | 81C001 |
| 19.71.3. | $N$-Methyl-4-carbomethoxy-py$^+$ | DMSO | | $\sim 23$ | $2.1 \times 10^5$ | SS/LUM; $\tau_0 = 36$ μs (LP/LUM/SST); OT | 81C001 |
| 19.71.4. | $N$-Methyl-4-cyano-py$^+$ | DMSO | | $\sim 23$ | $3.4 \times 10^8$ | SS/LUM; $\tau_0 = 36$ μs (LP/LUM/SST); OT | 81C001 |
| 19.71.5. | MV$^{2+}$ | DMSO | | $\sim 23$ | $6.6 \times 10^8$ | SS/LUM; $\tau_0 = 36$ μs (LP/LUM/SST); OT | 81C001 |

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TABLE 19. Quenching of excited ruthenium complexes (except Ru(bpy)$_3$$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **19.72.** | **Ru[2-(thiazol-2-yl)pyridine]$_3$$^{2+}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 19.72.1. | MV$^{2+}$ | H$_2$O | | | $5.2 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.22$ μs; OT; $f = \sim0.25$ | 83N214 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$** | | | | | | |
| 20.1.1. | $Ag^+$ | AN | | | $1.1 \times 10^5$ | SS/LUM; OT | 80C004 |
| | $Ag^+$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $6.7 \times 10^5$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/AVE); [Q] = 0.005-0.012 mol/L | 766319 |
| | $Ag^+$ | $H_2O$ | | | $3.5 \times 10^6$ | SS/LUM; $E_a = $ ~2.5 kJ/mol (23-50°C); OT | 80C004 |
| 20.1.2. | $Ag(bpy)_2^+$ | AN | | | $1.5 \times 10^6$ | SS/LUM; OT | 80C004 |
| 20.1.3. | $ClO_4^-$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $<1 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ μs (LF/LUM/AVE); [Q] = 0.04 mol/L | 766319 |
| 20.1.4. | $Co^{2+}$ | AN/2-PrOH/$H_2O$ (3/1/1) | $CO_2$ satd | | $5 \times 10^6$ | SS/LUM; OT? | 86F230 |
| | $Co^{2+}$ | AN/TEOA/$H_2O$ (3/1/1) | | | $7.1 \times 10^7$ | SS/LUM; OT? | 86F230 |
| | $Co^{2+}$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $<5 \times 10^5$ | SS/LUM; $\tau_0 = 0.60$ μs (LF/LUM/AVE); [Q] = 0.05-0.07 mol/L | 766319 |
| 20.1.5. | $Co(acac)_2$ | MeOH | | ~21 | $5.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.77$ μs (LF/LUM/AVE); ET; [Q] = 0.002-0.008 mol/L | 766319 |
| 20.1.6. | $Co(acac)_3$ | $H_2O$ | | 16-18 | $8.0 \times 10^8$ | LP/LUM/SST; $\tau_0^{air} = 0.38$ μs; OT; [Q] = 0.0013 mol/L | 80E566 |
| | $Co(acac)_3$ | $H_2O$ | | 16-18 | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.37$ μs; OT; [Q] = 0.0013 mol/L; $p_{app} = 2.3 \times 10^8$ Pa | 80E566 |
| | $Co(acac)_3$ | $H_2O$ | | 22 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766014); OT; [Q] = (5-25) $\times 10^{-4}$ mol/L | 78A219 |
| | $Co(acac)_3$ | $H_2O$ | 0.0054 mol/L PVS | 22 | $4.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766014); OT; [Q] = (5-25) $\times 10^{-4}$ mol/L | 78A219 |
| | $Co(acac)_3$ | MeOH | | ~21 | $5.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.77$ μs (LF/LUM/AVE); OT; [Q] = 0.001-0.010 mol/L | 766319 |
| 20.1.7. | $Co(AMcapten)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu =$ 0.1 (NaClO$_4$) | 20 | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; ET, OT; $f = 0.53$ | 85F222 |
| | $Co(AMcapten)^{3+}$ | $H_2O$ | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | $1.8 \times 10^{10}$ | LP/LUM/SST; $\tau_0 = 0.64$ μs | 85F222 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| 20.1.8. | $Co(AMMEsar)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $6 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (80%), OT (20%); $f$ = 0.2; same $k_q$ from same lab in 83S090 | 85F222 |
| | $Co(AMMEsar)^{3+}$ | $H_2O$ | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | $3.3 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; same $k_q$ from same lab in 83S090 | 85F222 |
| 20.1.9. | $Co(AZAcapten)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.3 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; OT; $f$ = 0.97; same $k_q$ from same lab in 83S090 | 85F222 |
| | $Co(AZAcapten)^{3+}$ | $H_2O$ | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | $5.8 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; same $k_q$ from same lab in 83S090 | 85F222 |
| 20.1.10. | $Co(AZAMEsar)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $4.5 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (70%), OT (30%); $f$ = 0.3 | 85F222 |
| 20.1.11. | $Co(bpy)^{2+}$ | $H_2O$ | 0.17 mol/L Na$_2$SO$_4$, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $4.2 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| | $Co(bpy)^{2+}$ | $H_2O$ | 0.5 mol/L NaCl, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $4.7 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| | $Co(bpy)^{2+}$ | $H_2O$ | 0.5 mol/L NaF, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $4.3 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| | $Co(bpy)^{2+}$ | $H_2O$ | 0.5 mol/L NaBr, 0.025 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $5.2 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| | $Co(bpy)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $5.5 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| 20.1.12. | $Co(bpy)_3^+$ | AN | 0.1 mol/L TEAP | 25 | $6.6 \times 10^0$ | LP/LUM/AVE; $\tau_0$ = 0.85 $\mu$s; RT | 86A077 |
| 20.1.13. | $Co(bpy)_3^{2+}$ | AN | 0.01 mol/L TEAP | 25 | $8 \times 10^7$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (LP/LUM/SST); OT, ET? | 86A077 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. Ru(bpy)$_3{}^{2+}$**—Continued | | | | | | | |
| | Co(bpy)$_3{}^{2+}$ | AN | 0.1 mol/L TEAP | 25 | $1.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (LP/LUM/AVE); OT, ET? | 86A077 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.16 mol/L Na$_2$SO$_4$, Pbuf; pH 7.8; μ = 0.5; [Co$^{II}$]/[L] = 0.2 | 25 | $6.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT, ET | 85S022 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.025 mol/L Pbuf; pH 8.0; μ = 0.03 (NaCl); [Co$^{II}$]/[L] = 0.2 | 25 | $2.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$, 0.025 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | $5.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT, ET | 85S022 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.5 mol/L NaCl, 0.025 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | $1.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT, ET | 85S022 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.5 mol/L NaBr, 0.025 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | $1.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT, ET | 85S022 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.025 mol/L Pbuf; pH 8.0; μ = 1.5 (NaCl); [Co$^{II}$]/[L] = 0.2 | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| | Co(bpy)$_3{}^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | $2.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT, ET | 85S022 |
| 20.1.14. | Co(bpy)$_3{}^{3+}$ | H$_2$O | 0.01 mol/L H$_2$SO$_4$, 0.33 mol/L Na$_2$SO$_4$ | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT | 80A003 |
| | Co(bpy)$_3{}^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$ | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| | Co(bpy)$_3{}^{3+}$ | H$_2$O | 0.5 mol/L NaCl | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| | Co(bpy)$_3{}^{3+}$ | H$_2$O | 0.5 mol/L NaBr | 25 | $3.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $Co(bpy)_3^{3+}$ | $H_2O$ | 0.33 mol/L $Na_2SO_4$; 0.028 mol/L $NaHSO_4$; $\mu$ = 1.0 | | $1.9 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/SST); OT | 82F048 |
| 20.1.15. | $Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$ | $H_2O$ | 0.01 mol/L HCl; $\mu$ = 0.01 | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 $\mu$s; OT; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 80F208 |
| | $Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$ | $H_2O$ | 0.11 mol/L HCl; $\mu$ = 0.11 | 25 | $4.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 $\mu$s; OT | 80F208 |
| | $Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$ | $H_2O$ | 0.81 mol/L HCl; $\mu$ = 0.81 | 25 | $4.5 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 $\mu$s; OT | 80F208 |
| 20.1.16. | cis-$Co(bzac)_3$ | EtOH/CHCl$_3$ (9/1) | | 23-24 | $1.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.79 $\mu$s (J.N. Demas, priv. comm.); OT | 77F726 |
| 20.1.17. | trans-$Co(bzac)_3$ | EtOH/CHCl$_3$ (9/1) | | 23-24 | $1.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.79 $\mu$s (J.N. Demas, priv. comm.); OT | 77F726 |
| 20.1.18. | $Co(C_5H_5)_2^+$ | $H_2O$/EtOH (1/1) | | 25 | $1.5 \times 10^8$ | SS/LUM; $\tau_0$ = ~0.9 $\mu$s (FL/LUM/SST); ET | 756002 |
| 20.1.19. | $Co(C_5H_4COOH)_2^+$ | $H_2O$ | pH 1-10; $\mu$ = 0.1 (NaCl) | | $1.5 \times 10^9$ | LP/LUM/SST | 82S072 |
| 20.1.20. | $Co(CLHOsar)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $2.0 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; OT; $f$ = 0.95 | 85F222 |
| | $Co(CLHOsar)^{3+}$ | $H_2O$ | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | $7.6 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s | 85F222 |
| 20.1.21. | $Co(CLNOsar)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $4.5 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; OT; $f$ = 1 | 85F222 |
| 20.1.22. | $Co(5\text{-}Clphen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | $2.3 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| 20.1.23. | $Co(5\text{-}Clphen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; [Co$^{II}$]/[L] = 0.2 | 25 | $6.3 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 85S022 |
| 20.1.24. | $Co(CLsar)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.4 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (65%), OT (35%); $f$ = 0.35; same $k_q$ from same lab in 83S090 | 85F222 |
| | $Co(CLsar)^{3+}$ | $H_2O$ | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | $3.0 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; same $k_q$ from same lab in 83S090 | 85F222 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 20.1.25. | Co(CMMEabsar)$^{3+}$ | H$_2$O | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | 7 × 10$^7$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET | 85F222 |
| | Co(CMMEabsar)$^{3+}$ | H$_2$O | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | 1.5 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s | 85F222 |
| 20.1.26. | Co(CN)$_6$$^{3-}$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 3.2 × 10$^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); ET; [Q] = 0.17 mol/L | 766319 |
| | Co(CN)$_6$$^{3-}$ | H$_2$O | 0.5 mol/L NaCl; pH 4 | 23 | <1 × 10$^6$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 $\mu$s (746112); [Q] = 0.05 mol/L | 766027 |
| 20.1.27. | Co$^{III}$(CN)$_5$($\mu$-O$_2$)Co$^{III}$(CN)$_5$$^{5-}$ | H$_2$O | 0.1 mol/L HCl; $\mu$ = 0.25 (NaCl) | 25 | 4.8 × 10$^9$ | LP/LUM/SST; OT | 82A068 |
| 20.1.28. | Co(CN)$_5$(pyrazinecarboxylato)$^{3-}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 2.9 × 10$^9$ | SS/LUM or LP/LUM/AVE; $\tau_0$ = 0.60 $\mu$s (766404); OT | 776405 |
| 20.1.29. | Co(C$_2$O$_4$)$_3$$^{2-}$ | H$_2$O | 0.05 mol/L H$_2$SO$_4$ | | 6.7 × 10$^9$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 0.66 $\mu$s; OT; [Q] = (1-8) × 10$^{-4}$ mol/L | 737656 |
| 20.1.30. | Co(C$_2$O$_4$)$_3$$^{3-}$ | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 3.8 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); [Q] $\leq$ 1.5 × 10$^{-4}$ mol/L; some SQ | 766319 |
| 20.1.31. | *lel*$_3$-Co(diAMchar)$^{3+}$ | H$_2$O | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | 8 × 10$^7$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (57%), OT (43%); $f$ = 0.43 | 85F222 |
| | *lel*$_3$-Co(diAMchar)$^{3+}$ | H$_2$O | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | 4.0 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s | 85F222 |
| 20.1.32. | Co(diAMsar)$^{3+}$ | H$_2$O | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | 4.4 × 10$^7$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (38%), OT (62%); $f$ = 0.62 | 85F222 |
| 20.1.33. | *lel*$_3$-Co(diAZAchar)$^{3+}$ | H$_2$O | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | 4.2 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s | 85F222 |
| | *lel*$_3$-Co(diAZAchar)$^{3+}$ | H$_2$O | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | 1.4 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (72%), OT (18%); $f$ = 0.18 | 85F222 |
| 20.1.34. | Co(diCLsar)$^{3+}$ | H$_2$O | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | 2.2 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; OT; $f$ = 1 | 85F222 |
| | Co(diCLsar)$^{3+}$ | H$_2$O | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | 9.6 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s | 85F222 |

QUENCHING OF EXCITED METAL COMPLEXES IN FLUID SOLUTION

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TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. $Ru(bpy)_3^{2+}$—Continued** | | | | | | | |
| 20.1.35. | $Co(diNOsar)^{3+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $6.1 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET (9%), OT (91%); $f$ = 0.91 | 85F222 |
| 20.1.36. | $Co(DMG)_2(C_2H_5)(H_2O)$ | $H_2O$ | | ~22 | $2.0 \times 10^9$ | LP/LUM/SST; ET? | 83E223 |
| 20.1.37. | $Co(EDTA)^-$ | $H_2O$ | | ~25 | $3 \times 10^8$ | SS/LUM; $\tau_0$ = 0.6 $\mu$s (69E219); OT | 73F673 |
| 20.1.38. | $Co(EFMEoxosar-H)^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $1.0 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; ET; same $k_q$ from same lab in 83S090 | 85F222 |
| | $Co(EFMEoxosar-H)^{2+}$ | $H_2O$ | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | $3.6 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; same $k_q$ from same lab in 83S090 | 85F222 |
| 20.1.39. | $Co(en)_3^{3+}$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $2.0 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| | $Co(en)_3^{3+}$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | 25 | $4.9 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (84A238); ET, OT; [Q] = (3-90) $\times$ 10$^{-4}$ mol/L | 85F161 |
| | $Co(en)_3^{3+}$ | $H_2O$ | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | $3.4 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (84A238); ET, OT; [Q] = (3-90) $\times$ 10$^{-4}$ mol/L | 85F161 |
| | $Co(en)_3^{3+}$ | $H_2O$ | 1 mol/L H$_2$SO$_4$ | | $6.2 \times 10^7$ | LP/LUM/SST; OT | 83S001 |
| 20.1.40. | cis-$Co(en)_2Cl_2^+$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.4 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| 20.1.41. | trans-$Co(en)_2Cl_2^+$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $2.0 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| 20.1.42. | $Co(en)_2(gly)^{2+}$ | $H_2O$ | | 25 | $1.2 \times 10^8$ | SS/LUM; $\tau_0$ = 0.6 $\mu$s (766539); OT; [Q] $\leq$ 0.02 mol/L | 85A470 |
| 20.1.43. | cis-$Co(en)_2(H_2O)Cl^{2+}$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $6.0 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| 20.1.44. | cis-$Co(en)_2(NCS)_2^+$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $7.6 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| 20.1.45. | trans-$Co(en)_2(NCS)_2^+$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $4.8 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| 20.1.46. | cis-$Co(en)_2(NCS)Cl^+$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.6 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| 20.1.47. | trans-$Co(en)_2(NCS)Cl^+$ | $H_2O$ | 0.1 mol/L H$_2$SO$_4$ | ~22 | $1.1 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 20.1.48. | cis-Co(en)$_2$(NH$_3$)Cl$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | 4.2 × 10$^8$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 μs (LP/LUM/AVE); OT | 84A255 |
| 20.1.49. | Co$^{III}$(en)$_2$(μ-O$_2$,NH$_2$)Co$^{III}$(en)$_2$$^{4+}$ | H$_2$O | 0.01 mol/L HCl; μ = 0.01 | 25 | 7.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(en)$_2$(μ-O$_2$,NH$_2$)Co$^{III}$(en)$_2$$^{4+}$ | H$_2$O | 0.01 mol/L HCl; μ = 0.51 (NaCl) | 25 | 3.6 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(en)$_2$(μ-O$_2$,NH$_2$)Co$^{III}$(en)$_2$$^{4+}$ | H$_2$O | 0.05 mol/L H$_2$SO$_4$; μ = 0.25 (NaCl) | 25 | 1.9 × 10$^9$ | LF/LUM/SST; OT | 82A068 |
| | Co$^{III}$(en)$_2$(μ-O$_2$,NH$_2$)Co$^{III}$(en)$_2$$^{4+}$ | H$_2$O | 0.1 mol/L HCl; μ = 0.1 | 25 | 4.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT; [Q] ≤ 3 × 10$^{-4}$ mol/L | 80F208 |
| | Co$^{III}$(en)$_2$(μ-O$_2$,NH$_2$)Co$^{III}$(en)$_2$$^{4+}$ | H$_2$O | 1 mol/L HCl; μ = 1.0 | 25 | 3.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| 20.1.50. | Co(HEDTA)Br$^-$ | H$_2$O | 0.1 mol/L HClO$_4$ or 1 mol/L H$_2$SO$_4$ | | 3.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.6 μs (69E219); ET? | 737081 |
| 20.1.51. | Co(HEDTA)Cl$^-$ | H$_2$O | 0.1 mol/L HClO$_4$ or 1 mol/L H$_2$SO$_4$ | | 8 × 10$^8$ | SS/LUM; $\tau_0$ = 0.6 μs (69E219); ET? | 737081 |
| 20.1.52. | Co(HEDTA)(NO$_2$)$^-$ | H$_2$O | 0.1 mol/L HClO$_4$ or 1 mol/L H$_2$SO$_4$ | | 1.3 × 10$^9$ | SS/LUM; $\tau_0$ = 0.6 μs (69E219); ET? | 737081 |
| 20.1.53. | Co(HYMEoxosar-H)$^{2+}$ | H$_2$O | ACbuf; pH 5; μ = 0.1 (NaClO$_4$) | 20 | 7 × 10$^7$ | LP/LUM/SST; $\tau_0$ = 0.64 μs; ET; same $k_q$ from same lab in 83S090 | 85F222 |
| | Co(HYMEoxosar-H)$^{2+}$ | H$_2$O | ACbuf; 0.5 mol/L NaClO$_4$; pH 5 | 20 | 2.8 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 μs; same $k_q$ from same lab in 83S090 | 85F222 |
| 20.1.54. | Co(4,4'-Me$_2$bpy)$_3$$^+$ | AN | 0.1 mol/L TEAP | 25 | 2.7 × 10$^9$ | LP/LUM/AVE; $\tau_0$ = 0.85 μs; RT | 86A077 |
| 20.1.55. | Co(4,4'-Me$_2$bpy)$_3$$^{2+}$ | AN | 0.1 mol/L TEAP | 25 | 1.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.85 μs (LP/LUM/AVE); OT, ET? | 86A077 |
| 20.1.56. | trans-Co(Me$_6$cycladiene)(H$_2$O)$_2$$^{3+}$ | H$_2$O | 0.1 mol/L TEOA | 25 | 2.7 × 10$^8$ | SS/QYP; $\tau_0$ = 0.6 μs (79F045); OT; [Q] ≤ 0.003 mol/L; see Mech. [7] | 83A333 |
| 20.1.57. | Co(MENOsar)$^{3+}$ | H$_2$O | ACbuf; pH 5; μ = 0.1 (NaClO$_4$) | 20 | 2.1 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.64 μs; ET, OT; $f$ = >0.27 | 85F222 |
| 20.1.58. | Co(4,7-Me$_2$phen)$^{2+}$ | H$_2$O | 0.05 mol/L Pbuf; pH 6.0; [Co$^{II}$]/[L] = 4.5 | 25 | 7 × 10$^7$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); OT | 85S022 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| 20.1.59. | $Co(4,7\text{-}Me_2phen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $7.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| 20.1.60. | $Co(NH_3)_6^{3+}$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $<3 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/AVE); [Q] = 0.002-0.009 mol/L | 766319 |
| | $Co(NH_3)_6^{3+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $4.0 \times 10^7$ | SS/LUM; $\tau_0^{air} = 0.40$ μs (LP/LUM/AVE); OT | 84A255 |
| | $Co(NH_3)_6^{3+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | 25 | $3.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (84A238); ET, OT; [Q] = (3-90) $\times 10^{-4}$ mol/L | 85F161 |
| | $Co(NH_3)_6^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $\sim 1 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/SPC); OT; [Q] = 0.007 mol/L | 747635 |
| | $Co(NH_3)_6^{3+}$ | $H_2O$ | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | $1.5 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (84A238); ET, OT; [Q] = (3-90) $\times 10^{-4}$ mol/L | 85F161 |
| 20.1.61. | $Co(NH_3)_5(benzoato)^{2+}$ | $H_2O$ | Pbuf; pH 5.8; $\mu$ = 0.10 (LiClO$_4$) | 25 | $1.5 \times 10^8$ | SS/LUM, SS/QYP; $\tau_0 = 0.60$ μs (747635); OT; $f$ = 0.5; [Q] = (5-50) $\times 10^{-4}$ mol/L; see Mech. [7] | 80F058 |
| 20.1.62. | $Co(NH_3)_5[1,2\text{-bis}(4\text{-}pyridyl)ethane]^{3+}$ | $H_2O$ | 0.01 mol/L Pbuf; pH 5.6; $\mu$ = 0.1 (LiClO$_4$) | 25 | $2.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] = (5-20) $\times 10^{-4}$ mol/L | 78E293 |
| 20.1.63. | $Co(NH_3)_5[trans\text{-}1,2\text{-bis}(4\text{-}pyridyl)ethene]^{3+}$ | $H_2O$ | 0.01 mol/L Pbuf; pH 5.6; $\mu$ = 0.1 (LiClO$_4$) | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] = (1.3-200) $\times 10^{-4}$ mol/L | 78E293 |
| 20.1.64. | $Co(NH_3)_5Br^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/SPC); OT; [Q] $\leq$ 0.002 mol/L | 747635 |
| | $Co(NH_3)_5Br^{2+}$ | $H_2O/2\text{-}PrOH$ (1/1) | 0.5 mol/L $H_2SO_4$ | 25 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.87$ μs (LP/LUM/SPC); OT | 747635 |
| 20.1.65. | $Co(NH_3)_5Cl^{2+}$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $7.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/AVE); OT; [Q] = 0.002-0.005 mol/L | 766319 |
| | $Co(NH_3)_5Cl^{2+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $5.8 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.40$ μs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L | 84A255 |
| | $Co(NH_3)_5Cl^{2+}$ | $H_2O$ | pH 0($H_2SO_4$) | ~25 | $6.7 \times 10^8$ | EMI; $\tau_0^{air} = 0.46$ μs; OT; $f$ = 0.85 | 82S163 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 9.3 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/SPC); OT; [Q] $\leq$ 0.005 mol/L | 747635 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | ACbuf; pH 4.7; $\mu$ = 0.01 (NaCl) | 25 | 3.8 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (84A238); OT; [Q] = (3-90) × 10$^{-4}$ mol/L | 85F161 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | ACbuf; pH 4.8; $\mu$ = 0.03 | 25 | 2.2 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85F089 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | ACbuf; pH 4.8; $\mu$ = 0.05 | 25 | 3.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85F089 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | ACbuf; pH 4.8; $\mu$ = 0.2 | 25 | 8.2 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85F089 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.1 mol/L ACbuf; pH 5 | | 9.3 × 10$^8$ | SS/LUM; OT | 81N178 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.01 mol/L Pbuf; pH 7 | | 2.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.6 $\mu$s (78Z170); OT; [Q] = 0.001-0.005 mol/L | 86F171 |
| | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O/2-PrOH (1/1) | 0.5 mol/L H$_2$SO$_4$ | 25 | 4.6 × 10$^8$ | SS/LUM; $\tau_0$ = 0.87 $\mu$s (LP/LUM/SPC); OT | 747635 |
| 20.1.66. | Co(NH$_3$)$_5$F$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | 8.0 × 10$^7$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L | 84A255 |
| 20.1.67. | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | 7.5 × 10$^7$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT | 84A255 |
| | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.05 mol/L H$_2$SO$_4$; $\mu$ = 0.25 (NaCl) | 25 | 1.4 × 10$^8$ | LP/LUM/SST; ET; $\Delta V^{\ddagger}$ = $-2.6$ × 10$^{-3}$ L/mol (0.1-300 MPa) | 82A068 |
| | Co(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 1.5 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/SPC); OT; [Q] $\leq$ 0.011 mol/L | 747635 |
| 20.1.68. | Co(NH$_3$)$_5$(N-Mevio)$^{4+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 7.2 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; $f$ = 0.9; [Q] = (4.5-16) × 10$^{-4}$ mol/L | 78E293 |
| | Co(NH$_3$)$_5$(N-Mevio)$^{4+}$ | H$_2$O | 0.01 mol/L Pbuf; pH 5.6; $\mu$ = 0.1 (LiClO$_4$) | 25 | 1.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] = (2.8-23) × 10$^{-4}$ mol/L | 78E293 |
| 20.1.69. | Co(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 0.1 mol/L H$_2$SO$_4$ | ~22 | 3.0 × 10$^9$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 $\mu$s (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L | 84A255 |

QUENCHING OF EXCITED METAL COMPLEXES IN FLUID SOLUTION

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TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| 20.1.70. | $Co(NH_3)_5(NO_2)^{2+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $1.0 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.40$ µs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L | 84A255 |
| 20.1.71. | $Co(NH_3)_5[2-(NO_2)benz]^{2+}$ | $H_2O$ | Pbuf; pH 5.8; µ = 0.10 (LiClO$_4$) | 25 | $1.3 \times 10^9$ | SS/LUM, SS/QYP; $\tau_0$ = 0.60 µs (747635); OT; $f$ = 0.05; [Q] = (5-50) × 10$^{-4}$ mol/L; see Mech. [7] | 80F058 |
| 20.1.72. | $Co(NH_3)_5[4-(NO_2)benz]^{2+}$ | $H_2O$ | Pbuf; pH 5.8; µ = 0.10 (LiClO$_4$) | 25 | $2.4 \times 10^9$ | SS/LUM, SS/QYP; $\tau_0$ = 0.60 µs (747635); OT; $f$ = 0.01; [Q] = (5-50) × 10$^{-4}$ mol/L; see Mech. [7] | 80F058 |
| 20.1.73. | $Co(NH_3)_5[OC(O)CH_3]^{2+}$ | $H_2O$ | Pbuf; pH 5.8; µ = 0.10 (LiClO$_4$) | 25 | $2.1 \times 10^8$ | SS/LUM; $\tau_0$ = 0.60 µs (747635); OT; [Q] = (5-50) × 10$^{-4}$ mol/L | 80F058 |
| 20.1.74. | $Co(NH_3)_5[OC(O)H]^{2+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $4.7 \times 10^7$ | SS/LUM; $\tau_0^{air} = 0.40$ µs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L | 84A255 |
| 20.1.75. | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 0.02 mol/L HClO$_4$; µ = 0.02 | 25 | $1.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 0.02 mol/L HClO$_4$; µ = 0.42 (NaClO$_4$) | 25 | $4.5 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 0.05 mol/L $H_2SO_4$; µ = 0.25 (NaCl) | 25 | $1.9 \times 10^9$ | LP/LUM/SST; OT | 82A068 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 0.1 mol/L HCl; µ = 0.1 | 25 | $7.4 \times 10^8$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 0.1 mol/L HClO$_4$; µ = 0.1 | 25 | $2.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $4.6 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 1 mol/L HCl; µ = 1.0 | 25 | $1.9 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ | $H_2O$ | 1 mol/L HClO$_4$; µ = 1.0 | 25 | $4.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT; [Q] ≤ 3 × 10$^{-4}$ mol/L | 80F208 |
| 20.1.76. | $Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$ | $H_2O$ | 0.01 mol/L HCl; µ = 0.01 | 25 | $1.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |
| | $Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$ | $H_2O$ | 0.01 mol/L HClO$_4$; µ = 0.21 (NaClO$_4$) | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.5 µs; OT | 80F208 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 0.01 mol/L HCl; μ = 0.54 (NaCl) | 25 | 2.8 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 0.01 mol/L HClO$_4$; μ = 0.81 (NaClO$_4$) | 25 | 3.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 0.01 mol/L HCl; μ = 1.3 (NaCl) | 25 | 4.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 0.1 mol/L HClO$_4$; μ = 0.1 | 25 | 1.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT; [Q] ≤ 7 × 10$^{-4}$ mol/L | 80F208 |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 0.1 mol/L HCl; μ = 0.1 | 25 | 2.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 1 mol/L HClO$_4$; μ = 1.0 | 25 | 8.8 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| | Co$^{III}$(NH$_3$)$_4$(μ-O$_2$,NH$_2$)Co$^{III}$(NH$_3$)$_4^{4+}$ | H$_2$O | 1 mol/L HCl; μ = 1.0 | 25 | 4.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.5 μs; OT | 80F208 |
| 20.1.77. | Co(NH$_3$)$_5$(py)$^{3+}$ | H$_2$O | 0.01 mol/L Pbuf; pH 5.6; μ = 0.1 (LiClO$_4$) | 25 | 1.7 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); OT; [Q] = (4.5-19) × 10$^{-4}$ mol/L | 78E293 |
| | Co(NH$_3$)$_5$(py)$^{3+}$ | H$_2$O | Pbuf; pH 5.8; μ = 0.10 (LiClO$_4$) | 25 | 2.1 × 10$^8$ | SS/QYP; $\tau_0$ = 0.60 μs (747635); OT; $f$ = 0.8; [Q] = (5-50) × 10$^{-4}$ mol/L; see Mech. [7] | 80F058 |
| 20.1.78. | Co(NH$_3$)$_5$(vio)$^{3+}$ | H$_2$O | 0.094 mol/L HClO$_4$; μ = 0.1 | 25 | 1.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); OT; [Q] = (2-10) × 10$^{-4}$ mol/L | 78E293 |
| | Co(NH$_3$)$_5$(vio)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 7.3 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); OT; $f$ = 0.9; [Q] = (5.5-16) × 10$^{-4}$ mol/L | 78E293 |
| | Co(NH$_3$)$_5$(vio)$^{3+}$ | H$_2$O | 0.01 mol/L Pbuf; pH 5.6; μ = 1.0 (LiClO$_4$) | 25 | 5.7 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); OT; $f$ = 1; [Q] = (2.1-16) × 10$^{-4}$ mol/L | 78E293 |
| 20.1.79. | Co(NO$_2$)$_6^{3-}$ | H$_2$O | μ = 0 (calc'd) | ~21 | ~9 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 μs (LP/LUM/AVE); OT; [Q] = (2-7) × 10$^{-4}$ mol/L | 766319 |
| 20.1.80. | Co[4-(NO$_2$)bpy]$_3^{3+}$ | H$_2$O | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; μ = 1.0 | | 9.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.60 μs (LP/LUM/SST); OT | 82F048 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L $mol^{-1}$ $s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2-}$—Continued** | | | | | | |
| 20.1.81. | $Co(phen)^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5 | 25 | $2.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| 20.1.82. | $Co(phen)_3^{2+}$ | $H_2O$ | 0.5 mol/L NaCl | 25 | $8.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); RT | 766046 |
| | $Co(phen)_3^{2+}$ | $H_2O$ | 0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2 | 25 | $3.0 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 85S022 |
| 20.1.83. | $Co(phen)_3^{3+}$ | $H_2O$ | 0.1 mol/L $H_2SO_4$ | ~22 | $1.9 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.40$ μs (LP/LUM/AVE); OT | 84A255 |
| | $Co(phen)_3^{3+}$ | $H_2O$ | 0.17 mol/L NaCl | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT | 766014 |
| | $Co(phen)_3^{3+}$ | $H_2O$ | 0.5 mol/L NaCl | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT; [Q] ≤ 0.025 mol/L | 766014 |
| | $Co(phen)_3^{3+}$ | $H_2O$ | 0.01 mol/L $H_2SO_4$, 0.33 mol/L $Na_2SO_4$; μ = 1.0 | | $2.4 \times 10^9$ | FP/QYP; $\tau_0 = 0.60$ μs (747635); OT, ET; $f = 0.53$; [Q] = (2.5-20) × $10^{-4}$ mol/L; see Mech. [8]; $k_q$ = $2.2 \times 10^9$ L $mol^{-1}$ $s^{-1}$ for SS/LUM from same lab in 80A003 | 82F065 |
| 20.1.84. | $Co^{II}(phen)_2(\mu\text{-}O_2,NH_2)Co^{III}(phen)_2^{4+}$ | $H_2O$ | 1 mol/L HCl; μ = 1.0 | 25 | $8.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.5$ μs; OT; [Q] ≤ 9 × $10^{-4}$ mol/L | 80F208 |
| 20.1.85. | $Co(sar)^{3+}$ | $H_2O$ | ACbuf pH 5; μ = 0.1 $(NaClO_4)$ | 20 | $1.6 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; ET (80%), OT (20%); $f$ = 0.2 | 85F222 |
| | $Co(sar)^{3+}$ | $H_2O$ | ACbuf 0.5 mol/L $NaClO_4$; pH 5 | 20 | $2.2 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; same $k_q$ from same lab in 83S090 | 85F222 |
| 20.1.86. | $Co(sep)^{3+}$ | $H_2O$ | ACbuf; pH 5; μ = 0.1 $(NaClO_4)$ | 20 | $1.5 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; ET (75%), OT (25%); $f$ = 0.25; same $k_q$ from same lab in 83S090 | 85F222 |
| | $Co(sep)^{3+}$ | $H_2O$ | ACbuf; 0.5 mol/L $NaClO_4$; pH 5 | 20 | $5.5 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; same $k_q$ from same lab in 83S090 | 85F222 |
| | $Co(sep)^{3+}$ | $H_2O$ | 0.2 mol/L LiCl | 25 | $2.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); ET, OT; $f = 0.51$ | 84A238 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $Co(sep)^{3+}$ | $H_2O$ | 0.2 mol/L TEOA; pH 8.1; $\mu$ = 0.2 (LiCl) | 25 | $3.4 \times 10^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu s$ (766404); ET, OT | 84A238 |
| | $Co(sep)^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.8 \times 10^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu s$ (766404); ET, OT | 84A238 |
| | $Co(sep)^{3+}$ | $H_2O$ | $\mu$ = 0.1 (NaCl) | | $2.6 \times 10^8$ | LP/LUM/SST; OT; $f$ = 0.9 | 82S072 |
| | $Co(sep)^{3+}$ | $H_2O$ | 1 mol/L $H_2SO_4$ | | $3.6 \times 10^8$ | LP/LUM/SST; OT | 83S001 |
| 20.1.87. | $CoSiW_{11}O_{39}H_2O^{6-}$ | $H_2O$ | | | $\sim 3 \times 10^{10}$ (calc) | SL/LUM/SPC; $\tau_0^{air}$ = 0.40 $\mu s$; OT; [Q] = (2, 4) $\times$ $10^{-4}$ mol/L; some SQ see Mech. [11] | 85E375 |
| 20.1.88. | $Co(terpy)_2^+$ | AN | 0.1 mol/L TEAP | 25 | $2.0 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 0.85 $\mu s$; RT | 86A077 |
| 20.1.89. | $Co(terpy)_2^{2+}$ | AN | 0.1 mol/L TEAP | 25 | $3.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 $\mu s$ (LP/LUM/AVE); OT, ET? | 86A077 |
| 20.1.90. | $cis$-$Co(tfac)_3$ | EtOH | | 23-24 | $1.8 \times 10^9$ | SS/LUM; $\tau_0$ = 0.79 $\mu s$ (J.N. Demas, priv. comm.); OT | 77F726 |
| 20.1.91. | $trans$-$Co(tfac)_3$ | EtOH | | 23-24 | $1.8 \times 10^9$ | SS/LUM; $\tau_0$ = 0.79 $\mu s$ (J.N. Demas, priv. comm.); OT | 77F726 |
| 20.1.92. | $Cr^{3+}$ | $H_2O$ | 1 mol/L $CF_3SO_3Na$ | 15 | $1.3 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| | $Cr^{3+}$ | $H_2O$ | 0.04 mol/L $H_2SO_4$; $\mu$ = 1.0 (MgCl$_2$) | 25 | $1.2 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu s$ (LP/LUM/AVE); ET | 766404 |
| | $Cr^{3+}$ | $H_2O$ | | | $9.7 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.59 $\mu s$ | 85N164 |
| | $Cr^{3+}$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 2 | | $9.3 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.59 $\mu s$; some SQ | 85N164 |
| | $Cr^{3+}$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 7 | | $8.4 \times 10^3$ | LP/LUM/SST; $\tau_0$ = 0.67 $\mu s$; some SQ | 85N164 |
| 20.1.93. | $Cr(acac)_3$ | MeOH | | $\sim 21$ | $3.0 \times 10^3$ | SS/LUM; $\tau_0$ = 0.77 $\mu s$ (LP/LUM/AVE); ET; [Q] = 0.001-0.004 mol/L | 766319 |
| 20.1.94. | $Cr(bpy)_3^{3+}$ | $H_2O$ | $\mu$ = 0.2 | 23 | $3.3 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu s$ (737633); OT | 756325 |
| 20.1.95. | $cis$-$Cr(bzac)_3$ | EtOH/CHCl$_3$ (9/1) | | 23-24 | $8.5 \times 10^3$ | SS/LUM; $\tau_0$ = 0.79 $\mu s$ (J.N. Demas, priv. comm.); ET | 77F726 |

TABLE 20. Quenching of Ru(bpy)$_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. Ru(bpy)$_3^{2+}$—Continued** | | | | | | | |
| 20.1.96. | trans-Cr(bzac)$_3$ | EtOH/CHCl$_3$ (9/1) | | 23-24 | $6.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.79$ μs (J.N. Demas, priv. comm.); ET | 77F726 |
| 20.1.97. | Cr(CN)$_6^{3-}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $2.5 \times 10^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0 = 0.60$ μs (LP/LUM/AVE); ET; [Q] $\leq 5 \times 10^{-4}$ mol/L; some SQ | 766319 |
| | Cr(CN)$_6^{3-}$ | H$_2$O | $\mu = 0.5$ (KCl) | | $2.1 \times 10^{10}$ | SS/LUM, SL/LUM/SST; $\tau_0^{air} = 0.40$ μs; ET; [Q] = (2-20) $\times 10^{-4}$ mol/L; $k_q$ calc for $\mu = 0$ | 737633 |
| 20.1.98. | Cr(C$_2$O$_4$)$_3^{3-}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $2.1 \times 10^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0 = 0.60$ μs (LP/LUM/AVE); ET; [Q] $\leq 3 \times 10^{-4}$ mol/L; some SQ | 766319 |
| | Cr(C$_2$O$_4$)$_3^{3-}$ | H$_2$O | | | $8.5 \times 10^9$ | SS/LUM, LP/LUM/SST; $\tau_0 = 0.66$ μs; ET; [Q] = (2-8) $\times 10^{-4}$ mol/L | 737656 |
| 20.1.99. | trans-Cr(cyclam)(CN)$_2^+$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $2.4 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.100. | Cr(en)$_3^{3+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $7.2 \times 10^6$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.101. | cis-Cr(en)$_2$Cl$_2^+$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $1.0 \times 10^8$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.102. | trans-Cr(en)$_2$Cl$_2^+$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $6.6 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.103. | Cr(NH$_3$)$_6^{3+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $<2 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.104. | Cr(NH$_3$)$_5$Br$^{2+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $8.6 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.105. | Cr(NH$_3$)$_5$(CN)$^{2+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $1.4 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.106. | Cr(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $6.2 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.107. | Cr(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | $1.6 \times 10^7$ (corr) | LP/LUM/SST; ET | 86E096 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 20.1.108. | Cr(NH$_3$)$_5$(N$_3$)$^{2+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | 9.2 × 10$^7$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.109. | Cr(NH$_3$)$_5$(NCS)$^{2+}$ | H$_2$O | 1 mol/L CF$_3$SO$_3$Na | 15 | 3.4 × 10$^3$ (corr) | LP/LUM/SST; ET | 86E096 |
| 20.1.110. | cis-Cr(tfac)$_3$ | EtOH | | 23-24 | 3.6 × 10$^3$ | SS/LUM; $\tau_0 = 0.79$ μs (J.N. Demas, priv. comm.); ET | 77F726 |
| 20.1.111. | trans-Cr(tfac)$_3$ | EtOH | | 23-24 | 2.5 × 10$^3$ | SS/LUM; $\tau_0 = 0.79$ μs (J.N. Demas, priv. comm.); ET | 77F726 |
| 20.1.112. | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 16.9 | 5.4 × 10$^7$ | SS/LUM; $\tau_0 = 0.65$ μs (766539); OT | 78A090 |
| | Cu$^{2+}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | 6.6 × 10$^6$ | SS/LUM and LP/LUM/AVE; $\tau_0 = 0.60$ μs (LP/LUM/AVE); OT; [Q] = 0.05-0.06 mol/L; some SQ | 766319 |
| | Cu$^{2+}$ | H$_2$O | 0.25 mol/L H$_2$SO$_4$; $\mu = 0.8-1$ | 25 | 6.2 × 10$^7$ | SL/LUM/SPC; $\tau_0 = 0.57$ μs; $\Delta H^{\ddagger} = 11$ kJ/mol; $\Delta S^{\ddagger} = -57$ J/mol·K (20-80°C); OT | 80A308 |
| | Cu$^{2+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | 25 | 6.6 × 10$^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; $f = 0.68$ | 78A090 |
| | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | 6.2 × 10$^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; $f = 0.56$ | 78A090 |
| | Cu$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 34.8 | 7.2 × 10$^7$ | SS/LUM; $\tau_0 = 0.54$ μs (766539); OT | 78A090 |
| | Cu$^{2+}$ | H$_2$O | | | 7 × 10$^7$ | SS/LUM; OT; [Q] = (5-20) × 10$^{-4}$ mol/L | 78A215 |
| | Cu$^{2+}$ | H$_2$O | | | 5.1 × 10$^7$ | LP/LUM/SST; $\tau_0 = 0.59$ μs | 85N164 |
| | Cu$^{2+}$ | H$_2$O | 1 mol/L KCl | | 8.3 × 10$^8$ | SS/LUM; $\tau_0 = 0.62$ μs (LP/LUM/AVE); OT | 85E218 |
| | Cu$^{2+}$ | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 2 | | 4.4 × 10$^7$ | LP/LUM/SST; $\tau_0 = 0.59$ μs; some SQ | 85N164 |
| | Cu$^{2+}$ | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 7 | | 3.9 × 10$^9$ | LP/LUM/SST; $\tau_0 = 0.67$ μs; some SQ | 85N164 |
| 20.1.113. | Cu(acac)$_2$ | MeOH | | ~21 | 1.1 × 10$^9$ | SS/LUM; $\tau_0 = 0.77$ μs (LP/LUM/AVE); OT; [Q] = (3-12) × 10$^{-4}$ mol/L | 766319 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2-}$—Continued** | | | | | | |
| 20.1.114. | Cu$^{II}$-Acetic acid | $H_2O$ | 0.5 mol/L HAc; 0.5 mol/L NaAc; $\mu = 1.0$ | 21 | $2.8 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s; OT; [Q] = 0.0025-0.010 mol/L; 90% of Q as $Cu(CH_3COO)_4^{2-}$ | 78F683 |
| 20.1.115. | Cu$^{II}$-azurin | $H_2O$ | 0.027 mol/L $Na_2HPO_4$; 0.020 mol/L $NaH_2PO_4$; pH 7; $\mu = 0.1$ | 25 | $1.2 \times 10^9$ | LP/LUM/AVE; ET or OT | 85A362 |
| 20.1.116. | Cu-azurin | $H_2O$ | Pbuf; pH 7; $\mu = 0.1$ | 25 | $6.9 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.61$ $\mu$s; RT; linear S-V plot only for [Q] < 0.002 mol/L | 82A022 |
| 20.1.117. | CuCl$^+$ | $H_2O$ | 0.1 mol/L $HClO_4$; 0.5 mol/L NaCl; $\mu = 1.0$ | 21 | $3.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s; OT; $f = 0.59$; [Q] = 0.0025-0.010 mol/L; 75% of Q as CuCl$^+$ | 78F683 |
| | CuCl$^+$ | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L Cu$^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ ($CuCl_2$, $MgCl_2$); $\mu = 0.35$ | 25 | $1.1 \times 10^3$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 20.1.118. | CuCl$_2$ | $H_2O$ | 0.0025 mol/L $H_2SO_4$ + 0.088 mol/L Cu$^{2+}$ ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ ($CuCl_2$, $MgCl_2$); $\mu = 0.35$ | 25 | $2.0 \times 10^9$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 20.1.119. | Cu$^{II}$-Formic acid | $H_2O$ | 0.5 mol/L HCOOH; 0.5 mol/L HCOONa; $\mu = 1.0$ | 21 | $2.7 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s; OT; $f = 0.16$; [Q] = 0.0025-0.010 mol/L; 80% of Q as $Cu(HCOO)_4^{2-}$ | 78F683 |
| 20.1.120. | Cu$(H_2O)_n^{2+}$ | $H_2O$ | $\mu = 1.0$ | 21 | $8 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s; OT; $f = 0.74$; [Q] = 0.01-0.04 mol/L | 78F683 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$**—Continued $Cu(H_2O)_n^{2+}$ | H$_2$O | 0.0025 mol/L H$_2$SO$_4$ + 0.088 mol/L Cu$^{2+}$ (CuSO$_4$, CuCl$_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl$^-$ (CuCl$_2$, MgCl$_2$); $\mu$ = 0.35 | 25 | $5.7 \times 10^7$ | SL/LUM/SPC; OT; $k_q$ from $k_{obs}$ at various [Cu$^{II}$] and [Cl$^-$] using known association constants | 81A031 |
| 20.1.121. | Cu$^{II}$-plastocyanin | H$_2$O | 0.027 mol/L Na$_2$HPO$_4$; 0.020 mol/L NaH$_2$PO$_4$; pH 7; $\mu$ = 0.1 | 25 | $4.2 \times 10^9$ | LP/LUM/AVE; ET or OT | 85A362 |
| 20.1.122. | Cu$^I$-plastocyanin | H$_2$O | Pbuf; pH 7; $\mu$ = 0.1 | 25 | $1.6 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.61 $\mu$s; RT; linear S-V plot only for [Q] < 0.002 mol/L | 82A022 |
| 20.1.123. | Cu$^{II}$-stellacyanin | H$_2$O | 0.027 mol/L Na$_2$HPO$_4$; 0.020 mol/L NaH$_2$PO$_4$; pH 7; $\mu$ = 0.1 | 25 | $1.3 \times 10^9$ | LP/LUM/AVE; ET or OT | 85A362 |
| 20.1.124. | Cu$^I$-stellacyanin | H$_2$O | Pbuf; pH 7; $\mu$ = 0.1 | 25 | $4.2 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.61 $\mu$s; RT; linear S-V plot only for [Q] < 0.002 mol/L | 82A022 |
| 20.1.125. | Eu$^{2+}$ | H$_2$O | 0.05 mol/L HCl; $\mu$ = 0.5 (NaCl) | 10 | $2.8 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.70 $\mu$s; RT; [Q] = 0.01-0.09 mol/L | 78A087 |
|  | Eu$^{2+}$ | H$_2$O | 0.05 mol/L HCl; $\mu$ = 0.5 (NaCl) | 24 | $2.8 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.62 $\mu$s; RT; [Q] = 0.01-0.09 mol/L | 78A087 |
|  | Eu$^{2+}$ | H$_2$O | 0.05 mol/L HCl | 25 | $2.8 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (747635); RT; [Q] $\leq$ 0.08 mol/L | 766046 |
|  | Eu$^{2+}$ | H$_2$O | 0.05 mol/L HCl; $\mu$ = 0.5 (NaCl) | 25 | $2.8 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); RT; [Q] = 0.01-0.09 mol/L | 78A087 |
|  | Eu$^{2+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | 25 | $8.2 \times 10^6$ | LP/LUM/SST; RT; $\Delta V^{\ddagger}$ = $-1.1 \times 10^{-2}$ L/mol (0.1-300 MPa) | 82A068 |
|  | Eu$^{2+}$ | H$_2$O | 0.05 mol/L HCl; $\mu$ = 0.5 (NaCl) | ~39 | $2.2 \times 10^7$ | LP/LUM/SST; $\tau_0$ = 0.48 $\mu$s; RT; [Q] = 0.01-0.09 mol/L | 78A087 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. Ru(bpy)$_3^{2+}$**—Continued | | | | | | | |
| 20.1.126. Eu$^{3+}$ | | H$_2$O | 0.025 mol/L HCl, [MgCl$_2$] + [Eu$^{3+}$] = 0.9 mol/L | 25 | $\leq 8 \times 10^4$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/AVE); Q mainly as EuCl$^{2+}$ | 766404 |
| | Eu$^{3+}$ | H$_2$O | 0.025 mol/L HCl; μ = 2.8 (MgCl$_2$) | 25 | $3.6 \times 10^5$ | SL/LUM/SPC; $\tau_0 = 0.57$ μs; $\Delta H^{\ddagger} = 17$ kJ/mol; $\Delta S^{\ddagger}$ = −81 J/mol·K (20-80°C); OT; Q mainly as EuCl$^{2+}$ | 80A308 |
| 20.1.127. Eu(crypt)$^{2+}$ | | H$_2$O | 1 mol/L KCl | ~22 | $1.3 \times 10^9$ | SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L | 86E195 |
| 20.1.128. Eu(crypt)$^{3+}$ | | H$_2$O | 1 mol/L KCl | ~22 | $4.9 \times 10^7$ | SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L | 86E195 |
| 20.1.129. Fe$^{2+}$ | | H$_2$O | 0.5 mol/L HClO$_4$ | ~20 | $1.6 \times 10^7$ | SS/LUM; $\tau_0^{air} = 0.40$ μs (737633); ET; [Q] $\leq 0.04$ mol/L | 746396 |
| | Fe$^{2+}$ | H$_2$O | 0.05 mol/L H$_2$SO$_4$; μ = 0.25 (NaCl) | 25 | $1 \times 10^7$ | LP/LUM/SST; RT | 82A068 |
| | Fe$^{2+}$ | H$_2$O | 0.5 mol/L HClO$_4$; μ = 0.64 (NaClO$_4$) | 25 | $2.8 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); RT | 766046 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L KCl | | $3.3 \times 10^6$ | SS/LUM; $\tau_0 = 0.62$ μs (LP/LUM/AVE); RT | 85E218 |
| 20.1.130. Fe$^{3+}$ | | H$_2$O | 0.1 mol/L CF$_3$SO$_3$H | 18 | $1.9 \times 10^9$ | SS/LUM; OT | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.1 mol/L HClO$_4$ | 18 | $1.5 \times 10^9$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.17 mol/L H$_2$SO$_4$ | 18 | $1.3 \times 10^9$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.25 mol/L HClO$_4$ | 18 | $1.7 \times 10^9$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.5 mol/L HCl | 18 | $6.7 \times 10^8$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | 18 | $2.1 \times 10^9$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.5 mol/L H$_3$PO$_4$ | 18 | $8.0 \times 10^8$ | SS/LUM; OT | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.5 mol/L CF$_3$SO$_3$H | 18 | $2.1 \times 10^9$ | SS/LUM; OT | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.75 mol/L HClO$_4$ | 18 | $2.5 \times 10^9$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 1 mol/L HClO$_4$ | 18 | $2.8 \times 10^9$ | SS/LUM; OT; $f = $ ~0.7 | 79A218 |
| | Fe$^{3+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | ~20 | $1.9 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.40$ μs (737633); OT; [Q] $\leq 0.01$ mol/L | 746396 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $Fe^{3+}$ | $H_2O$ | 0.11 mol/L $HClO_4$ | 25 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT; [Q] $\leq 0.003$ mol/L; same $k_q$ from same lab in 757640 | 766014 |
| | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT; same $k_q$ from same lab in 766404 | 766014 |
| | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $HClO_4$ | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT; same $k_q$ from same lab in 757640 | 766014 |
| | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $HCl$ | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT | 766014 |
| | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | | $2.7 \times 10^9$ | FP/PCM/SST; $\tau_0 = 0.60$ μs (766404); OT, ET?; [Q] $\leq 0.002$ mol/L; $[Fe^{2+}] = [Fe^{3+}]$; see Mech. [8] | 80E224 |
| | $Fe^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/SST); OT | 82F048 |
| | $Fe^{3+}$ | $H_2O$ | 1 mol/L $HClO_4$ | | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.62$ μs (FP/LUM/SST); OT; same $k_q$ from same lab in 747159 | 767009 |
| | $Fe^{3+}$ | $H_2O$ | 1 mol/L $KCl$ | | $4.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.62$ μs (LP/LUM/AVE); OT | 85E218 |
| | $Fe^{3+}$ | $H_2O$ | 0.1 mol/L ACbuf; pH 5 | | $5.5 \times 10^8$ | SS/LUM; OT | 81N178 |
| 20.1.131. | $Fe(bpy)_3^{2+}$ | $H_2O$ | $\mu = 0.5$ ($Na_2SO_4$) | 25 | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.60$ μs; ET; [Q] $\leq 0.005$ mol/L | 80E040 |
| 20.1.132. | $Fe(C_5H_5)_2$ | DMF | 0.1 mol/L TBAB | | $3.2 \times 10^9$ | LP/LUM; $\tau_0 = 0.38$ μs; ET | 85A093 |
| | $Fe(C_5H_5)_2$ | DMF | 0.1 mol/L TBAC | | $4.0 \times 10^9$ | LP/LUM; $\tau_0 = 0.77$ μs; [Q] $= (1-6.5) \times 10^{-4}$ mol/L; ET | 85A093 |
| | $Fe(C_5H_5)_2$ | EtOH | | 25 | $5.9 \times 10^9$ | SS/LUM; $\tau_0 = \sim 0.9$ μs (FL/LUM/SST); ET | 756002 |
| 20.1.133. | $Fe(C_5H_5)[C_5H_4C(O)CH_3]$ | EtOH | | 25 | $3.4 \times 10^9$ | SS/LUM; $\tau_0 = \sim 0.9$ μs (FL/LUM/SST); ET | 756002 |
| 20.1.134. | $Fe(C_5H_5)[C_5H_4C(O)C_6H_5]$ | EtOH | | 25 | $7.4 \times 10^9$ | SS/LUM; $\tau_0 = \sim 0.9$ μs (FL/LUM/SST); ET | 756002 |

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TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. Ru(bpy)$_3$$^{2+}$**—Continued | | | | | | | |
| 20.1.135. Fe(CN)$_6$$^{3-}$ | | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 5.1 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); [Q] ≤ 4 × 10$^{-4}$ mol/L; some SQ | 766319 |
| | Fe(CN)$_6$$^{3-}$ | H$_2$O | 0.1 mol/L HCl; $\mu$ = 0.25 (NaCl) | 25 | 5.6 × 10$^9$ | LP/LUM/SST; OT | 82A068 |
| | Fe(CN)$_6$$^{3-}$ | H$_2$O | 0.5 mol/L NaCl | 25 | 6.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (747635); OT; [Q] ≤ 6 × 10$^{-4}$ mol/L | 766014 |
| | Fe(CN)$_6$$^{3-}$ | H$_2$O | | | 3.2 × 10$^{10}$ | LP/LUM/SST; $\tau_0$ = 0.59 $\mu$s | 85N164 |
| | Fe(CN)$_6$$^{3-}$ | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 2 | | 3.2 × 10$^{10}$ | LP/LUM/SST; $\tau_0$ = 0.59 $\mu$s | 85N164 |
| | Fe(CN)$_6$$^{3-}$ | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 8 | | 2.5 × 10$^9$ | LP/LUM/SST | 85N164 |
| 20.1.136. Fe(CN)$_6$$^{4-}$ | | H$_2$O | $\mu$ = 0 (calc'd) | ~21 | 7.3 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); ET?; [Q] ≤ 1 × 10$^{-4}$ mol/L; some SQ | 766319 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | 0.5 mol/L NaCl; pH 4 | 23 | 3.3 × 10$^9$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 $\mu$s (746112); RT; [Q] = (5-20) × 10$^{-4}$ mol/L | 766027 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | $\mu$ = 0.001 (NaCl) | 25 | 5.1 × 10$^{10}$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); RT; [Q] ≤ 0.001 mol/L; some SQ, see Mech. [11] | 81A250 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | $\mu$ = 0.1 (NaCl) | 25 | 7.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); RT; [Q] ≤ 0.0015 mol/L; some SQ, see Mech. [11] | 81A250 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | 0.02 mol/L ACbuf; pH 5 | 25 | 3.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (747635); RT; [Q] ≤ 0.0045 mol/L | 766046 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | 0.02 mol/L Pbuf; pH 5.2; $\mu$ = 0.5 (NaCl) | 25 | 3.0 × 10$^9$ | LP/LUM/SST; RT | 82A068 |
| | Fe(CN)$_6$$^{4-}$ | H$_2$O | | | 3.4 × 10$^{10}$ | SL/LUM/SPC; $\tau_0$$^{air}$ = 0.39 $\mu$s; [Q] ≤ 2 × 10$^{-4}$ mol/L; some SQ | 85R098 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| | Fe(CN)$_6^{4-}$ | H$_2$O | 0.005 mol/L TRbuf; 0.05 mol/L NaCl; pH 7.2 | | $9.0 \times 10^9$ | SL/LUM/SPC; $\tau_0^{air}$ = 0.41 µs; [Q] $\leq 4 \times 10^{-4}$ mol/L; some SQ | 85R098 |
| | Fe(CN)$_6^{4-}$ | H$_2$O | 0.005 mol/L TRbuf; 0.05 mol/L NaCl; [DNA-phosphate]/[S] = 40; pH 7.2 | | $7 \times 10^9$ | SL/LUM/SPC; $\tau_0^{air}$ = 0.42 µs | 85R098 |
| 20.1.137. | Fe(CN)$_5$(CO)$^{3-}$ | H$_2$O | pH 4-5; µ = 0.50 (NaCl) | 25 | $5 \times 10^6$ | SS/LUM; $\tau_0$ = 0.60 µs (766404); RT | 776405 |
| 20.1.138. | Fe(CN)$_5$(DMSO)$^{3-}$ | H$_2$O | $1 \times 10^{-4}$ mol/L DMSO; pH 4-5; µ = 0.50 (NaCl) | 25 | $5.6 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 µs (766404); RT | 776405 |
| 20.1.139. | Fe(CN)$_5$(imidazole)$^{3-}$ | H$_2$O | 0.001 mol/L IMIDbuf; pH 4-5; µ = 0.50 (NaCl) | 25 | $3.8 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 µs (766404); RT; [Q] $\leq$ 0.0012 mol/L | 776405 |
| 20.1.140. | Fe(CN)$_5$($N$-methylpyrazinium)$^{2-}$ | H$_2$O | pH 4-5; µ = 0.50 (NaCl) | 25 | $5.3 \times 10^9$ | LP/LUM/AVE; OT, ET; [Q] $\leq$ 0.0015 mol/L | 776405 |
| 20.1.141. | Fe(CN)$_5$(NO)$^{2-}$ | H$_2$O | pH 4-5; µ = 0.50 (NaCl) | 25 | $5.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 µs (766404); OT, ET; [Q] $\leq$ 0.0015 mol/L | 776405 |
| 20.1.142. | Fe(CN)$_5$(py)$^{3-}$ | H$_2$O | 0.001 mol/L PYbuf; pH 4-5; µ = 0.50 (NaCl) | 25 | $4.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 µs (766404); RT | 776405 |
| 20.1.143. | Fe(CN)$_5$(pyrazinecarboxylato)$^{4-}$ | H$_2$O | pH 4-5; µ = 0.50 (NaCl) | 25 | $1.9 \times 10^9$ | LP/LUM/AVE; RT; [Q] $\leq$ 0.0016 mol/L | 776405 |
| 20.1.144. | Fe(C$_2$O$_4$)$_2^-$ | H$_2$O | 0.05 mol/L H$_2$SO$_4$ | | $3.6 \times 10^9$ | SS/LUM; $\tau_0$ = 0.66 µs (LP/LUM/SST); OT?; [Q] = (2-12) $\times 10^{-4}$ mol/L | 737656 |
| 20.1.145. | Fe$^{III}$(cytochrome c) | H$_2$O | Pbuf; pH 7; µ = 0.1 | | $2.5 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.57 µs; OT; same $k_q$ from same lab in 84A242 | 82A280 |
| | Fe$^{III}$(cytochrome c) | H$_2$O | Pbuf; pH 7 | | $>2 \times 10^8$ | LP/ABS/AVE; $\tau_0$ = 0.60 µs (80E040); OT; [Q] = (1-10) $\times 10^{-5}$ mol/L; 10.6% of Q as Fe$^{II}$ | 84A306 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. $Ru(bpy)_3^{2+}$—Continued** | | | | | | | |
| 20.1.146. | $Fe^{III}$(cytochrome c)-(histidine-33)$Ru^{III}(NH_3)_5$ | $H_2O$ | Pbuf; pH 7; $\mu$ = 0.1 | | $7.8 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.57 $\mu$s; OT (80% to $Ru^{III}$ and 20% to $Fe^{III}$); [Q] $\leq$ 0.0013 mol/L; same $k_q$ from same lab in 84 | 82A280 |
| 20.1.147. | Fe(NTA) | $H_2O$ | pH 2.6 | 22 | $3.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] = (1-10) $\times$ 10$^{-4}$ mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | $2 \times 10^{-4}$ mol/L NTA; pH 2.6-3.3 | 22 | $3.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | $2 \times 10^{-4}$ mol/L NTA; pH 3.8 | 22 | $4.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | $2 \times 10^{-4}$ mol/L NTA; pH 4.8 | 22 | $4.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | 0.0054 mol/L PVS; pH 2.2 | 22 | $3.4 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | 0.0054 mol/L PVS; pH 2.7 | 22 | $2.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | 0.0054 mol/L PVS; $2 \times 10^{-4}$ - 0.0014 mol/L NTA; pH 2.7-3.4 | 22 | $2.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | 0.0054 mol/L PVS; $2 \times 10^{-4}$ mol/L NTA; pH 3.8 | 22 | $1.4 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| | Fe(NTA) | $H_2O$ | 0.0054 mol/L PVS; $2 \times 10^{-4}$ mol/L NTA; pH 4.8 | 22 | $6 \times 10^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] $\leq$ 0.002 mol/L | 78A219 |
| 20.1.148. | $Fe(phen)_3^{2+}$ | $H_2O$ | $\mu$ = 0.1 (NaCl) | 25 | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s; ET, OT?; [Q] $\leq$ 0.005 mol/L | 80E040 |
| 20.1.149. | $Hg^{2+}$ | $H_2O$ | 0.1 mol/L $HClO_4$; $\mu$ = 1.0 | 21 | $1.5 \times 10^8$ | $\tau_0$ = 0.60 $\mu$s; OT | 80A233 |

| No. | Quencher | Solvent | Solution Medium | $T/^\circ$C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. Ru(bpy)$_3^{2+}$**—Continued | | | | | | | |
| | Hg$^{2+}$ | H$_2$O | 0.05 mol/L HNO$_3$; $\mu = 0.063$ (NaNO$_3$) | ~23 | $6.7 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.61$ $\mu$s; OT | 84A148 |
| | Hg$^{2+}$ | H$_2$O | 0.05 mol/L HNO$_3$; $\mu = 0.5$ (NaNO$_3$) | ~23 | $2.1 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.59$ $\mu$s; OT | 84A148 |
| | Hg$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | | $1.5 \times 10^8$ | LP/LUM/SST; OT; $f = 0.32$ | 82A111 |
| | Hg$^{2+}$ | H$_2$O | 0.5 mol/L HClO$_4$; $\mu = 0.5$ | | $1.5 \times 10^8$ | LP/LUM/SST; OT | 82A111 |
| | Hg$^{2+}$ | H$_2$O | 3 mol/L HCl; $\mu = 3.0$ | | $1.9 \times 10^8$ | LP/LUM/SST; OT; $f < 0.01$ | 82A111 |
| 20.1.150. | HgCl$_2$ | H$_2$O | 0.1 mol/L HClO$_4$; $\mu = 1.0$ | 21 | $3.8 \times 10^8$ | $\tau_0 = 0.60$ $\mu$s; OT | 80A233 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.09 mol/L NaNO$_3$ | | $1.7 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.63$ $\mu$s; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.99 mol/L NaNO$_3$ | | $2.3 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.63$ $\mu$s; OT | 84A077 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.01 mol/L SLS | | $3.8 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.78$ $\mu$s; OT | 84N034 |
| | HgCl$_2$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $1.8 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.77$ $\mu$s; OT | 84N034 |
| 20.1.151. | HgCl$_3^-$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $1.7 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.63$ $\mu$s; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| | HgCl$_3^-$ | H$_2$O | 0.01 mol/L HNO$_3$, 0.1 mol/L NaNO$_3$, 0.01 mol/L SLS | | $< 6 \times 10^4$ | LP/LUM/AVE; $\tau_0 = 0.77$ $\mu$s; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84N034 |
| 20.1.152. | HgCl$_4^{2-}$ | H$_2$O | 0.01 mol/L HNO$_3$, [NaNO$_3$] + [NaCl] = 0.99 mol/L | | $3.7 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.63$ $\mu$s; OT; $k_q$ from Cl$^-$ titration at fixed [Hg$^{II}$]$_{tot}$ | 84A077 |
| 20.1.153. | I$^-$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $1 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (LP/LUM/AVE); [Q] = 0.5-0.7 mol/L | 766319 |
| 20.1.154. | In$^{3+}$ | H$_2$O | 0.3 mol/L HCl | | $7.7 \times 10^5$ | SL/LUM/SPC, SS/LUM | 85S227 |

TABLE 20. Quenching of Ru(bpy)$_3$$^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 20.1.155. | IrCl$_6$$^{3-}$ | H$_2$O | 0.0035 mol/L KCl | ~22 | 1.2 × 10$^{10}$ | SL/LUM/SST; $\tau_0$$^{air}$ = 0.40 μs; [Q] = (2-5) × 10$^{-4}$ mol/L | 746112 |
| | IrCl$_6$$^{3-}$ | H$_2$O | 0.1 mol/L HCl; μ = 0.25 (NaCl) | 25 | 8.3 × 10$^8$ | LP/LUM/SST; RT; $\Delta V^{\neq}$ = 1.1 × 10$^{-3}$ L/mol (0.1-300 MPa) | 82A068 |
| | IrCl$_6$$^{3-}$ | MF | 0.0035 mol/L NH$_4$Cl | ~22 | 2 × 10$^9$ | SL/LUM/SST; $\tau_0$$^{air}$ = 0.31 μs; [Q] = (2-5) × 10$^{-4}$ mol/L | 746112 |
| 20.1.156. | Mn(TMePyP)$^{5+}$ | H$_2$O | 0.01 mol/L Pbuf; pH 7 | | 2.8 × 10$^{10}$ | SS/LUM; $\tau_0$ = 0.6 μs (78Z170); OT?; [Q] = (1-5) × 10$^{-5}$ mol/L | 86F171 |
| 20.1.157. | Mo(CN)$_8$$^{4-}$ | H$_2$O | 0.01 mol/L KCl | ~22 | 9 × 10$^6$ | SL/LUM/SST; $\tau_0$$^{air}$ = 0.40 μs; [Q] = (1-10) × 10$^{-4}$ mol/L; also SQ | 746112 |
| | Mo(CN)$_8$$^{4-}$ | H$_2$O | 0.5 mol/L NaCl; pH 4 | 23 | 3.4 × 10$^8$ | SS/LUM; $\tau_0$$^{air}$ = 0.40 μs (746112); RT; [Q] = (5-80) × 10$^{-4}$ mol/L | 766027 |
| | Mo(CN)$_8$$^{4-}$ | H$_2$O | 0.1 mol/L HCl; μ = 0.25 (NaCl) | 25 | 6.3 × 10$^8$ | LP/LUM/SST; RT; $\Delta V^{\neq}$ = 2.5 × 10$^{-2}$ L/mol (0.1-300 MPa) | 82A068 |
| | Mo(CN)$_8$$^{4-}$ | MF | 0.01 mol/L NH$_4$Cl | ~22 | 4 × 10$^9$ | SL/LUM/SST; $\tau_0$$^{air}$ = 0.31 μs; [Q] = (2-10) × 10$^{-4}$ mol/L | 746112 |
| 20.1.158. | NO$_3$$^-$ | H$_2$O | μ = 0 (calc'd) | ~21 | <4 × 10$^5$ | SS/LUM; $\tau_0$ = 0.60 μs (LP/LUM/AVE); [Q] = 0.1 mol/L | 766319 |
| 20.1.159. | Ni$^{2+}$ | H$_2$O | μ = 0 (calc'd) | ~21 | 6 × 10$^5$ | SS/LUM; $\tau_0$ = 0.60 μs (LP/LUM/AVE); [Q] = 0.05-0.07 mol/L | 766319 |
| 20.1.160. | Ni(acac)$_2$ | MeOH | | ~21 | 2.7 × 10$^7$ | SS/LUM; $\tau_0$ = 0.77 μs (LP/LUM/AVE); ET; [Q] = 0.001-0.007 mol/L | 766319 |
| 20.1.161. | Ni(CN)$_4$$^{2-}$ | H$_2$O | μ = 0 (calc'd) | ~21 | 2.8 × 10$^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0$ = 0.60 μs (LP/LUM/AVE); ET?; [Q] ≤ 5 × 10$^{-4}$ mol/L; some SQ | 766319 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $Ni(CN)_4^{2-}$ | $H_2O$ | 0.5 mol/L NaCl; pH 4 | 23 | $5.6 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.40$ μs (746112); ET or RT; [Q] = (5-15) $\times$ 10$^{-4}$ mol/L | 766027 |
| 20.1.162. | $Ni[S_2C_2(C_6H_5)_2]_2$ | DMF | | | $1.3 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; OT; $f = 0.35$; [Q] $\leq$ 3 $\times$ 10$^{-5}$ mol/L | 86A133 |
| | $Ni[S_2C_2(C_6H_5)_2]_2$ | DMF | $\mu = 0.10$ (TEAP) | | $1.3 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; OT; $f = 0.35$; [Q] $\leq$ 3 $\times$ 10$^{-5}$ mol/L | 86A133 |
| | $Ni[S_2C_2(C_6H_5)_2]_2$ | THF/$H_2O$ (10/1) | | | $8.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.80$ μs (LP/LUM/SST); OT; [Q] $\leq$ 3.5 $\times$ 10$^{-4}$ mol/L | 82N184 |
| 20.1.163. | $Ni[S_2C_2(C_6H_5)_2]_2^{-}$ | AN | | | $4.7 \times 10^{10}$ | SS/LUM | 82N184 |
| 20.1.164. | $Ni[S_2C_2(CN)_2]_2^{2-}$ | AN | | | $1.0 \times 10^{11}$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 μs; RT; [Q] $\leq$ 2.5 $\times$ 10$^{-5}$ mol/L | 83E621 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | AN | | | $1.2 \times 10^{11}$ | SL/LUM/SPC, SS/LUM; RT or ET | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | AN | $\mu = 0.001$ (TEAP) | | $8.5 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; RT or ET | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | AN | $\mu = 0.01$ (TEAP) | | $2.9 \times 10^{10}$ | SL/LUM/SPC; RT or ET; some SQ | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | AN | $\mu = 0.10$ (TEAP) | | $1.4 \times 10^{10}$ | SL/LUM/SPC; RT or ET; some SQ | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | DMF | | | $4.1 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; RT or ET; [Q] $\leq$ 3.5 $\times$ 10$^{-5}$ mol/L | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | DMF | $\mu = 0.001$ (TEAP) | | $2.9 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; RT or ET | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | DMF | $\mu = 0.01$ (TEAP) | | $1.6 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; RT or ET | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | DMF | $\mu = 0.10$ (TEAP) | | $7.5 \times 10^9$ | SL/LUM/SPC; RT or ET; [Q] $\leq$ 3.5 $\times$ 10$^{-5}$ mol/L; some SQ | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | DMF | $\mu = 0.25$ (TEAP) | | $5 \times 10^9$ | SL/LUM/SPC; RT or ET; some SQ | 86A133 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | $H_2O$ | | | $2.0 \times 10^{10}$ | LP/LUM/SST; $\tau_0 = 0.60$ μs; RT; [Q] $\leq$ 9 $\times$ 10$^{-6}$ mol/L; some SQ | 83E621 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **20.1. Ru(bpy)₃²⁺—Continued** | | | | | | | |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | MF | | | $5.8 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.90 μs; RT | 83E621 |
| | $Ni[S_2C_2(CN)_2]_2^{2-}$ | MeOH | | | $6.7 \times 10^{10}$ | LP/LUM/SST; $\tau_0$ = 0.71 μs; RT; [Q] ≤ 6.5 × 10$^{-5}$ mol/L; some SQ | 83E621 |
| 20.1.165. | $O_2$ | AN | 0.1 mol/L TBAC | | $6.8 \times 10^8$ | LP/LUM; $\tau_0$ = 0.74 μs; $p_Q$ = (2-10) × 10$^4$ Pa; ET | 85A093 |
| | $O_2$ | $H_2O$ | | 16-18 | $1.7 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.56 μs; ET; $p_Q$ = 1 × 10$^5$ Pa | 80E566 |
| | $O_2$ | $H_2O$ | | 16-18 | $1.6 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.51 μs; ET; $p_Q$ = 1 × 10$^5$ Pa; $p_{app}$ = 2.3 × 10$^8$ Pa | 80E566 |
| | $O_2$ | $H_2O$ | | 18 | $2.6 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (SL/LUM/SPC, LP/LUM/SST); ET; [Q] = 3 × 10$^{-4}$ mol/L | 86S150 |
| | $O_2$ | $H_2O$ | | 22 | $3.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (766014); OT?; [Q] = (2.5-13) × 10$^{-4}$ mol/L; same $k_q$ from same lab in 776406 | 78A219 |
| | $O_2$ | $H_2O$ | 0.0065 mol/L PVS | 22 | $2.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (766014); OT?; [Q] = (2.5-13) × 10$^{-4}$ mol/L | 78A219 |
| | $O_2$ | $H_2O$ | | 25 | $3.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (747635); [Q] ≤ 0.0015 mol/L; same $k_q$ from same lab in 766404 | 766014 |
| | $O_2$ | $H_2O$ | 0.5 mol/L HCl | 25 | $3.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (766014); OT; $p_Q$ ≤ 1.0 × 10$^5$ Pa | 80F402 |
| | $O_2$ | $H_2O$ | ACbuf; pH 4.6 | 25 | $3.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (766014); OT; $p_Q$ = (2-10) × 10$^4$ Pa | 81F401 |
| | $O_2$ | $H_2O$ | 0.05 mol/L $H_2SO_4$ | ~26 | $3.5 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 μs (76F936); OT, ET | 767179 |
| | $O_2$ | $H_2O$ | | | $3.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.66 μs (LP/LUM/SST); ET; $p_Q$ = (2-10) × 10$^4$ Pa; same $k_q$ from same lab in 737658 | 737656 |
| | $O_2$ | $H_2O$ | | | $3.0 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.59 μs | 85N164 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| | $O_2$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 2 | | $2.9 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ $\mu$s | 85N164 |
| | $O_2$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 7 | | $1.8 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.67$ $\mu$s | 85N164 |
| | $O_2$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 9 | | $2.9 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ $\mu$s | 85N164 |
| | $O_2$ | $H_2O$ | 0.11% PVS | | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (766404); $p_Q = (2\text{-}10) \times 10^4$ Pa | 776406 |
| | $O_2$ | MeOH | | ~21 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.81$ $\mu$s (LP/LUM/SST); ET; same $k_q$ from same lab in 777221 | 737658 |
| | $O_2$ | MeOH | | | $1.6 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.63$ $\mu$s; ET | 84F005 |
| 20.1.166. | $Os(bpy)_3^{2+}$ | $H_2O$ | $\mu = 0.1$ (NaCl) | 25 | $1.5 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s; ET, RT; [Q] $\leq 0.005$ mol/L | 80E040 |
| 20.1.167. | $Os(bpy)_3^{3+}$ | $H_2O$ | 0.4 mol/L NaCl, 0.1 mol/L HCl | 25 | $3.8 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (747635); OT; [Q] $\leq 6 \times 10^{-4}$ mol/L | 766014 |
| 20.1.168. | $Os(C_5H_5)[C_5H_4C(O)CH_3]$ | EtOH | | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0 = \sim 0.9$ $\mu$s (FL/LUM/SST) | 756002 |
| 20.1.169. | $Os(CN)_6^{1-}$ | $H_2O$ | 0.5 mol/L NaCl; pH 4 | 23 | $1.2 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.40$ $\mu$s (746112); RT; [Q] = (5-40) $\times 10^{-4}$ mol/L | 766027 |
| | $Os(CN)_6^{1-}$ | $H_2O$ | 0.1 mol/L HCl; $\mu$ = 0.25 (NaCl) | 25 | $8.4 \times 10^8$ | LP/LUM/SST; RT; $\Delta V^{\ddagger} = 6.8 \times 10^{-3}$ L/mol (0.1-300 MPa) | 82A068 |
| 20.1.170. | $trans$-Os(en)$_2$Cl$_2^+$ | $H_2O$ | 0.13 mol/L HCl, 0.37 mol/L NaCl; $\mu = 0.5$ | 25 | $5.2 \times 10^7$ | SS/LUM; $\tau_0 = 0.6$ $\mu$s; [Q] $\leq 0.0075$ mol/L | 80F334 |
| 20.1.171. | $cis$-Os(en)$_2$H$_2^{2+}$ | $H_2O$ | 0.13 mol/L HCl, 0.37 mol/L NaCl; $\mu = 0.5$ | 25 | $2.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.6$ $\mu$s; [Q] $\leq 0.0064$ mol/L | 80F334 |
| 20.1.172. | $trans$-Os(en)$_2$O$_2^{2+}$ | $H_2O$ | 0.13 mol/L HCl, 0.37 mol/L NaCl; $\mu = 0.5$ | 25 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.6$ $\mu$s; OT?; [Q] $\leq 0.001$ mol/L | 80F334 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| 20.1.173. | Os(NH$_3$)$_6^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $\leq 1.4 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s (766404); OT, ET; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 20.1.174. | Os(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $\leq 4 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s (766404); OT, ET; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 20.1.175. | Os(NH$_3$)$_5$(H$_2$O)$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $\leq 7 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s (766404); OT, ET; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 20.1.176. | Os(NH$_3$)$_5$I$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $3.2 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s (766404); ET; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 20.1.177. | Os(NH$_3$)$_5$(N$_2$)$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu = 0.5$ | 25 | $9 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.60$ $\mu$s (766404); RT; [Q] = (3-200) $\times$ 10$^{-4}$ mol/L | 82A145 |
| 20.1.178. | Pd(CN)$_4^{2-}$ | H$_2$O | 0.5 mol/L NaCl; pH 4 | 23 | $< 1 \times 10^6$ | SS/LUM; $\tau_0^{air} = 0.40$ $\mu$s (746112); [Q] = 0.05 mol/L | 766027 |
| 20.1.179. | PtBr$_4^{2-}$ | H$_2$O | $\mu = 2$ (HClO$_4$) | | $4.5 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.38$ $\mu$s; ET | 83E719 |
| 20.1.180. | PtBr$_6^{2-}$ | H$_2$O | $\mu = 2$ (HClO$_4$) | | $6.1 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.38$ $\mu$s; OT; [Q] $\leq 0.001$ mol/L | 83A403 |
| 20.1.181. | Pt(CN)$_4^{2-}$ | H$_2$O | $\mu = 0$ (calc'd) | ~21 | $< 7 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (LP/LUM/AVE); [Q] = 0.006-0.017 mol/L | 766319 |
| | Pt(CN)$_4^{2-}$ | H$_2$O | 0.5 mol/L NaCl; pH 4 | 23 | $< 1 \times 10^6$ | SS/LUM; $\tau_0^{air} = 0.40$ $\mu$s (746112); [Q] = 0.05 mol/L | 766027 |
| 20.1.182. | Pt(C$_2$O$_4$)$_2^{2-}$ | H$_2$O | $\mu = 2$ (HClO$_4$) | | $< 2 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.38$ $\mu$s | 83E719 |
| 20.1.183. | PtCl$_4^{2-}$ | DMF | 0.0018 mol/L NH$_4$Cl | ~22 | $1.5 \times 10^{10}$ | SL/LUM/SST; $\tau_0^{air} = 0.32$ $\mu$s; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L; also SQ | 746112 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $PtCl_4^{2-}$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $1.5 \times 10^{10}$ | SS/LUM and LP/LUM/AVE; $\tau_0 = 0.60$ $\mu$s (LP/LUM/AVE); ET; [Q] $\leq 6 \times 10^{-4}$ mol/L; some SQ | 766319 |
| | $PtCl_4^{2-}$ | $H_2O$ | 0.0018 mol/L KCl | ~22 | $1.0 \times 10^{10}$ | SL/LUM/SST; $\tau_0^{air} = 0.40$ $\mu$s; [Q] = (1-5) $\times$ $10^{-4}$ mol/L | 746112 |
| | $PtCl_4^{2-}$ | $H_2O$ | 0.17 mol/L $Na_2SO_4$; $\mu = 0.5$ | 25 | $2.6 \times 10^9$ | SS/LUM or LP/LUM/SST; same $k_q$ from same lab in 79A317 | 81N003 |
| | $PtCl_4^{2-}$ | $H_2O$ | 0.001 mol/L $HClO_4$ | | $6.5 \times 10^9$ | SS/LUM, LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; ET; [Q] = (2-12) $\times$ 1)$^{-4}$ mol/L | 717111 |
| | $PtCl_4^{2-}$ | $H_2O$ | $\mu = 2$ ($HClO_4$) | | $1.4 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.38$ $\mu$s; ET | 83E719 |
| | $PtCl_4^{2-}$ | MF | 0.0018 mol/L $NH_4Cl$ | ~22 | $8 \times 10^8$ | SL/LUM/SST; $\tau_0^{air} = 0.31$ $\mu$s; [Q] = (1-5) $\times$ $10^{-4}$ mol/L | 746112 |
| 20.1.184. | $PtCl_6^{2-}$ | $H_2O$ | $\mu = 0$ (calc'd) | ~21 | $3.4 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (LP/LUM/AVE); OT, ET?; [Q] = (4-13) $\times$ $10^{-5}$ mol/L | 766319 |
| | $PtCl_6^{2-}$ | $H_2O$ | 0.17 mol/L $Na_2SO_4$; $\mu = 0.5$ | 25 | $7.2 \times 10^9$ | SS/LUM or LP/LUM/SST; same $k_q$ from same lab in 79A317 | 81N003 |
| | $PtCl_6^{2-}$ | $H_2O$ | $\mu = 2$ ($HClO_4$) | | $3.9 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.38$ $\mu$s; OT; [Q] $\leq$ 0.001 mol/L | 83A403 |
| 20.1.185. | $PtF_6^{2-}$ | $H_2O$ | $\mu = 2$ ($HClO_4$) | | $3.2 \times 10^8$ | LP/LUM/SST; $\tau_0^{air} = 0.38$ $\mu$s; OT; [Q] $\leq$ 0.001 mol/L | 83A403 |
| 20.1.186. | $Pt(NH_3)_4Br_2^{2+}$ | $H_2O$ | $\mu = 0.02$ ($HClO_4$ or $H_2SO_4$) | | $1 \times 10^9$ | EMI; OT | 85A469 |
| 20.1.187. | $Pt(NH_3)_5Br^{3+}$ | $H_2O$ | $\mu = 0.1$ ($HClO_4$ or $H_2SO_4$) | | $1 \times 10^9$ | EMI; OT | 85A469 |
| 20.1.188. | $Pt(NH_3)_4Cl_2^{2+}$ | $H_2O$ | $\mu = 0.02$ ($HClO_4$ or $H_2SO_4$) | | $8 \times 10^8$ | EMI; OT | 85A469 |
| 20.1.189. | $Pt(NH_3)_5Cl^{3+}$ | $H_2O$ | $\mu = 0.1$ ($HClO_4$ or $H_2SO_4$) | | $3 \times 10^8$ | EMI; OT | 85A469 |
| 20.1.190. | $Pt[S_2C_2(C_6H_5)_2]_2$ | DMF | | | $1.3 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; OT; $f = 0.35$ | 86A133 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------|----------|------|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| 20.1.191. | $Pt|S_2C_2(CN)_2|_2^{2-}$ | DMF | $\mu$ = 0.001 (TEAP) | | $2.0 \times 10^{10}$ | SL/LUM/SPC, SS/LUM; RT or ET | 86A133 |
| | $Pt|S_2C_2(CN)_2|_2^{2-}$ | DMF | $\mu$ = 0.10 (TEAP) | | $6 \times 10^9$ | SL/LUM/SPC; RT or ET; some SQ | 86A133 |
| 20.1.192. | $Pt(SCN)_4^{2-}$ | $H_2O$ | $\mu$ = 4 (HClO$_4$) | | $5.5 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.38 $\mu$s; ET | 83E719 |
| 20.1.193. | $Pt(SCN)_6^{2-}$ | $H_2O$ | $\mu$ = 2 (HClO$_4$) | | $1.9 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.38 $\mu$s; OT; [Q] $\leq$ 0.001 mol/L | 83A403 |
| 20.1.194. | $Rh(bpy)_3^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$; $\mu$ = 0.5 | 25 | $6.2 \times 10^8$ | SS/LUM or LP/LUM/SST; OT; $f$ = 0.15; same $k_q$ from same lab in 79A317 | 81N003 |
| | $Rh(bpy)_3^{3+}$ | $H_2O$ | 0.5 mol/L NaOH; $\mu$ = 0.5 | 25 | $3.7 \times 10^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | $Rh(bpy)_3^{3+}$ | $H_2O$ | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | $6 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT; $k_q$ = 3.9 $\times$ 10$^8$ L mol$^{-1}$ s$^{-1}$ at 25 °C in 0.17 mol/L Na$_2$SO$_4$ at pH 8 with SS/LUM or LP/LUM/SST ($f$ = 0.15) from same lab in 81N003 | 82A145 |
| | $Rh(bpy)_3^{3+}$ | $H_2O$ | 0.5 mol/L Pbuf; pH 7.1 | 25 | $3.5 \times 10^8$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] $\leq$ 0.003 mol/L | 79F206 |
| 20.1.195. | $cis$-$Rh(bpy)_2(H_2O)_2^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$; $\mu$ = 0.5 | 25 | $4.4 \times 10^3$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | $cis$-$Rh(bpy)_2(H_2O)_2^{3+}$ | $H_2O$ | 0.5 mol/L Pbuf; pH 3.0 | 25 | $3.2 \times 10^3$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] $\leq$ 0.007 mol/L | 79F206 |
| 20.1.196. | $cis$-$Rh(bpy)_2(H_2O)Cl^{2+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$; $\mu$ = 0.5 | 25 | $1.0 \times 10^3$ | SS/LUM or LP/LUM/SST | 81N003 |
| 20.1.197. | $cis$-$Rh(bpy)_2(H_2O)(OH)^{2+}$ | $H_2O$ | | 25 | $2.0 \times 10^7$ | SS/LUM or LP/LUM/SST; $k_q$ evaluated from pH dependence of $k_{obs}$ for $Rh(bpy)_2(H_2O)_2^{3+}$ | 81N003 |
| 20.1.198. | $cis$-$Rh(bpy)_2(OH)_2^+$ | $H_2O$ | 0.5 mol/L NaOH; $\mu$ = 0.5 | 25 | $1.2 \times 10^7$ | SS/LUM or LP/LUM/SST; ET | 81N003 |
| | $cis$-$Rh(bpy)_2(OH)_2^+$ | $H_2O$ | 0.5 mol/L Pbuf; pH 7.1 | 25 | $5.2 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] $\leq$ 0.006 mol/L | 79F206 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | |
| 20.1.199. | cis-Rh(bpy)$_2$(OH)Cl$^+$ | H$_2$O | 0.5 mol/L NaOH; $\mu$ = 0.5 | 25 | 4 × 10$^8$ | SS/LUM or LP/LUM/SST | 81N003 |
| 20.1.200. | Rh(5-Brphen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.5 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.201. | Rh(5-Clphen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.5 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.202. | Rh(4,4'-Me$_2$bpy)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 3 × 10$^7$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| | Rh(4,4'-Me$_2$bpy)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L Pbuf; pH 7.1 | 25 | 7 × 10$^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] ≤ 0.004 mol/L | 79F206 |
| 20.1.203. | Rh(4,7-Me$_2$phen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.7 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.204. | Rh(5-Mephen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 4 × 10$^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.205. | Rh(5,6-Me$_2$phen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 3 × 10$^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.206. | Rh(phen)$_3$$^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$; $\mu$ = 0.5 | 25 | 6.8 × 10$^8$ | SS/LUM or LP/LUM/SST; OT | 81N003 |
| | Rh(phen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 4 × 10$^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.207. | Rh(5-Phphen)$_3$$^{3+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 1.6 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT | 82A145 |
| 20.1.208. | Ru(acac)$_3$ | H$_2$O | | 22 | 3.1 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] = 5 × 10$^{-4}$ mol/L | 78A219 |
| | Ru(acac)$_3$ | H$_2$O | 0.0062 mol/L PVS | 22 | 2.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766014); OT; [Q] = 5 × 10$^{-4}$ mol/L | 78A219 |
| 20.1.209. | Ru(bpy)$_3$$^{2+}$ | H$_2$O | $\mu$ = 1.0 (Na$_2$SO$_4$) | 25 | ≤1 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s; [Q] ≤ 0.005 mol/L | 80E040 |
| | Ru(bpy)$_3$$^{2+}$ | H$_2$O | | | 1.6 × 10$^{10}$ | SS/LUM; $\tau_0$ = 0.7 $\mu$s (737633); see Mech. [3]; $\tau_0$ at [S] = 1.2 × 10$^{-4}$ mol/L; $\tau$ independent of [S] in the range 1 × 10$^{-5}$ - 0.07 mol/L (L. Moggi, unpub. obs.) | 86E677 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **Ru(bpy)$_3^{2+}$**—Continued | | | | | | |
| 20.1.210. | Ru(bpy)$_3^{3+}$ | AN | 0.1 mol/L TEAP | 25 | $3.2 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.85$ μs; OT | 86A077 |
| | Ru(bpy)$_3^{3+}$ | H$_2$O | 0.5 mol/L t-BuOH; 0.002 mol/L ACbuf; pH 4.6; μ = 1.5 (Na$_2$SO$_4$) | 24 | $1.8 \times 10^9$ | PR/LUM/AVE; $\tau_0 = 0.71$ μs; OT; $f = 0.11$; [Q] ≤0.00125 mol/L mol/L; *S generated from Q + e$_{aq}^-$ | 78A070 |
| 20.1.211. | Ru(C$_5$H$_5$)$_2$ | EtOH | | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0 = $ ~0.9 μs (FL/LUM/SST) | 756002 |
| 20.1.212. | Ru[C$_5$H$_4$C(O)CH$_3$]$_2$ | EtOH | | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0 = $ ~0.9 μs (FL/LUM/SST) | 756002 |
| 20.1.213. | Ru(C$_2$O$_4$)$_2$(H$_2$O)$_2^-$ | H$_2$O | pH 10 | | $9.5 \times 10^8$ | OT | 85M244 |
| 20.1.214. | Ru(EDTA)$^-$ | H$_2$O | pH 10 | | $4.9 \times 10^9$ | OT | 85M244 |
| 20.1.215. | Ru(H$_2$O)Cl$_5^{2-}$ | H$_2$O | pH 10 | | $8.2 \times 10^9$ | OT | 85M244 |
| 20.1.216. | Ru(NH$_3$)$_6^{2+}$ | H$_2$O | 0.2 mol/L ACbuf; pH 5 | 25 | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); RT; [Q] ≤ 0.005 mol/L | 766046 |
| 20.1.217. | Ru(NH$_3$)$_6^{3+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/SPC); OT; [Q] ≤ 0.004 mol/L | 747635 |
| | Ru(NH$_3$)$_6^{3+}$ | H$_2$O | 0.5 mol/L NaCl | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT; [Q] ≤ 0.0015 mol/L | 766014 |
| | Ru(NH$_3$)$_6^{3+}$ | H$_2$O | 0.2 mol/L ACbuf; pH 5 | 25 | $3.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT | 766046 |
| | Ru(NH$_3$)$_6^{3+}$ | H$_2$O | 1 mol/L CF$_3$CO$_2$H | | $\sim 2 \times 10^9$ | SS/LUM; $\tau_0 = 0.6$ μs (69E219); OT; [Q] ≤ 0.001 mol/L | 747159 |
| 20.1.218. | Ru(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/SPC); OT; [Q] ≤ 0.004 mol/L | 747635 |
| | Ru(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | pH 10 | | $2.7 \times 10^9$ | OT | 85M244 |
| 20.1.219. | Ru(NH$_3$)$_5$(histidine)$^{3+}$ | H$_2$O | Pbuf; pH 7; μ = 0.1 | | $1.2 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.57$ μs; OT; same $k_q$ from same lab in 84A242 | 82A280 |
| 20.1.220. | Ru[5-(NO$_2$)phen]$_3^{2+}$ | H$_2$O | μ = 0.1 (NaCl) | 25 | $2.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.60$ μs; ET, OT?; [Q] ≤ 0.005 mol/L | 80E040 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1. Ru(bpy)$_3$$^{2+}$**–Continued | | | | | | | |
| 20.1.221. | Ru(terpy)$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.1 (NaCl) | 25 | 1.2 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s; ET; [Q] ≤ 0.005 mol/L | 80E040 |
| | Ru(terpy)$_2$$^{2+}$ | H$_2$O | $\mu$ = 1.0 (Na$_2$SO$_4$) | 25 | 1.5 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s; ET; [Q] ≤ 0.005 mol/L | 80E040 |
| 20.1.222. | Ru(TPTZ)$_2$$^{2+}$ | H$_2$O | $\mu$ = 0.5 (NaCl) | 25 | 1.2 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s; ET, OT; [Q] ≤ 0.005 mol/L | 80E040 |
| 20.1.223. | SO$_3$$^{2-}$ | H$_2$O | | 25 | ~3 × 10$^5$ | LP/ABS/SST; OT; [Q] = 0.1-1 mol/L; also SQ | 79F045 |
| 20.1.224. | S$_2$O$_4$$^{2-}$ | H$_2$O | 0.02 mol/L ACbuf; pH 5 | 25 | 2.4 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (747635); RT; [Q] ≤ 0.0025 mol/L | 766046 |
| 20.1.225. | S$_2$O$_8$$^{2-}$ | H$_2$O | $\mu$ = 0.05 (NaClO$_4$) | 30 | 9.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT; [Q] ≤ 0.007 mol/L | 85A062 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | $\mu$ = 0.1 (NaClO$_4$) | 30 | 7.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85A062 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | $\mu$ = 0.2 (NaClO$_4$) | 30 | 4.8 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85A062 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | $\mu$ = 0.3 (NaClO$_4$) | 30 | 3.3 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85A062 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | $\mu$ = 0.4 (NaClO$_4$) | 30 | 2.4 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT | 85A062 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | $\mu$ = 0.5 (NaClO$_4$) | 30 | 2.0 × 10$^8$ | SS/LUM; $\tau_0$ = 0.66 $\mu$s (737656); OT; [Q] ≤ 0.01 mol/L | 85A062 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | | | 6.8 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.59 $\mu$s | 85N164 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | 0.2 mol/L (NH$_4$)$_2$SO$_4$ | | 1.1 × 10$^9$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 0.55 $\mu$s; OT; [Q] ≤ 0.01 mol/L | 84F121 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | | 5.3 × 10$^8$ | SS/LUM; OT | 80F128 |
| | S$_2$O$_4$$^{2-}$ | H$_2$O | Acbuf; pH 4.7; $\mu$ = 0.1 | | 8 × 10$^8$ | LP/LUM/SST; OT; [Q] ≤ 0.02 mol/L | 80C077 |
| | S$_2$O$_4$$^{2-}$ | H$_2$O | 0.1 mol/L ACbuf; pH 5 | | 8 × 10$^8$ | SS/LUM; OT | 81N178 |
| | S$_2$O$_8$$^{2-}$ | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 2 | | 4.6 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.59 $\mu$s | 85N164 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $S_2O_8^{2-}$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 8 | | $2.8 \times 10^8$ | LP/LUM/SST | 85N164 |
| | $S_2O_8^{2-}$ | $H_2O/AN$ (9/1) | 0.2 mol/L $(NH_4)_2SO_4$ | | $4.3 \times 10^8$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 0.64 µs; OT; [Q] ≤ 0.02 mol/L | 84F121 |
| | $S_2O_8^{2-}$ | $H_2O/AN$ (4/1) | 0.2 mol/L $(NH_4)_2SO_4$ | | $1.3 \times 10^8$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 0.71 µs; OT; [Q] ≤ 0.04 mol/L | 84F121 |
| | $S_2O_8^{2-}$ | $H_2O/AN$ (2.3/1) | 0.2 mol/L $(NH_4)_2SO_4$ | | $6.9 \times 10^7$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 0.78 µs; OT; [Q] ≤ 0.07 mol/L | 84F121 |
| | $S_2O_8^{2-}$ | $H_2O/AN$ (1.5/1) | 0.2 mol/L $(NH_4)_2SO_4$ | | $3.4 \times 10^7$ | SS/LUM, LP/LUM/AVE; $\tau_0$ = 0.81 µs; OT; [Q] ≤ 0.06 mol/L | 84F121 |
| 20.1.226. | $Sm^{3+}$ | $H_2O$ | 0.3 mol/L HCl | | $2.1 \times 10^6$ | SL/LUM/SPC, SS/LUM | 85S227 |
| 20.1.227. | $Ti^{3+}$ | $H_2O$ | 1.5 mol/L HCl; $\mu$ = 3.0 (LiCl) | 25 | $6.0 \times 10^6$ | LP/LUM/SST; $\tau_0$ = 0.53 µs; ET; 20-60% $Ti^{3+}$ coordinated by Cl$^-$ | 79A183 |
| | $Ti^{3+}$ | $H_2O$ | 1 mol/L HCl | | $6.0 \times 10^6$ | SL/LUM/SPC; $\tau_0$ = 0.66 µs; OT; [Q] ≤ 0.035 mol/L; $k_q$ = 7.2 × 10$^6$ with SS/LUM | 80F183 |
| 20.1.228. | $Tl^+$ | $H_2O$ | 0.5 mol/L $HClO_4$ | ~20 | $<1 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 0.40 µs (737633); [Q] = 0.01 mol/L | 746396 |
| 20.1.229. | $Tl^{3+}$ | $H_2O$ | 0.5 mol/L $HClO_4$ | ~20 | $1.1 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.40 µs (737633); OT; [Q] ≤ 0.01 mol/L | 746396 |
| | $Tl^{3+}$ | $H_2O$ | 4.8 mol/L $HClO_4$ | 25 | $1.0 \times 10^9$ | LP/LUM/SST; OT | 82A068 |
| | $Tl^{3+}$ | $H_2O$ | 0.5 mol/L $H_2SO_4$; $\mu$ = 1.5 | | $1.0 \times 10^8$ | LP/LUM/SST; OT; $f$ = 1 | 82A111 |
| | $Tl^{3+}$ | $H_2O$ | 1 mol/L HCl; $\mu$ = 1.0 | | $3.4 \times 10^9$ | LP/LUM/SST; OT | 82A111 |
| | $Tl^{3-}$ | $H_2O$ | 3 mol/L HCl; $\mu$ = 3.0 | | $4.3 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.07(?) | 82A111 |
| 20.1.230. | $UO_2^{2+}$ | $H_2O$ | pH 2 ($HNO_3$) | | $4.4 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.60 µs; OT; $f$ = 0.45; [Q] ≤ 5 × 10$^{-4}$ mol/L | 80A291 |
| | $UO_2^{2+}$ | $H_2O$ | 2 mol/L $H_3PO_4$ | | $3.5 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.50 µs; OT; $f$ = 0.45 | 80A291 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.2.** | **$(-)_D$-Ru(bpy)$_3{}^{2+}$** | | | | | | |
| 20.2.1. | Co(acac)$_3$ | H$_2$O | | 22 | $9.0 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.65$ μs; OT; $k_q = 5.7 \times 10^8$ with SS/QYP, see Mech. [5] | 80F228 |
| 20.2.2. | $(-)_C$-Co(EDTA)$^-$ | H$_2$O/MeOH (1/1) | | 25 | $4.2 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(-)_C$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 15 | $1.0 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 14$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(-)_C$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 25 | $1.4 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 14$ kJ/mol; $\Delta G^\ddagger = 15$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(-)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 35 | $1.7 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 14$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(-)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 45 | $2.1 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 14$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(-)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (4.3/1) | | 25 | $9.1 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| 20.2.3. | $(+)_D$-Co(EDTA)$^-$ | H$_2$O/MeOH (1/1) | | 25 | $3.5 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(+)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 15 | $9.7 \times 10^9$ | LP/LUM/SST; $\Delta H^\ddagger = 11$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(+)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 25 | $1.2 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 11$ kJ/mol; $\Delta G^\ddagger = 15$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(+)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 35 | $1.4 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 11$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(+)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (9/1) | | 45 | $1.7 \times 10^{10}$ | LP/LUM/SST; $\Delta H^\ddagger = 11$ kJ/mol; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| | $(+)_D$-Co(EDTA)$^-$ | MeOH/H$_2$O (4.3/1) | | 25 | $8.2 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |
| 20.2.4. | $rac$-Co(EDTA)$^-$ | H$_2$O | | 25 | $6.7 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ μs; OT; [Q] = (1-5) $\times$ 10$^{-4}$ mol/L | 85F008 |

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **20.2.** | **$(-)_D$-Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| | rac-Co(EDTA)$^-$ | $H_2O$ | 0.039 mol/L KBr | 25 | $3.7 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ μs; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| | rac-Co(EDTA)$^-$ | $H_2O$ | 0.12 mol/L KBr | 25 | $3.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ μs; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| | rac-Co(EDTA)$^-$ | $H_2O$/MeOH (1/1) | | 25 | $3.9 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| | rac-Co(EDTA)$^-$ | MeOH/$H_2O$ (9/1) | | 25 | $1.3 \times 10^{10}$ | LP/LUM/SST; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| | rac-Co(EDTA)$^-$ | MeOH/$H_2O$ (4.3/1) | | 25 | $8.5 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| | rac-Co(EDTA)$^-$ | MeOH/$H_2O$ (4.3/1) | 0.042 mol/L KBr | 25 | $1.7 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| | rac-Co(EDTA)$^-$ | MeOH/$H_2O$ (4.3/1) | 0.13 mol/L KBr | 25 | $1.1 \times 10^9$ | LP/LUM/SST; OT; [Q] = (1-5) × 10$^{-4}$ mol/L | 85F008 |
| 20.2.5. | Co(phen)$_3^{3+}$ | $H_2O$ | 0.5 mol/L NaCl | 22 | $6.8 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.65$ μs; OT; $k_q = 3.5 \times 10^8$ with SS/QYP, see Mech. [5] | 80F228 |
| 20.2.6. | Fe$^{3+}$ | $H_2O$ | 0.1 mol/L NaClO$_4$, 0.01 mol/L HClO$_4$ | 22 | $8.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.65$ μs; OT; $k_q = 1.3 \times 10^8$ with SS/QYP, see Mech. [5] | 80F228 |
| 20.2.7. | Fe(CN)$_6^{1-}$ | $H_2O$ | 0.5 mol/L NaCl | 22 | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.65$ μs; RT; $k_q = 3.3 \times 10^8$ with SS/QYP, see Mech. [5] | 80F228 |

TABLE 21. Quenching of Ru(bpy)$_3^{2+}$ by organic compounds (except MV$^{2+}$)

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **Ru(bpy)$_3^{2+}$** | | | | | | |
| 21.1.1. | Acetate ion | H$_2$O | Pbuf; pH 5.8; $\mu$ = 0.10 (LiClO$_4$) | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (747635); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L | 80F058 |
| 21.1.2. | cis-$\alpha$-Acetoxystilbene | MeOH | | | $1.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.83 $\mu$s (LP/LUM/SST); ET? | 84F069 |
| 21.1.3. | 4-Acetylphenol | H$_2$O | 0.05 mol/L NaOH | 23 | $\sim 3 \times 10^6$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (LP/LUM/AVE); RT | 82A365 |
| 21.1.4. | cis-$\alpha$-Acetylstilbene | MeOH | | | $1.1 \times 10^7$ | SS/LUM; $\tau_0$ = 0.83 $\mu$s (LP/LUM/SST) | 84F069 |
| 21.1.5. | 1-Aminonaphthalene | AN | | 18 | $8.5 \times 10^7$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.22 $\mu$s; RT | 84E192 |
| | 1-Aminonaphthalene | AN | | $\sim$22 | $1.2 \times 10^8$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (77A240); RT | 777106 |
| | 1-Aminonaphthalene | AN | | 25 | $1.6 \times 10^8$ | SS/LUM; $\Delta H^{\ddagger}$ = 9.2 kJ/mol; $\Delta S^{\ddagger}$ = -57 J/mol·K | 86A165 |
| | 1-Aminonaphthalene | EtOH | | 18 | $1.4 \times 10^9$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.29 $\mu$s; RT | 84E192 |
| | 1-Aminonaphthalene | MeOH | | 25 | $2.0 \times 10^9$ | SS/LUM; $\Delta H^{\ddagger}$ = 7.9 kJ/mol; $\Delta S^{\ddagger}$ = -39 J/mol·K | 86A165 |
| 21.1.6. | 2-Aminonaphthalene | AN | | 18 | $1.5 \times 10^7$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.22 $\mu$s; RT | 84E192 |
| | 2-Aminonaphthalene | AN | | 25 | $2.1 \times 10^7$ | SS/LUM; $\Delta H^{\ddagger}$ = 13 kJ/mol; $\Delta S^{\ddagger}$ = -59 J/mol·K | 86A165 |
| | 2-Aminonaphthalene | EtOH | | 18 | $3.9 \times 10^8$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.29 $\mu$s; RT | 84E192 |
| | 2-Aminonaphthalene | MeOH | | 25 | $3.6 \times 10^8$ | SS/LUM; $\Delta H^{\ddagger}$ = 12 kJ/mol; $\Delta S^{\ddagger}$ = -41 J/mol·K | 86A165 |
| 21.1.7. | 4-Aminophenol | H$_2$O | pH 7; $\mu$ = 0.05 | 23 | $3.8 \times 10^8$ | LP/LUM/AVE; $\tau_0$ = 0.60 $\mu$s; RT; $f$ = 0.68 | 82A365 |
| 21.1.8. | N-(4-Aminophenyl)aniline | AN | 0.1 mol/L TEAP | $\sim$22 | $6.7 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.15 $\mu$s (SL/LUM/SPC); RT | 78E518 |
| | N-(4-Aminophenyl)aniline | AN | $\mu$ = 2 $\times$ 10$^{-4}$ | | $9.2 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.16 $\mu$s; RT | 85A248 |
| 21.1.9. | Anthracene | C$_6$H$_6$/EtOH (15/1) | | 25 | $2.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.69 $\mu$s (717111); ET; [Q] = 0.003-0.015 mol/L | 736244 |

TABLE 21. Quenching of Ru(bpy)$_3^{2+}$ by organic compounds (except M$V^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T$/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3^{2+}$—Continued** | | | | | | | |
| 21.1.10. | Anthracene-9-carboxylate ion | H$_2$O | ACbuf; pH 5 | | $5.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.63 μs (81S134); ET; [Q] ≤ 0.002 mol/L | 83A008 |
| 21.1.11. | 9,10-Anthraquinone-2,6-disulfonate ion | H$_2$O | 0.005 mol/L Pbuf; pH 6.9; μ = 0.04 | | $6.0 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.63 μs; OT; $f$ = <0.01; [Q] = (2-20) × 10$^{-4}$ mol/L | 81A042 |
| | 9,10-Anthraquinone-2,6-disulfonate ion | H$_2$O | pH 9.8 | | $1.6 \times 10^{10}$ | SS/LUM; $\tau_0^{air}$ = 0.4 μs (78A002); OT | 82N119 |
| | 9,10-Anthraquinone-2,6-disulfonate ion | H$_2$O | 0.2% w/w colloidal silica; pH 9.8 | | $1.2 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.4 μs (78A002); OT; S adsorbed | 82N119 |
| 21.1.12. | 9,10-Anthraquinone-2-sulfonate ion | H$_2$O | pH 9.8 | | $2.5 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.4 μs (78A002); OT | 82N119 |
| | 9,10-Anthraquinone-2-sulfonate ion | H$_2$O | 0.2% w/w colloidal silica; pH 9.8 | | $1.1 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.4 μs (78A002); OT; S adsorbed | 82N119 |
| 21.1.13. | Ascorbate ion | H$_2$O | pH 5; μ = 0.7 (Na$_2$SO$_4$) | 25 | $3.0 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); RT | 82A278 |
| | Ascorbate ion | H$_2$O | | | $2 \times 10^7$ | LP/ABS/SST; OT; [Q] = 0.01-0.1 mol/L | 79F045 |
| 21.1.14. | Benzenediazonium cation | AN | 0.1 mol/L TBAP | | $2.1 \times 10^{10}$ | SS/LUM; RT | 84F366 |
| 21.1.15. | Benzenethiolate ion | AN | | | $5.7 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 μs (777106); RT; [Q] ≤ 2 × 10$^{-4}$ mol/L | 81F266 |
| 21.1.16. | Benzoate ion | H$_2$O | Pbuf; pH 5.8; μ = 0.10 (LiClO$_4$) | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0$ = 0.60 μs (747635); OT; [Q] = (5-50) × 10$^{-4}$ mol/L | 80F058 |
| 21.1.17. | 1,4-Benzoquinone | DMF | | | $6.3 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.20 μs (LP/LUM/AVE); OT | 83E170 |
| | 1,4-Benzoquinone | H$_2$O | | | $1.1 \times 10^{10}$ | LP/LUM/SST; $\tau_0$ = 0.59 μs | 85N164 |
| | 1,4-Benzoquinone | H$_2$O | 0.005 mol/L Pbuf; pH 6.9; μ = 0.04 | | $3.7 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.63 μs; OT; $f$ = 0.08; [Q] = (2-20) × 10$^{-4}$ mol/L | 81A042 |
| | 1,4-Benzoquinone | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 2 | | $8.7 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.59 μs | 85N164 |
| | 1,4-Benzoquinone | H$_2$O | 9.4 × 10$^{-5}$ mol/L PMA; pH 7 | | $5.6 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.67 μs | 85N164 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. $Ru(bpy)_3^{2+}$—Continued** | | | | | | | |
| | 1,4-Benzoquinone | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 9 | | $9.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ μs | 85N164 |
| 21.1.18. | 1-Benzyl-1,4-dihydronicotinamide | AN | | | $3.5 \times 10^8$ | EMI; $\tau_0 = 0.84$ μs; RT; $k_q$ = $2.9 \times 10^8$ L mol$^{-1}$ s$^{-1}$ with SS/LUM and $\tau_0 = 1.0$ μs from same lab in 84F069 | 81F381 |
| | 1-Benzyl-1,4-dihydronicotinamide | AN | 0.1 mol/L TBAP | | $4.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (79C010); RT; $k_q = 4.9 \times 10^8$ with SS/QYP, see Mech. [7] | 84F351 |
| | 1-Benzyl-1,4-dihydronicotinamide | DMF | | | $2.0 \times 10^8$ | SS/LUM; $\tau_0 = 0.93$ μs (LP/LUM/SST); RT | 84F069 |
| | 1-Benzyl-1,4-dihydronicotinamide | MeOH | 0.025 mol/L $Mg(ClO_4)_2$ | 20 | $1.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.73$ μs; RT; Q partially bound to $Mg^{2+}$; $k_q = 1.5 \times 10^8$ for unbound Q; $k_q = 9 \times 10^7$ for bound Q | 85F228 |
| | 1-Benzyl-1,4-dihydronicotinamide | MeOH | | | $1.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.83$ μs (LP/LUM/SST); RT | 84F069 |
| | 1-Benzyl-1,4-dihydronicotinamide | py/MeOH (10/1) | 0.1 mol/L $Mg(ClO_4)_2$ | 20 | $1.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs; RT; Q partially bound to $Mg^{2+}$; $k_q = 3.7 \times 10^8$ for unbound Q; $k_q = \sim5 \times 10^6$ for bound Q | 85F228 |
| | 1-Benzyl-1,4-dihydronicotinamide | py/MeOH (10/1) | | | $3.5 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/SST); RT | 84F069 |
| 21.1.19. | 2,6-Bis(tert-butyl)-1,4-benzoquinone | DMF | | | $2.2 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.20$ μs (LP/LUM/AVE); OT | 83E170 |
| 21.1.20. | 3,5-Bis(tert-butyl)-1,2-benzoquinone | DMF | | | $3.4 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.20$ μs (LP/LUM/AVE); OT | 83E170 |
| 21.1.21. | $N,N'$-Bis(2-carboxylatoethyl)-(vio$^{2+}$) zwitterion | $H_2O$ | | | $1.3 \times 10^9$ | OT | 82N022 |
| 21.1.22. | 1,4-Bis($N,N$-dimethylamino)benzene | AN | | $\sim22$ | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.85$ μs (77A240); RT | 777106 |
| | 1,4-Bis($N,N$-dimethylamino)benzene | AN | 0.1 mol/L TEAP | $\sim22$ | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); RT | 79C010 |
| | 1,4-Bis($N,N$-dimethylamino)benzene | AN | $\mu = 2 \times 10^{-4}$ | | $1.3 \times 10^{10}$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.16$ μs; RT | 85A248 |

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TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| | 1,4-Bis($N,N$-dimethylamino)benzene | $H_2O$ | pH 8(?) | | $1 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.6 μs (777296); RT | 78A392 |
| | 1,4-Bis($N,N$-dimethylamino)benzene | MeOH | | 25 | $6.9 \times 10^9$ | SL/LUM/SPC; $\tau_0$ = 0.67 μs; $\Delta G^{\ddagger}$ = 17 kJ/mol; RT | 83E623 |
| 21.1.23. | 4,4'-Bis($N,N$-dimethylamino)biphenyl | AN | 0.1 mol/L TEAP | ~22 | $7.4 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.15 μs (SL/LUM/SPC); RT | 78E518 |
| | 4,4'-Bis($N,N$-dimethylamino)biphenyl | AN | 0.1 mol/L TEAP | ~22 | $4.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 μs (767009); RT | 79C010 |
| | 4,4'-Bis($N,N$-dimethylamino)biphenyl | MeOH | | | $7.4 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.75 μs; RT | 777296 |
| 21.1.24. | 1,2-Bis(H-3-pyl)ethane dication | AN | | | $6.8 \times 10^6$ | EMI; ET, OT (10%) | 767528 |
| 21.1.25. | 1,2-Bis(H-4-pyl)ethane dication | AN | | | $2.4 \times 10^9$ | EMI; OT, ET (1%) | 767528 |
| 21.1.26. | $N,N'$-Bis(2-hydroxyethyl)-vio$^{2+}$ | $H_2O$ | | | $2.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.6 μs; OT; [Q] = (2-10) $\times$ 10$^{-4}$ mol/L | 78A269 |
| | $N,N'$-Bis(2-hydroxyethyl)-vio$^{2+}$ | $H_2O$ | 0.5 mol/L ACbuf; pH 5 | | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.27. | trans-1,2-Bis(Me-4-pyl)ethene dication | AN | 0.1 mol/L TEAP or TBAF | | $2.4 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 μs; OT; [Q] $\leq$ 0.001 mol/L | 747159 |
| 21.1.28. | trans-1,2-Bis(Me-2-pyl)ethene dication | AN | 0.1 mol/L TEAP | ~22 | $1.6 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 μs (767009); RT | 79C010 |
| 21.1.29. | trans-1,2-Bis(Me-3-pyl)ethene dication | AN | 0.1 mol/L TEAP | ~22 | $1.6 \times 10^8$ | SS/LUM; $\tau_0$ = 0.85 μs (767009); RT, ET; $k_q$ for RT only | 79C010 |
| 21.1.30. | trans-1,2-Bis(Me-4-pyl)ethene dication | AN | 0.1 mol/L TEAP | ~22 | $2.4 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 μs (767009); RT | 79C010 |
| 21.1.31. | 1,4-Bis($N$-phenylamino)benzene | AN | 0.1 mol/L TEAP | ~22 | $5.8 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.15 μs (SL/LUM/SPC); RT | 78E518 |
| | 1,4-Bis($N$-phenylamino)benzene | AN | $\mu$ = 2 $\times$ 10$^{-4}$ | | $7.3 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.16 μs; RT | 85A248 |
| 21.1.32. | $N,N'$-Bis(poly-2,4-ionene)-(vio$^{2+}$) polycation | $H_2O$ | pH 5-7 | | $5.4 \times 10^8$ | LP/LUM/AVE; OT; $f$ = 0.14; [Q] = 0.001 mol/L | 85B030 |
| | $N,N'$-Bis(poly-2,4-ionene)-(vio$^{2+}$) polycation | $H_2O$ | 2 $\times$ 10$^{-4}$ mol/L Fe(CN)$_6^{3-}$; pH 5-7 | | $6.1 \times 10^8$ | LP/LUM/AVE; OT; [Q] = 0.001 mol/L | 85B030 |
| 21.1.33. | $N,N'$-Bis(2-propyl)-vio$^{2+}$ | $H_2O$ | 0.5 mol/L ACbuf; pH 5 | | $5.3 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT | 82C019 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **Ru(bpy)$_3{}^{2+}$**—Continued | | | | | | |
| 21.1.34. | 1,2-Bis(4-pyridyl)ethane | H$_2$O | 0.01 mol/L Pbuf; pH 5.6; $\mu = 0.1$ (LiClO$_4$) | 25 | $\leq 3 \times 10^7$ | SS/LUM; $\tau_0 = 0.6$ μs (766404); OT; [Q] = 0.0020 mol/L | 78E293 |
| 21.1.35. | *trans*-1,2-Bis(4-pyridyl)ethene | H$_2$O | 0.01 mol/L Pbuf; pH 5.6; $\mu = 0.1$ (LiClO$_4$) | 25 | $9.2 \times 10^7$ (calc) | SS/LUM; $\tau_0 = 0.6$ μs (766404); OT; [Q] = 0.0013-0.0049 mol/L; Q partially protonated | 78E293 |
| 21.1.36. | $N,N'$-Bis(4-sulfonatobenzyl)-(vio$^{2+}$) zwitterion | H$_2$O | pH 4 | | $1.4 \times 10^9$ | SS/LUM; OT; $f = 0.1$; [Q] $\leq 5 \times 10^{-4}$ mol/L; same $k_q$ from same lab in 85S084 | 82N118 |
| 21.1.37. | $N,N'$-Bis(3-sulfonato-1-propyl)-(bpy$^{2+}$) zwitterion | H$_2$O | $\mu = 0.1$ (TBAC) | 25 | $6.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.58$ μs (82E392); OT | 85S182 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(bpy$^{2+}$) zwitterion | H$_2$O | 0.002 mol/L NaCl | | $\sim 4 \times 10^8$ (estd) | SS/LUM; OT; [Q] = 0.002 mol/L | 85F007 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(bpy$^{2+}$) zwitterion | H$_2$O | pH 9.2 | | $3.2 \times 10^8$ | OT | 85N094 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(bpy$^{2+}$) zwitterion | H$_2$O | 0.2% w/w colloidal silica; pH 9.2 | | $4.0 \times 10^8$ | OT; S adsorbed | 85N094 |
| 21.1.38. | $N,N'$-Bis(3-sulfonato-1-propyl)-3,3'-dimethyl-(bpy$^{2+}$) zwitterion | H$_2$O | pH 9.2 | | $1.7 \times 10^8$ | OT | 85N094 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-3,3'-dimethyl-(bpy$^{2+}$) zwitterion | H$_2$O | 0.2% w/w colloidal silica; pH 9.2 | | $2.4 \times 10^8$ | OT; S adsorbed | 85N094 |
| 21.1.39. | $N,N'$-Bis(3-sulfonato-1-propyl)-2,2'-dimethyl-(vio$^{2+}$) zwitterion | H$_2$O | pH 9.2 | | $1.1 \times 10^9$ | OT | 85N094 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-2,2'-dimethyl-(vio$^{2+}$) zwitterion | H$_2$O | 0.2% w/w colloidal silica; pH 9.2 | | $1.2 \times 10^9$ | OT; S adsorbed | 85N094 |
| 21.1.40. | $N,N'$-Bis(3-sulfonato-1-propyl)-2,2',6,6'-tetramethyl-(vio$^{2+}$) zwitterion | H$_2$O | pH 9.2 | | $4.8 \times 10^8$ | OT | 85N094 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-2,2',6,6'-tetramethyl-(vio$^{2+}$) zwitterion | H$_2$O | 0.2% w/w colloidal silica; pH 9.2 | | $5.1 \times 10^8$ | OT; S adsorbed | 85N094 |
| 21.1.41. | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | H$_2$O | | | $1.3 \times 10^9$ | LP/LUM/SST; OT; $f = 0.14$ | 82A111 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | H$_2$O | 0.002 mol/L NaCl | | $\sim 2 \times 10^9$ (estd) | SS/LUM; OT; [Q] = 5 $\times$ 10$^{-4}$ mol/L | 85F007 |

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | 0.5 mol/L $H_2SO_4$ | | $1.9 \times 10^9$ | LP/LUM/SST; OT; $f = 0.23$ | 82A111 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | pH 9.2 | | $1.1 \times 10^9$ | OT | 85N094 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | 0.2% w/w colloidal silica; pH 9.2 | | $1.3 \times 10^9$ | OT; S adsorbed | 85N094 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | 0.2% w/w colloidal silica; pH 9.8 | | $1.5 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.4$ µs (78A002); OT; S adsorbed | 82N119 |
| 21.1.42. | bpy | $H_2O$ | 0.33 mol/L $Na_2SO_4$; 0.028 mol/L $NaHSO_4$; µ = 1.0 | | $4.2 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ µs (LP/LUM/SST); OT | 82F048 |
| 21.1.43. | bpyH$_2^{2+}$ | $H_2O$ | µ = 0.5 (HCl, NaCl) | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ µs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | bpyH$_2^{2+}$ | $H_2O$ | µ = 0.5 (HNO$_3$, NaNO$_3$) | 25 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ µs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 21.1.44. | 4-Bromobenzenediazonium cation | AN | 0.1 mol/L TBAP | | $2.6 \times 10^{10}$ | SS/LUM; RT | 84F366 |
| 21.1.45. | 4-Bromophenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $1.7 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ µs; RT; $f = 0.35$ | 82A365 |
| 21.1.46. | 4-(*tert*-Butyl)phenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $1.2 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.60$ µs; RT; $f = 0.67$ | 82A365 |
| 21.1.47. | 4-Chloro-$N,N$-dimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $7.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ µs (767009); RT | 79C010 |
| 21.1.48. | 1-Chloro-4-nitrobenzene | AN | 0.1 mol/L TEAP | ~22 | $8.0 \times 10^6$ | SS/LUM; $\tau_0 = 0.85$ µs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.49. | 4-Chlorophenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $1.9 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ µs; RT; $f = 0.65$ | 82A365 |
| 21.1.50. | Cresyl Violet | Ethylene glycol | | 22 | $4.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.84$ µs (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3{}^{2+}$**—Continued | | | | | | | |
| | Cresyl Violet | Glycerol | | 22 | $1.2 \times 10^8$ | SS/LUM; $\tau_0{}^{air} = 0.89$ μs (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| | Cresyl Violet | MeOH | | 22 | $6.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.77$ μs (LP/LUM/AVE); ET; [Q] = $(5-20) \times 10^{-4}$ mol/L | 83E052 |
| 21.1.51. | 3-Cyanophenol | H$_2$O | 0.05 mol/L NaOH | 23 | $8.2 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0$ | 82A365 |
| 21.1.52. | 4-Cyanophenol | H$_2$O | 0.05 mol/L NaOH | 23 | $\leq 2 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ μs (LP/LUM/AVE) | 82A365 |
| 21.1.53. | *trans*-α-Cyanostilbene | MeOH | | | $2.1 \times 10^8$ | SS/LUM; $\tau_0 = 0.83$ μs (LP/LUM/SST); ET? | 84F069 |
| 21.1.54. | 4,4′-Diaminobiphenyl | AN | 0.1 mol/L TEAP | ~22 | $4.5 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.15$ μs (SL/LUM/SPC); RT | 78E518 |
| 21.1.55. | $N,N'$-Dibenzyl-vio$^{2+}$ | EtOH | | 22 | $3.4 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0 = 0.90$ μs; OT | 80S001 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | ACbuf; pH 5; μ = 0.1 (NaClO$_4$) | 20 | $1.4 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.64$ μs; OT | 85F222 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | | 22 | $8.3 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0 = 0.64$ μs; OT | 80S001 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.64$ μs (80S001); OT | 82S257 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; μ = 0.5 | 25 | $1.8 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.60$ μs (766404); OT; [Q] = $(3-50) \times 10^{-4}$ mol/L | 82A145 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | | | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.6$ μs; OT; [Q] = $(2-10) \times 10^{-4}$ mol/L | 78A269 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | μ = 0 (extrap'd) | | $4.4 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.55$ μs; OT; [Q] $\leq 0.02$ mol/L | 80N138 |
| | $N,N'$-Dibenzyl-vio$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $1.4 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.69$ μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.56. | $N,N$-Diethylaniline | AN | 0.1 mol/L TEAP | ~22 | $1.5 \times 10^8$ | SS/LUM; $\tau_0{}^{air} = 0.15$ μs (SL/LUM/SPC); RT | 78E518 |
| | $N,N$-Diethylaniline | AN | 0.1 mol/L TEAP | ~22 | $1.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); RT | 79C010 |
| | $N,N$-Diethylaniline | MeOH | | 25 | $3.9 \times 10^8$ | SL/LUM/SPC; $\tau_0 = 0.67$ μs; $\Delta G^{\ddagger} = 24$ kJ/mol; RT | 83E623 |

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|---|
| 21.1. | | $Ru(bpy)_3^{2+}$—Continued | | | | | | |
| | 21.1.57. | Diethyldithiocarbamate ion | AN | | 23 | $2.9 \times 10^{10}$ | LP/LUM/SST; RT; some SQ | 80A259 |
| | | Diethyldithiocarbamate ion | AN | 0.1 mol/L LiClO$_4$ | 23 | $1.3 \times 10^9$ | SS/LUM; RT; [Q] $\leq$ 0.0025 mol/L | 80A259 |
| | | Diethyldithiocarbamate ion | AN | 0.1 mol/L NaClO$_4$ | 23 | $4.0 \times 10^9$ | SS/LUM; RT; [Q] $\leq$ 0.0025 mol/L | 80A259 |
| | | Diethyldithiocarbamate ion | AN | 0.1 mol/L TEAP | 23 | $9.6 \times 10^9$ | SS/LUM; RT; [Q] $\leq$ 0.0025 mol/L | 80A259 |
| | | Diethyldithiocarbamate ion | AN | 0.1 mol/L TBAP | 23 | $1.3 \times 10^{10}$ | SS/LUM; RT; [Q] $\leq$ 0.0025 mol/L | 80A259 |
| | | Diethyldithiocarbamate ion | $H_2O$ | | 23 | $2.2 \times 10^9$ | SS/LUM; RT | 80A259 |
| | 21.1.58. | $O,O'$-Diethyldithiophosphate ion | AN | 0.1 mol/L NaClO$_4$ | 23 | $<1.3 \times 10^7$ | SS/LUM; nonlinear S-V plot | 80A259 |
| | 21.1.59. | $N,N'$-Diethyl-2-methyl-vio$^{2+}$ | $H_2O$ | ACbuf; pH 5 | 22 | $7.4 \times 10^8$ | SS/LUM; $\tau_0$ = 0.64 µs (80S001); OT | 82S257 |
| | 21.1.60. | $N,N'$-Diheptyl-vio$^{2+}$ | $H_2O$ | µ = 0 (extrap'd) | | $4.2 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.55 µs; OT; [Q] $\leq$ 0.02 mol/L | 80N138 |
| | | $N,N'$-Diheptyl-vio$^{2+}$ | $H_2O$ | 0.5 mol/L ACbuf; pH 5 | | $1.2 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.69 µs; OT | 82C019 |
| | 21.1.61. | 1,4-Dihydroxybenzene | $H_2O$ | 0.005 mol/L Pbuf; pH 6.9; µ = 0.04 | | $<5 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.63 µs; RT; [Q] = 0.005-0.5 mol/L | 81A042 |
| | 21.1.62. | 4-($N,N$-Dimethylamino)phenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $3.9 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 0.60 µs; RT; $f$ = 0.42 | 82A365 |
| | | 4-($N,N$-Dimethylamino)phenol | $H_2O$ | pH 7; µ = 0.05 | 23 | $2.4 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 0.60 µs; RT; $f$ = 0.52 | 82A365 |
| | 21.1.63. | $N,N$-Dimethylaniline | AN | | ~22 | $7.1 \times 10^7$ | SS/LUM; $\tau_0$ = 0.85 µs (77A240); RT; same $k_q$ from same lab in 776441 | 777106 |
| | | $N,N$-Dimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $6.5 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 0.15 µs (SL/LUM/SPC); RT | 78E518 |
| | | $N,N$-Dimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $7.2 \times 10^7$ | SS/LUM; $\tau_0$ = 0.85 µs (767009); RT; same $k_q$ from same lab in 77F920 | 79C010 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3{}^{2+}$—Continued** | | | | | | | |
| | $N,N$-Dimethylaniline | AN | | 25 | $9.9 \times 10^7$ | SS/LUM; $\tau_0 = 0.85$ μs (LP/LUM/AVE); $\Delta H^{\ddagger} = 8.9$ kJ/mol; $\Delta S^{\ddagger} = -62$ J/mol·K (10-40 °C); $\Delta G^{\ddagger} = 27$ kJ/mol; RT; [Q] $\leq 0.014$ mol/L | 82A189 |
| | $N,N$-Dimethylaniline | AN | | 25 | $9.5 \times 10^7$ | SS/LUM; $\Delta H^{\ddagger} = 9.2$ kJ/mol; $\Delta S^{\ddagger} = -61$ J/mol·K | 86A165 |
| | $N,N$-Dimethylaniline | AN | $\mu = 2 \times 10^{-4}$ | | $9.8 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0{}^{air} = 0.16$ μs; RT | 85A248 |
| | $N,N$-Dimethylaniline | EtOH | | 22 | $1.8 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0 = 0.90$ μs; RT | 80S001 |
| | $N,N$-Dimethylaniline | MeOH | | 25 | $1.7 \times 10^8$ | SL/LUM/SPC; $\tau_0 = 0.67$ μs; $\Delta G^{\ddagger} = 26$ kJ/mol; RT | 83E623 |
| | $N,N$-Dimethylaniline | MeOH | | 25 | $1.6 \times 10^8$ | SS/LUM; $\Delta H^{\ddagger} = 14$ kJ/mol; $\Delta S^{\ddagger} = -42$ J/mol·K | 86A165 |
| 21.1.64. | $N,N'$-Dimethyl-3,3'-bipyridinium dication | AN | 0.1 mol/L TEAP | ~22 | $1.0 \times 10^6$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT | 79C010 |
| 21.1.65. | $N,N'$-Dimethyl-bpy$^{2+}$ | AN | 0.1 mol/L TEAP | ~22 | $9.1 \times 10^7$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT | 79C010 |
| | $N,N'$-Dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $1.8 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.69$ μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.66. | 4,4'-Dimethyl-bpyH$_2{}^{2+}$ | H$_2$O | $\mu = 0.5$ (NaHSO$_4$, Na$_2$SO$_4$) | 25 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] $= (5-50) \times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | 4,4'-Dimethyl-bpyH$_2{}^{2+}$ | H$_2$O | $\mu = 0.5$ (HCl, NaCl) | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] $= (5-50) \times 10^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 21.1.67. | $N,N'$-Dimethyl-2,7-diazaphenanthrene dication | AN | 0.1 mol/L TEAP | ~22 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT | 79C010 |
| 21.1.68. | Dimethyldibenzothiafulvalene | MeOH/THF (1/1) | | | $4 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.75$ μs; RT | 777296 |
| 21.1.69. | $N,N'$-Dimethyl-phen$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $1.4 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.69$ μs; OT; same $k_q$ from same lab in 83N211 | 82C019 |

TABLE 21. Quenching of Ru(bpy)$_3^{2+}$ by organic compounds (except MV$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T$/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3^{2+}$**—Continued | | | | | | | |
| 21.1.70. | $N,N'$-Dimethyl-3,3'-thio-vio$^{2+}$ | H$_2$O | ACbuf; pH 5 | | $8.4 \times 10^8$ | EMI or LIF; OT | 86F456 |
| 21.1.71. | 1,2-Dinitrobenzene | AN | 0.1 mol/L TEAP | ~22 | $3.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 and 77F920 | 79C010 |
| 21.1.72. | 1,3-Dinitrobenzene | AN | 0.1 mol/L TEAP | ~22 | $1.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.73. | 1,4-Dinitrobenzene | AN | 0.1 mol/L TEAP | | $6.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.86$ μs (SL/LUM/SPC); OT; same $k_q$ from same lab in 77F920; $8.6 \times 10^9$ L mol$^{-1}$ s$^{-1}$ at ~22 °C with SS/LUM and $\tau_0 = 0.85$ μs from same lab in 79C010 | 757168 |
| 21.1.74. | 4,4'-Dinitrobiphenyl | AN | 0.1 mol/L TEAP | ~22 | $1.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| | 4,4'-Dinitrobiphenyl | AN | | 25 | $4.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.85$ μs (LP/LUM/AVE); $\Delta H^{\ddagger} = -24$ kJ/mol; $\Delta S^{\ddagger} = -180$ J/mol·K (10-40 °C); $\Delta G^{\ddagger} = 29$ kJ/mol; OT; [Q] $\leq 0.014$ mol/L | 82A189 |
| 21.1.75. | $cis$-4,4'-Dinitrostilbene | AN | 0.1 mol/L TEAP | ~22 | $1.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.76. | $N,N'$-Dioctyl-vio$^{2+}$ | H$_2$O | | | $2.5 \times 10^9$ | SS/LUM; OT | 86N119 |
| 21.1.77. | $N,N'$-Dioctyl-vio$^{2+}$, β-CD complex | H$_2$O | variable [β-CD] | | $8.5 \times 10^8$ | SS/LUM; OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; nonlinear S-V plots; $k_q$ eval'd from $k_{obs}$ at various [β-CD] | 86N119 |
| 21.1.78. | Diphenylamine | MeOH | | | $2.5 \times 10^7$ | LP/LUM/SST; $\tau_0 = 0.75$ μs; RT | 777296 |
| 21.1.79. | 3,4-Diphenyl-sydnone | AN | | 24 | $2.4 \times 10^9$ | LP/LUM/AVE; ET | 86A380 |
| 21.1.80. | DMSO | H$_2$O | pH 4-5; μ = 0.50 (NaCl) | 25 | $<1 \times 10^6$ | SS/LUM; $\tau_0 = 0.60$ μs (766404) | 776405 |
| 21.1.81. | DQ$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.64$ μs (80S001); OT | 82S257 |

| No. | Quencher | Solvent | Solution Medium | $T$/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3^{2+}$**—Continued | | | | | | | |
| | DQ$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; μ = 0.5 | 25 | 2.0 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 μs (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| | DQ$^{2+}$ | H$_2$O | μ = 0.5 (HCl, NaCl) | 25 | 3.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 μs (766404); OT; [Q] = (5-50) × 10$^{-4}$ mol/L | 83C017 |
| | DQ$^{2+}$ | H$_2$O | μ = 0 (extrap'd) | | 3.5 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.55 μs; OT; [Q] ≤ 0.02 mol/L | 80N138 |
| | DQ$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 1.4 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.82. | 4-Ethoxyphenol | H$_2$O | 0.05 mol/L NaOH | 23 | 4.4 × 10$^9$ | LP/LUM/AVE; $\tau_0$ = 0.60 μs; RT; $f$ = 0.44 | 82A365 |
| 21.1.83. | $N,N'$-Ethylene-3,3'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 6.0 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.84. | $N,N'$-Ethylene-4,4'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; μ = 0.5 | 25 | 1.4 × 10$^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 μs (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| | $N,N'$-Ethylene-4,4'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 9.9 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.85. | $N,N'$-Ethylene-5,5'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 9.5 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.86. | $N,N'$-Ethylene-6,6'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 9.3 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT | 82C019 |
| 21.1.87. | $N,N'$-Ethylene-6-ethyl-bpy$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | 1.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.64 μs (80S001); OT | 82S257 |
| 21.1.88. | $N,N'$-Ethylene-6-methyl-bpy$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | 1.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.64 μs (80S001); OT | 82S257 |
| 21.1.89. | $N,N'$-Ethylene-phen$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 1.8 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 0.69 μs; OT; same $k_q$ from same lab in 83N211 | 82C019 |
| 21.1.90. | 4-Ethylphenol | H$_2$O | 0.05 mol/L NaOH | 23 | 1.8 × 10$^9$ | LP/LUM/AVE; $\tau_0$ = 0.60 μs; RT; $f$ = 0.56 | 82A365 |
| 21.1.91. | Ethylxanthate ion | AN | 0.1 mol/L NaClO$_4$ | 23 | 3.6 × 10$^9$ | SS/LUM; RT | 80A259 |

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TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| 21.1.92. | 1-Fluoro-4-nitrobenzene | AN | 0.1 mol/L TEAP | ~22 | $8.3 \times 10^5$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.93. | 3-Fluorophenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $8.5 \times 10^6$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0.95$ | 82A365 |
| 21.1.94. | 4-Fluorophenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $2.1 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0.60$ | 82A365 |
| 21.1.95. | $N,N',2,2',6,6'$-Hexamethyl-vio$^{2+}$ | $H_2O$ | ACbuf; pH 5 | 22 | $4.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ μs (80S001); OT; same $k_q$ from same lab in 82F316 | 82S257 |
| 21.1.96. | 1-(H-3-pyl)-2-(H-4-pyl)ethane dication | AN | | | $9.1 \times 10^8$ | EMI; OT, ET (4%) | 767528 |
| 21.1.97. | 4-Hydroxybenzoic acid | $H_2O$ | 0.05 mol/L NaOH | 23 | $2.1 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; $E_a = 54$ kJ/mol; RT; $f = 0.57$ | 82A365 |
| 21.1.98. | 4-Hydroxybiphenyl | $H_2O$ | 0.05 mol/L NaOH | 23 | $4.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0.46$ | 82A365 |
| 21.1.99. | Imidazole | $H_2O$ | pH 4-5; $\mu = 0.50$ (NaCl) | 25 | $<1 \times 10^5$ | SS/LUM; $\tau_0 = 0.60$ μs (766404) | 776405 |
| 21.1.100. | 4-Iodophenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $4.2 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0.14$ | 82A365 |
| 21.1.101. | *trans*-1-(Me-3-pyl)-2-(Me-4-pyl)ethene dication | AN | 0.1 mol/L TEAP | ~22 | $7.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); RT, ET; $k_q$ for RT only | 79C010 |
| 21.1.102. | *trans*-1-(Me-2-pyl)-2-(Me-3-pyl)ethene dication | AN | 0.1 mol/L TEAP | ~22 | $5.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); RT | 79C010 |
| 21.1.103. | 2-Mercaptobenzoic acid | $H_2O$ | pH 9.4 | | $1.7 \times 10^9$ | SS/LUM, LP/LUM/SST; [Q] = 0.001-0.004 mol/L | 85F408 |
| 21.1.104. | 4-Mercaptopyridine | $H_2O$ | pH 10.8 | | $5 \times 10^7$ | LP/LUM/SST; [Q] = 0.0015, 0.0038 mol/L; some SQ | 85F408 |
| 21.1.105. | 4-Methoxyaniline | AN | | ~22 | $6.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (77A240); RT | 777106 |
| 21.1.106. | 4-Methoxybenzenediazonium cation | AN | 0.1 mol/L TBAP | | $1.6 \times 10^{10}$ | SS/LUM; RT | 84F366 |
| 21.1.107. | 4-Methoxy-$N,N$-dimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $5.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); RT | 79C010 |
| | 4-Methoxy-$N,N$-dimethylaniline | Acetone/$H_2O$ (19/1) | 0.002 mol/L NaOH | 23 | $5.1 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.71$ μs; RT; $f = 0.74$ | 82A365 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3$$^{2+}$—Continued** | | | | | | | |
| | 4-Methoxy-$N,N$-dimethylaniline | Acetone/H$_2$O (5.7/1) | 0.002 mol/L NaOH | 23 | $3.7 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.77$ $\mu$s; RT; $f = 0.80$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | Acetone/H$_2$O (1.9/1) | 0.002 mol/L NaOH | 23 | $2.9 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.80$ $\mu$s; RT; $f = 0.81$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | EtOH/H$_2$O (19/1) | 0.002 mol/L NaOH | 23 | $3.4 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.74$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | EtOH/H$_2$O (5.7/1) | 0.002 mol/L NaOH | 23 | $2.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.79$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | EtOH/H$_2$O (1.9/1) | 0.002 mol/L NaOH | 23 | $1.8 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.81$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O | pH 7; $\mu = 0.05$ | 23 | $2.6 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.60$ $\mu$s; RT; $f = 0.58$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O/Acetone (19/1) | 0.002 mol/L NaOH | 23 | $3.1 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.61$ $\mu$s; RT; $f = 0.58$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O/Acetone (3/1) | 0.002 mol/L NaOH | 23 | $2.9 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.72$ $\mu$s; RT; $f = 0.65$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O/Acetone (1.2/1) | 0.002 mol/L NaOH | 23 | $2.7 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.79$ $\mu$s; RT; $f = 0.82$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O/EtOH (19/1) | 0.002 mol/L NaOH | 23 | $2.9 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.62$ $\mu$s; RT; $f = 0.58$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O/EtOH (3/1) | 0.002 mol/L NaOH | 23 | $2.7 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.74$ $\mu$s; RT; $f = 0.61$ | 82A365 |
| | 4-Methoxy-$N,N$-dimethylaniline | H$_2$O/EtOH (1.2/1) | 0.002 mol/L NaOH | 23 | $2.0 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.77$ $\mu$s; RT; $f = 0.87$ | 82A365 |
| 21.1.108. | 4-Methoxydithiobenzoate ion | AN | 0.1 mol/L NaClO$_4$ | 23 | $5.0 \times 10^9$ | SS/LUM; RT | 80A259 |
| 21.1.109. | 3-Methoxyphenol | H$_2$O | 0.05 mol/L NaOH | 23 | $3.3 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ $\mu$s; RT; $f = 0.44$ | 82A365 |
| 21.1.110. | 4-Methoxyphenol | Acetone/H$_2$O (19/1) | 0.002 mol/L NaOH | 23 | $2.4 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 0.71$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (9/1) | 0.002 mol/L NaOH | 23 | $1.8 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 0.76$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (5.7/1) | 0.002 mol/L NaOH | 23 | $1.4 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 0.77$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (4/1) | 0.002 mol/L NaOH | 23 | $1.1 \times 10^{10}$ | LP/LUM/AVE; $\tau_0 = 0.80$ $\mu$s; RT; $f = 1$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (3/1) | 0.002 mol/L NaOH | 23 | $8.8 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.81$ $\mu$s; RT; $f = 1$ | 82A365 |

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **Ru(bpy)$_3$$^{2+}$**—Continued | | | | | | |
| | 4-Methoxyphenol | Acetone/H$_2$O (2.3/1) | 0.002 mol/L NaOH | 23 | $7.3 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.81$ µs; RT; $f = 0.98$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (1.9/1) | 0.002 mol/L NaOH | 23 | $6.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.80$ µs; RT; $f = 1$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (1.5/1) | 0.002 mol/L NaOH | 23 | $5.8 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.81$ µs; RT; $f = 0.95$ | 82A365 |
| | 4-Methoxyphenol | Acetone/H$_2$O (1.2/1) | 0.002 mol/L NaOH | 23 | $5.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.80$ µs; RT; $f = 0.97$ | 82A365 |
| | 4-Methoxyphenol | EtOH/H$_2$O (19/1) | 0.002 mol/L NaOH | 23 | $6.8 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.74$ µs; RT; $f = 0.98$ | 82A365 |
| | 4-Methoxyphenol | EtOH/H$_2$O (5.7/1) | 0.002 mol/L NaOH | 23 | $5.8 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.79$ µs; RT; $f = 0.85$ | 82A365 |
| | 4-Methoxyphenol | EtOH/H$_2$O (3/1) | 0.002 mol/L NaOH | 23 | $5.0 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.81$ µs; RT; $f = 0.82$ | 82A365 |
| | 4-Methoxyphenol | EtOH/H$_2$O (1.9/1) | 0.002 mol/L NaOH | 23 | $4.2 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.81$ µs; RT; $f = 0.80$ | 82A365 |
| | 4-Methoxyphenol | EtOH/H$_2$O (1.2/1) | 0.002 mol/L NaOH | 23 | $3.7 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.78$ µs; RT; $f = 0.64$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O | 0.05 mol/L NaOH | 23 | $4.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.60$ µs; $E_a = 18$ kJ/mol; RT; $f = 0.40$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O | pH 7; $\mu = 0.05$ | 23 | $1.8 \times 10^7$ | LP/LUM/AVE; $\tau_0 = 0.60$ µs; RT; $f = 0.80$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/Acetone (19/1) | 0.002 mol/L NaOH | 23 | $4.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.61$ µs; RT; $f = 0.42$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/Acetone (5.7/1) | 0.002 mol/L NaOH | 23 | $4.4 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.67$ µs; RT; $f = 0.54$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/Acetone (3/1) | 0.002 mol/L NaOH | 23 | $4.3 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.72$ µs; RT; $f = 0.56$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/Acetone (1.9/1) | 0.002 mol/L NaOH | 23 | $4.4 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.77$ µs; RT; $f = 0.72$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/Acetone (1.2/1) | 0.002 mol/L NaOH | 23 | $4.6 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.79$ µs; RT; $f = 0.80$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/EtOH (19/1) | 0.002 mol/L NaOH | 23 | $5.0 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.62$ µs; RT; $f = 0.40$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/EtOH (5.7/1) | 0.002 mol/L NaOH | 23 | $4.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.70$ µs; RT; $f = 0.39$ | 82A365 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **Ru(bpy)$_3{}^{2+}$—Continued** | | | | | | |
| | 4-Methoxyphenol | H$_2$O/EtOH (3/1) | 0.002 mol/L NaOH | 23 | $3.9 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.74$ $\mu$s; RT; $f = 0.40$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/EtOH (1.9/1) | 0.002 mol/L NaOH | 23 | $3.6 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.76$ $\mu$s; RT; $f = 0.46$ | 82A365 |
| | 4-Methoxyphenol | H$_2$O/EtOH (1.2/1) | 0.002 mol/L NaOH | 23 | $3.2 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.77$ $\mu$s; RT; $f = 0.51$ | 82A365 |
| 21.1.111. | $N$-Methyl-4-acetyl-py$^+$ | H$_2$O | 0.03 mol/L ACbuf; pH 5 | | $1.8 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| | $N$-Methyl-4-acetyl-py$^+$ | H$_2$O | 0.5 mol/L Pbuf; pH 5 | | $1.8 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| 21.1.112. | $N$-Methylaniline | AN | | 25 | $2.4 \times 10^7$ | SS/LUM; $\tau_0 = 0.85$ $\mu$s (LP/LUM/AVE); $\Delta H^{\ddagger} = 13$ kJ/mol; $\Delta S^{\ddagger} = -59$ J/mol·K (10-40 °C); $\Delta G^{\ddagger} = 31$ kJ/mol; RT; [Q] $\leq 0.014$ mol/L | 82A189 |
| 21.1.113. | 4-Methylbenzenediazonium cation | AN | 0.1 mol/L TBAP | | $1.8 \times 10^{10}$ | SS/LUM; RT | 84F366 |
| 21.1.114. | Methyl-1,4-benzoquinone | DMF | | | $5.0 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.20$ $\mu$s (LP/LUM/AVE); OT | 83E170 |
| 21.1.115. | $N$-Methyl-4-carbomethoxy-py$^+$ | H$_2$O | 0.03 mol/L ACbuf; pH 5 | | $1.4 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| | $N$-Methyl-4-carbomethoxy-py$^+$ | H$_2$O | 0.5 mol/L Pbuf; pH 5 | | $1.9 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| 21.1.116. | $N$-Methyl-4-carboxylato-(py$^+$) zwitterion | H$_2$O | 0.03 mol/L ACbuf; pH 5 | | $5.5 \times 10^7$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| | $N$-Methyl-4-carboxylato-(py$^+$) zwitterion | H$_2$O | 0.5 mol/L Pbuf; pH 5 | | $5.3 \times 10^7$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| 21.1.117. | $N$-Methyl-4-carboxy-py$^+$ | H$_2$O | 0.5 mol/L Pbuf; pH 0.5 | | $2.2 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| 21.1.118. | $N$-Methyl-4-cyano-py$^+$ | H$_2$O | 0.03 mol/L ACbuf; pH 5 | | $1.9 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| | $N$-Methyl-4-cyano-py$^+$ | H$_2$O | 0.5 mol/L Pbuf; pH 5 | | $2.1 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| 21.1.119. | $N$-Methyl-$N'$-hexadecyl-vio$^{2+}$ | H$_2$O | | | $6.7 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.62$ $\mu$s; OT; $f = 0.30$; linear S-V plot for [Q] $\leq 0.004$ mol/L, corresponding to CMC | 81N002 |

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TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. $Ru(bpy)_3^{2+}$—Continued** | | | | | | | |
| 21.1.120. | Methyl 3-nitrobenzoate | AN | 0.1 mol/L TEAP | ~22 | $1.7 \times 10^7$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| | Methyl 3-nitrobenzoate | AN | | 25 | $1.5 \times 10^7$ | SS/LUM; $\tau_0 = 0.85$ μs (LP/LUM/AVE); $\Delta H^{\ddagger} = -20$ kJ/mol; $\Delta S^{\ddagger} = -180$ J/mol·K (10-40 °C); $\Delta G^{\ddagger} = 32$ kJ/mol; OT; [Q] $\leq 0.014$ mol/L | 82A189 |
| 21.1.121. | Methyl 4-nitrobenzoate | AN | 0.1 mol/L TEAP | ~22 | $6.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.122. | 3-Methylphenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $4.7 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0.61$ | 82A365 |
| 21.1.123. | 4-Methylphenol | $H_2O$ | 0.05 mol/L NaOH | 23 | $1.5 \times 10^9$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; RT; $f = 0.60$ | 82A365 |
| 21.1.124. | *N*-Methylphenothiazine | AN | | ~22 | $1.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (77A240); RT | 777106 |
| | *N*-Methylphenothiazine | AN | 0.1 mol/L TEAP | ~22 | $1.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); RT | 79C010 |
| | *N*-Methylphenothiazine | MeOH | | | $1.3 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.75$ μs; RT | 777296 |
| 21.1.125. | 3-Methyl-4-phenyl-sydnone | AN | | 24 | $8 \times 10^8$ | LP/LUM/AVE; ET | 86A380 |
| 21.1.126. | *N*-Methyl-*N'*-(poly-2,4-ionene)-(vio$^{2+}$) polycation | $H_2O$ | pH 5-7 | | $1.3 \times 10^9$ | LP/LUM/AVE; OT; $f = 0.14$; [Q] = 0.001 mol/L | 85B030 |
| 21.1.127. | *N*-Methylpyrazinium cation | $H_2O$ | pH 4-5; $\mu = 0.50$ (NaCl) | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT | 776405 |
| 21.1.128. | *N*-Methyl-*N'*-tetradecyl-vio$^{2+}$ | $H_2O$ | $\mu = 0.0014$ | | $8 \times 10^8$ | LP/LUM/SST; OT; $f = 0.3$ (0.05 mol/L CTAC); [Q] = $5 \times 10^{-4}$ mol/L; $k_q$ not affected by $\leq 0.05$ mol/L CTAC; $k_q = 7 \times 10^8$ L mol$^{-1}$ s$^{-1}$ for $\tau_0 = 0.62$ μs from same lab in 81N002 | 80N025 |
| | *N*-Methyl-*N'*-tetradecyl-vio$^{2+}$ | $H_2O$ | 0.01 mol/L NaCl; $\mu = 0.011$ | | $1.1 \times 10^9$ | LP/LUM/SST; OT; [Q] = $5 \times 10^{-4}$ mol/L | 80N025 |
| 21.1.129. | *N*-Methyl-vio$^+$ | $H_2O$ | 0.01 mol/L Pbuf; pH 5.6; $\mu = 0.1$ (LiClO$_4$) | 25 | $7.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.6$ μs (766404); OT; [Q] = (5.4-19) $\times 10^{-4}$ mol/L | 78E293 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3^{2+}$—Continued** | | | | | | | |
| 21.1.130. $N$-Methyl-vioH$^{2+}$ | H$_2$O | 0.094 mol/L HClO$_4$; $\mu$ = 0.1 | 25 | 2.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] = (6-21) × 10$^{-4}$ mol/L | 78E293 |
| 21.1.131. 1,2-Naphthoquinone | DMF | | | 5.1 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 0.20 $\mu$s (LP/LUM/AVE); OT | 83E170 |
| 21.1.132. 1,4-Naphthoquinone | DMF | | | 4.4 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 0.20 $\mu$s (LP/LUM/AVE); OT | 83E170 |
| 21.1.133. 1-Naphthyldimethylamine | AN | | 18 | 2 × 10$^6$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.22 $\mu$s; RT | 84E192 |
| 1-Naphthyldimethylamine | EtOH | | 18 | 6 × 10$^7$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.29 $\mu$s; RT | 84E192 |
| 21.1.134. 1-Naphthylphenylamine | AN | | 18 | 3.5 × 10$^7$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.22 $\mu$s; RT | 84E192 |
| 1-Naphthylphenylamine | EtOH | | 18 | 3.4 × 10$^8$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.29 $\mu$s; RT | 84E192 |
| 21.1.135. 2-Naphthylphenylamine | AN | | 18 | 1.8 × 10$^7$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.22 $\mu$s; RT | 84E192 |
| 2-Naphthylphenylamine | EtOH | | 18 | 3.1 × 10$^8$ | SS/LUM, FP/LUM/SST; $\tau_0^{air}$ = 0.29 $\mu$s; RT | 84E192 |
| 21.1.136. Nile Blue A | Ethylene glycol | | 22 | 1.2 × 10$^9$ | SS/LUM; $\tau_0$ = 0.84 $\mu$s (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| Nile Blue A | Glycerol | | 22 | 2.8 × 10$^8$ | SS/LUM; $\tau_0^{air}$ = 0.89 $\mu$s (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| Nile Blue A | MeOH | | 22 | 2.5 × 10$^9$ | SS/LUM; $\tau_0$ = 0.77 $\mu$s (LP/LUM/AVE); ET; [Q] = (2.5-20) × 10$^{-4}$ mol/L | 83E052 |
| 21.1.137. 3-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | ~22 | 4.9 × 10$^7$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.138. 4-Nitrobenzaldehyde | AN | 0.1 mol/L TEAP | ~22 | 2.0 × 10$^9$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.139. Nitrobenzene | AN | 0.1 mol/L TEAP | ~22 | 2.2 × 10$^5$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3^{2+}$—Continued** | | | | | | | |
| | Nitrobenzene | $H_2O$ | | 22 | $3.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ µs (766014); OT; [Q] = (1-15) $\times 10^{-4}$ mol/L | 78A219 |
| | Nitrobenzene | $H_2O$ | 0.0064 mol/L PVS | 22 | $2.1 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ µs (766014); OT; [Q] = (1-15) $\times 10^{-4}$ mol/L | 78A219 |
| | Nitrobenzene | $H_2O$ | | | $7.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ µs | 85N164 |
| | Nitrobenzene | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 2 | | $7.3 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ µs | 85N164 |
| | Nitrobenzene | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 7 | | $3.6 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.67$ µs | 85N164 |
| | Nitrobenzene | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 9 | | $5.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.59$ µs | 85N164 |
| 21.1.140. | 4-Nitrobenzoate ion | $H_2O$ | Pbuf; pH 5.8; $\mu$ = 0.10 (LiClO$_4$) | 25 | $4.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ µs (747635); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L | 80F058 |
| 21.1.141. | 4-Nitro-bpy | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu$ = 1.0 | | $2.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ µs (LP/LUM/SST); OT | 82F048 |
| 21.1.142. | 1-Nitro-4-nitrosobenzene | AN | 0.1 mol/L TEAP | ~22 | $9.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ µs (767009); OT; same $k_q$ from same lab in 757168 | 79C010 |
| 21.1.143. | 4-Nitrotoluene | AN | 0.1 mol/L TEAP | | $<3 \times 10^5$ | SS/LUM; $\tau_0 = 0.86$ µs (SL/LUM/SPC) | 757168 |
| 21.1.144. | OrgQue1 | $H_2O$ | ACbuf | | $3.6 \times 10^9$ | SS/LUM | 85F001 |
| 21.1.145. | OrgQue2 | $H_2O$ | ACbuf | | $3.2 \times 10^9$ | SS/LUM | 85F001 |
| 21.1.146. | OrgQue3 | $H_2O$ | ACbuf | | $3.7 \times 10^9$ | SS/LUM | 85F001 |
| 21.1.147. | OrgQue4 | $H_2O$ | ACbuf | | $4.0 \times 10^9$ | SS/LUM | 85F001 |
| 21.1.148. | OrgQue5 | $H_2O$ | ACbuf | | $3.7 \times 10^9$ | SS/LUM; [Q] $\leq$ 0.003 mol/L | 85F001 |
| 21.1.149. | OrgQue6 | $H_2O$ | ACbuf | | $4.1 \times 10^9$ | SS/LUM | 85F001 |
| 21.1.150. | OrgQue7 | py/MeOH (10/1) | | | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 1.0$ µs (LP/LUM/SST) | 84F069 |
| 21.1.151. | OrgQue8 | AN | 0.1 mol/L TBAP | | $5.5 \times 10^9$ | SS/LUM; OT, ET? | 84F159 |
| 21.1.152. | OrgQue9 | AN | 0.1 mol/L TBAP | | $3.5 \times 10^9$ | SS/LUM; OT, ET? | 84F159 |
| 21.1.153. | OrgQue10 | AN | 0.1 mol/L TBAP | | $3.8 \times 10^9$ | SS/LUM; OT, ET? | 84F159 |

TABLE 21. Quenching of Ru(bpy)$_3{}^{2+}$ by organic compounds (except MV$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1. Ru(bpy)$_3{}^{2+}$**—Continued | | | | | | | |
| 21.1.154. | Oxazine 1 | Ethylene glycol | | 22 | $1.0 \times 10^9$ | SS/LUM; $\tau_0 = 0.84$ μs (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| | Oxazine 1 | Glycerol | | 22 | $3.1 \times 10^8$ | SS/LUM; $\tau_0{}^{air} = 0.89$ μs (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| | Oxazine 1 | MeOH | | 22 | $2.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.77$ μs (LP/LUM/AVE); ET; [Q] = (7.5-20) $\times$ 10$^{-4}$ mol/L | 83E052 |
| 21.1.155. | 9,10-Phenanthrenequinone | DMF | | | $4.1 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.20$ μs (LP/LUM/AVE); OT | 83E170 |
| 21.1.156. | phenH$^+$ | H$_2$O | $\mu$ = 0.5 (NaHSO$_4$, Na$_2$SO$_4$) | 25 | $1.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| | phenH$^+$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | $1.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 21.1.157. | phenH$_2{}^{2+}$ | H$_2$O | $\mu$ = 0.5 (HCl, NaCl) | 25 | $9.2 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L; $k_q$ from pH dependence of $K_{SV}$ | 83C017 |
| 21.1.158. | Phenol | H$_2$O | 0.05 mol/L NaOH | 23 | $1.2 \times 10^8$ | LP/LUM/AVE; $\tau_0 = 0.60$ μs; $E_a$ = 34 kJ/mol; RT; $f$ = 0.53 | 82A365 |
| 21.1.159. | Phenothiazine | AN | 0.1 mol/L TEAP | ~22 | $4.1 \times 10^9$ | SS/LUM; $\tau_0{}^{air} = 0.15$ μs (SL/LUM/SPC); RT | 78E518 |
| | Phenothiazine | AN | $\mu$ = 2 $\times$ 10$^{-4}$ | | $5.5 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0{}^{air} = 0.16$ μs; RT | 85A248 |
| | Phenothiazine | MeOH | | | $5.6 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.75$ μs; RT | 777296 |
| 21.1.160. | cis-1-Phenyl-2-(Me-4-pyl)ethene cation | H$_2$O | | | $2.9 \times 10^7$ | SS/LUM; $\tau_0 = 0.69$ μs (717111); OT | 82F153 |
| 21.1.161. | trans-1-Phenyl-2-(2-pyridyl)ethene | C$_6$H$_6$/EtOH (15/1) | | 25 | $4.5 \times 10^6$ | SS/LUM; $\tau_0 = 0.69$ μs (717111); ET | 736244 |
| 21.1.162. | trans-1-Phenyl-2-(4-pyridyl)ethene | C$_6$H$_6$/EtOH (15/1) | | 25 | $4.3 \times 10^6$ | SS/LUM; $\tau_0 = 0.69$ μs (717111); ET | 736244 |
| 21.1.163. | 3-Phenyl-sydnone | AN | | 24 | $1.2 \times 10^9$ | LP/LUM/AVE; ET | 86A380 |

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| 21.1.164. | PolyVio1 | $H_2O$ | | | $2.7 \times 10^8$ | SS/LUM, LP/LUM/SST; OT; [Q] = 0.001-0.004 mol/L; [Q] based on viologen units | 82N117 |
| 21.1.165. | PolyVio2 | $H_2O$ | | | $8.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ μs (766404); OT; [Q] ≤ 0.002 mol/L; [Q] based on viologen units | 81S011 |
| 21.1.166. | PolyVio10 | $H_2O$ | pH 5-7 | | $1.6 \times 10^8$ | LP/LUM/AVE; OT; $f = 0.12$; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| 21.1.167. | PolyVio11 | $H_2O$ | pH 5-7 | | $5 \times 10^7$ | LP/LUM/AVE; OT; $f = 0.57$; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| | PolyVio11 | $H_2O$ | $2 \times 10^{-4}$ mol/L $Fe(CN)_6^{3-}$; pH 5-7 | | $1.1 \times 10^8$ | LP/LUM/AVE; OT; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| 21.1.168. | PolyVio12 | $H_2O$ | pH 5-7 | | $1.1 \times 10^8$ | LP/LUM/AVE; OT; $f = 0.15$; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| 21.1.169. | PolyVio13 | $H_2O$ | pH 5-7 | | $1.0 \times 10^8$ | LP/LUM/AVE; OT; $f = 0.16$; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| | PolyVio13 | $H_2O$ | $2 \times 10^{-4}$ mol/L $Fe(CN)_6^{3-}$; pH 5-7 | | $1.4 \times 10^8$ | LP/LUM/AVE; OT; [Q] = 0.001 mol/L; [Q] based on viologen units | 85B030 |
| 21.1.170. | PolyVio14 | $H_2O$ | | | $3.1 \times 10^8$ | SS/LUM, LP/LUM/SST; OT; [Q] = 0.001-0.004 mol/L; [Q] based on viologen units | 82N117 |
| 21.1.171. | py | $H_2O$ | pH 4-5; $\mu = 0.50$ (NaCl) | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (766404) | 776405 |
| | py | $H_2O$ | 0.01 mol/L Pbuf; pH 5.6; $\mu = 0.1$ (LiClO$_4$) | 25 | $\leq 3 \times 10^7$ | SS/LUM; $\tau_0 = 0.6$ μs (766404); OT; [Q] = 0.0025 mol/L; Q partially protonated | 78E293 |
| 21.1.172. | pyH$^+$ | $H_2O$ | Pbuf; pH 5.8; $\mu = 0.10$ (LiClO$_4$) | 25 | $<1 \times 10^7$ | SS/LUM; $\tau_0 = 0.60$ μs (747635); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L | 80F058 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| 21.1.173. | Pyrazinecarboxylic acid | H$_2$O | pH 4-5; $\mu$ = 0.50 (NaCl) | 25 | 1.8 × 10$^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (766404); OT | 776405 |
| 21.1.174. | Rhodamine 101 | Ethylene glycol | | 22 | 5.5 × 10$^8$ | SS/LUM; $\tau_0$ = 0.84 $\mu$s (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| | Rhodamine 101 | Glycerol | | 22 | 7 × 10$^7$ | SS/LUM; $\tau_0^{air}$ = 0.89 $\mu$s (LP/LUM/AVE); ET; [Q] = 0.001 mol/L | 83E052 |
| | Rhodamine 101 | MeOH | | 22 | 8.5 × 10$^8$ | SS/LUM; $\tau_0$ = 0.77 $\mu$s (LP/LUM/AVE); ET; [Q] = (2.5-20) × 10$^{-4}$ mol/L; $k_q$ = 9 × 10$^8$ L mol$^{-1}$ s$^{-1}$ for SS/LUM (see Mech. [6]) from same lab in 80E412 | 83E052 |
| 21.1.175. | *trans*-Stilbene | C$_6$H$_6$/EtOH (15/1) | | 25 | 2.1 × 10$^6$ | SS/LUM; $\tau_0$ = 0.69 $\mu$s (717111); ET; [Q] = 0.01-0.06 mol/L | 736244 |
| 21.1.176. | Tetrachloro-1,4-benzoquinone | DMF | | | 6.9 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 0.20 $\mu$s (LP/LUM/AVE); OT | 83E170 |
| 21.1.177. | Tetrachloro-1,2-benzoquinone | DMF | | | 7.2 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 0.20 $\mu$s (LP/LUM/AVE); OT | 83E170 |
| 21.1.178. | Tetracyanoethene | AN | 0.1 mol/L TEAP | 25 | 1.6 × 10$^{10}$ | SS/LUM; OT | 77F920 |
| 21.1.179. | Tetramethyl-1,4-benzoquinone | AN | | 25 | 3.9 × 10$^9$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (LP/LUM/AVE); $\Delta H^{\ddagger}$ = −8.6 kJ/mol; $\Delta S^{\ddagger}$ = −90 J/mol·K (10-40 °C); $\Delta G^{\ddagger}$ = 18 kJ/mol; OT; [Q] $\leq$ 0.014 mol/L | 82A189 |
| | Tetramethyl-1,4-benzoquinone | AN | | | 3.3 × 10$^9$ | LP/LUM/SST; OT | 80N138 |
| | Tetramethyl-1,4-benzoquinone | DMF | | | 2.4 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 0.20 $\mu$s (LP/LUM/AVE); OT | 83E170 |
| 21.1.180. | $N,N'$-(Tetramethylene)-bpy$^{2+}$ | H$_2$O | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | 5.0 × 10$^8$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] = (3-50) × 10$^{-4}$ mol/L | 82A145 |
| | $N,N'$-(Tetramethylene)-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 3.2 × 10$^8$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.181. | $N,N'$-(Tetramethylene)-4,4'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | 9.6 × 10$^7$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 82C019 | 80A247 |

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except $MV^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| 21.1.182. | $N,N'$-(Tetramethylene)-phen$^{2+}$ | $H_2O$ | 0.5 mol/L ACbuf; pH 5 | | $2.1 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.69$ $\mu$s; OT; same $k_q$ from same lab in 83N211 | 82C019 |
| 21.1.183. | $N,N',2,2'$-Tetramethyl-vio$^{2+}$ | $H_2O$ | ACbuf; pH 5 | 22 | $6.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.64$ $\mu$s (80S001); OT; same $k_q$ from same lab in 82F316 | 82S257 |
| 21.1.184. | $N,N',3,3'$-Tetramethyl-vio$^{2+}$ | $H_2O$ | ACbuf; pH 5 | 22 | $8.8 \times 10^7$ | SS/LUM; $\tau_0 = 0.64$ $\mu$s (80S001); OT | 82S257 |
| 21.1.185. | Tetrathiafulvalene | MeOH | | | $1.1 \times 10^{10}$ | LP/LUM/AVE; RT; [Q] = (5-50) $\times$ 10$^{-4}$ mol/L | 82N068 |
| 21.1.186. | Triethanolamine | DMF | | | $1.7 \times 10^5$ | SS/LUM; $\tau_0 = 0.67$ $\mu$s; RT? | 86F230 |
| | Triethanolamine | $H_2O$ | 0.17 mol/L Na$_2$SO$_4$; $\mu = 0.5$ | 25 | $<2 \times 10^5$ | SS/LUM or LP/LUM/SST | 81N003 |
| 21.1.187. | 4-(Triethylphosphonio)-bpy cation | $H_2O$ | 0.33 mol/L Na$_2$SO$_4$; 0.028 mol/L NaHSO$_4$; $\mu$ = 1.0 | | $2.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (LP/LUM/SST); OT | 82F048 |
| 21.1.188. | 4,$N,N$-Trimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $1.1 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.15$ $\mu$s (SL/LUM/SPC); RT | 78E518 |
| | 4,$N,N$-Trimethylaniline | AN | 0.1 mol/L TEAP | ~22 | $1.5 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ $\mu$s (767009); RT | 79C010 |
| | 4,$N,N$-Trimethylaniline | AN | | ~23 | $1.5 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.86$ $\mu$s; RT | 81E203 |
| | 4,$N,N$-Trimethylaniline | AN | | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ $\mu$s (LP/LUM/AVE); $\Delta H^{\ddagger} = 3.3$ kJ/mol; $\Delta S^{\ddagger} = -60$ J/mol·K (10-40 °C); $\Delta G^{\ddagger} = 21$ kJ/mol; RT; [Q] $\leq$ 0.014 mol/L | 82A189 |
| | 4,$N,N$-Trimethylaniline | AN | $\mu = 2 \times 10^{-4}$ | | $1.3 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.16$ $\mu$s; RT | 85A248 |
| | 4,$N,N$-Trimethylaniline | MeOH | | 25 | $2.6 \times 10^9$ | SL/LUM/SPC; $\tau_0 = 0.67$ $\mu$s; $\Delta G^{\ddagger} = 19$ kJ/mol; RT | 83E623 |
| | 4,$N,N$-Trimethylaniline | MeOH | | | $9.9 \times 10^8$ | SS/LUM; $\tau_0 = 0.83$ $\mu$s (LP/LUM/SST) | 84F069 |
| 21.1.189. | Trimethyl-1,4-benzoquinone | $H_2O$ | 0.005 mol/L Pbuf; pH 6.9; $\mu = 0.04$ | | $2.4 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.63$ $\mu$s; OT; $f = <0.01$; [Q] = (2-20) $\times$ 10$^{-4}$ mol/L | 81A042 |

| No. | Quencher | Solvent | Solution Medium | $T/^\circ$C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **21.1.** | **Ru(bpy)$_3^{2+}$—Continued** | | | | | | |
| 21.1.190. | 1,2,3-Trimethyl-5,6-dicyanonorbornadiene | AN | | 25 | $2.0 \times 10^8$ | SL/LUM/SPC, SS/LUM; $\tau_0$ = 0.86 $\mu$s; ET; [Q] $\leq$ 0.015 mol/L | 86F060 |
| 21.1.191. | Trimethyl-1,4-dihydroxybenzene | H$_2$O | 0.005 mol/L Pbuf; pH 6.9; $\mu$ = 0.04 | | $<5 \times 10^7$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.63 $\mu$s; RT | 81A042 |
| 21.1.192. | N,N'-(Trimethylene)-4,4'-bis(4-sulfonatophenethyl)-(bpy$^{2+}$) zwitterion | H$_2$O | $\mu$ = 0.1 (TBAC) | 25 | $1.5 \times 10^9$ | SS/LUM; $\tau_0$ = 0.58 $\mu$s (82E392); OT; [Q] $\leq$ 0.0015 mol/L | 85S182 |
| 21.1.193. | N,N'-(Trimethylene)-bpy$^{2+}$ | H$_2$O | | | $1.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.6 $\mu$s; OT; [Q] = (2-10) $\times$ 10$^{-4}$ mol/L | 78A269 |
| | N,N'-(Trimethylene)-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $5.7 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.194. | N,N'-(Trimethylene)-4,4'-dimethyl-bpy$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $4.0 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 82C019 | 80A247 |
| 21.1.195. | N,N'-(Trimethylene)-4,7-dimethyl-phen$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $1.1 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 83N211 | 82C019 |
| 21.1.196. | N,N'-(Trimethylene)-4,4'-diphenethyl-bpy$^{2+}$ | H$_2$O | $\mu$ = 0.1 (TBAC) | 25 | $1.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.58 $\mu$s (82E392); OT | 85S182 |
| 21.1.197. | N,N'-(Trimethylene)-4,7-diphenyl-phen$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $1.7 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 83N211 | 82C019 |
| 21.1.198. | N,N'-(Trimethylene)-5-methoxy-bpy$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | $4.3 \times 10^8$ | SS/LUM; $\tau_0$ = 0.64 $\mu$s (80S001); OT | 82S257 |
| 21.1.199. | N,N'-(Trimethylene)-6-methyl-bpy$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | $5.1 \times 10^8$ | SS/LUM; $\tau_0$ = 0.64 $\mu$s (80S001); OT | 82S257 |
| 21.1.200. | N,N'-(Trimethylene)-phen$^{2+}$ | H$_2$O | 0.5 mol/L ACbuf; pH 5 | | $2.2 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 83N211 | 82C019 |
| 21.1.201. | N,N'-(Trimethylene)-4,4',5,5'-tetramethyl-bpy$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | $3.1 \times 10^8$ | SS/LUM; $\tau_0$ = 0.64 $\mu$s (80S001); OT | 82S257 |
| 21.1.202. | 2,4,6-Trimethylphenol | H$_2$O | 0.05 mol/L NaOH | 23 | $1.6 \times 10^9$ | LP/LUM/AVE; $\tau_0$ = 0.60 $\mu$s; RT; $f$ = 0.36 | 82A365 |
| 21.1.203. | N,N',2-Trimethyl-vio$^{2+}$ | H$_2$O | ACbuf; pH 5 | 22 | $8.0 \times 10^8$ | SS/LUM; $\tau_0$ = 0.64 $\mu$s (80S001); OT | 82S257 |
| 21.1.204. | Triphenylamine | AN | 0.1 mol/L TEAP | ~22 | $9.5 \times 10^5$ | SS/LUM; $\tau_0$ = 0.85 $\mu$s (767009); RT | 79C010 |

TABLE 21. Quenching of Ru(bpy)$_3^{2+}$ by organic compounds (except MV$^{2+}$)—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ$C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|-------------|------------------------------|----------|------|
| **21.1.** | **Ru(bpy)$_3^{2+}$**—Continued Triphenylamine | AN | $\mu = 2 \times 10^{-4}$ | | $1.1 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.16$ $\mu$s; RT | 85A248 |
| 21.1.205. | vioH$^+$ | H$_2$O | 0.02 mol/L ACbuf; pH 4.6; $\mu$ = 0.1 (LiClO$_4$) | 25 | $5.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.6$ $\mu$s (766404); OT; [Q] = (8.3-21) $\times$ 10$^{-4}$ mol/L | 78E293 |
| 21.1.206. | vioH$_2^{2+}$ | H$_2$O | 0.094 mol/L HClO$_4$; $\mu$ = 0.1 | 25 | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (766404); OT; [Q] = (4.2-21) $\times$ 10$^{-4}$ mol/L | 78E293 |
| **21.2.** | **(+)$_D$-Ru(bpy)$_3^{2+}$** | | | | | | |
| 21.2.1. | $N$-Methyl-$N'$-[(3$S$)-(−)-3-pinanylmethyl]-vio$^{2+}$ | H$_2$O | | | $3.3 \times 10^8$ | LP/LUM/SST, SS/LUM; OT; 54% enantiomeric purity of S | 83A402 |
| **21.3.** | **(−)$_D$-Ru(bpy)$_3^{2+}$** | | | | | | |
| 21.3.1. | $N$-Methyl-$N'$-[(3$S$)-(−)-3-pinanylmethyl]-vio$^{2+}$ | H$_2$O | | | $2.0 \times 10^8$ | LP/LUM/SST, SS/LUM; OT; 92% enantiomeric purity of S | 83A402 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1. Ru(bpy)$_3^{2+}$** | | | | | | | |
| 22.1.1. | $MV^{2+}$ | AN | 0.1 mol/L TEAP | ~22 | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (767009); OT, ET; same $k_q$ from same lab in 747159; $k_q$ for OT only | 79C010 |
| | $MV^{2+}$ | AN | | | $2.8 \times 10^9$ | EMI; $\tau_0 = 0.85$ μs (SL/LUM/SPC); OT | 776441 |
| | $MV^{2+}$ | AN | 0.1 mol/L TBAP | | $2.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.85$ μs (FP/LUM/SST); OT | 767009 |
| | $MV^{2+}$ | AN | 0.1 mol/L TBAP; $\mu = 0.1$ | | $2.0 \times 10^9$ | LP/LUM/SST; OT; $f = 0.42$ | 82A111 |
| | $MV^{2+}$ | AN/BuN (1/1) | 0.1 mol/L TEAP | 25 | $2.8 \times 10^9$ | SS/LUM; OT | 77F920 |
| | $MV^{2+}$ | AN/H$_2$O (19/1) | | | $6.8 \times 10^8$ | LP/LUM/SST; OT; $f = 0.35$ | 82A111 |
| | $MV^{2+}$ | Acetone/H$_2$O (2.3/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $1.1 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | Acetone/H$_2$O (2.3/1) | 0.012-0.062 mol/L LiI | 25 | $8.4 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | Acetone/H$_2$O (1.5/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $6.1 \times 10^8$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | Acetone/H$_2$O (1.5/1) | 0.012-0.062 mol/L LiI | 25 | $2.9 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | EtOH | | 22 | $3.5 \times 10^8$ | LP/LUM/SST, SS/LUM; $\tau_0 = 0.90$ μs; OT | 80S001 |
| | $MV^{2+}$ | EtOH/H$_2$O (5.7/1) | | | $2.7 \times 10^8$ | SL/LUM/SPC or LP/LUM/SST; $\tau_0 = $ ~0.9 μs; OT; [Q] = (0.05-1) $\times$ 10$^{-2}$ mol/L | 86A140 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu$ = 0.1 (NaClO$_4$) | 20 | $9.6 \times 10^8$ | LP/LUM/SST; $\tau_0$ = 0.64 $\mu$s; OT | 85F222 |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5 | 22 | $9.6 \times 10^8$ | SS/LUM; $\tau_0$ = 0.64 $\mu$s (80S001); OT; same $k_q$ from same lab in 82F316, 83A008, 83N214, and 80S001 | 82S257 |
| | $MV^{2+}$ | $H_2O$ | $\mu$ = 0.027 (NaCl) | ~23 | $5.6 \times 10^8$ | LP/LUM/SST; $\tau_0^{air}$ = 0.40 $\mu$s; OT; [Q] $\leq$ 0.009 mol/L | 79F442 |
| | $MV^{2+}$ | $H_2O$ | $\mu$ = 0.20 (NaClO$_4$) | ~23 | $3.7 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.38 $\mu$s; OT; [Q] $\leq$ 0.024 mol/L | 79F442 |
| | $MV^{2+}$ | $H_2O$ | $\mu$ = 0.23 (NaCl) | ~23 | $1.5 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.41 $\mu$s; OT; [Q] $\leq$ 0.024 mol/L | 79F442 |
| | $MV^{2+}$ | $H_2O$ | $\mu$ = 0.52 (NaCl) | ~23 | $2.0 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.41 $\mu$s; OT; [Q] $\leq$ 0.024 mol/L | 79F442 |
| | $MV^{2+}$ | $H_2O$ | $\mu$ = 1.5 (NaCl) | ~23 | $3.6 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.44 $\mu$s; OT; [Q] $\leq$ 0.024 mol/L | 79F442 |
| | $MV^{2+}$ | $H_2O$ | 0.17 mol/L Na$_2$SO$_4$; $\mu$ = 0.5 | 25 | $1.2 \times 10^9$ | SS/LUM or LP/LUM/SST; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] = (3-50) $\times$ 10$^{-4}$ mol/L | 82A145 |
| | $MV^{2+}$ | $H_2O$ | $\mu$ = 0 (calc'd, Na$_2$SO$_4$) | 25 | $2.8 \times 10^8$ | SL/LUM/SPC; OT; [Q] $\leq$ 0.001 mol/L | 85E617 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L KCl | 25 | $2.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.64 $\mu$s (83E209); OT | 83F371 |
| | $MV^{2+}$ | $H_2O$ | 0.012-0.062 mol/L LiI, KI | 25 | $3.4 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (78E887); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$ | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $1.0 \times 10^9$ | SS/LUM; $\tau_0$ = 0.60 $\mu$s (78E887); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$ | 0.0067 mol/L Pbuf, $\leq$0.2 mol/L HSEtOH; pH 7 | 30 | $2.5 \times 10^8$ | SS/QYP; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] $\leq$ 0.01 mol/L; see Mech. [7] | 81A139 |
| | $MV^{2+}$ | $H_2O$ | 0.0067 mol/L Pbuf, $\leq$0.2 mol/L TEOA; pH 7 | 30 | $2.9 \times 10^8$ | SS/QYP; $\tau_0$ = 0.60 $\mu$s (766404); OT; [Q] $\leq$ 0.01 mol/L; see Mech. [7] | 81A139 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1.** **Ru(bpy)$_3^{2+}$**—Continued | | | | | | | |
| | $MV^{2+}$ | $H_2O$ | | | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.69$ $\mu$s; OT; [Q] = (5-50) $\times$ $10^{-4}$ mol/L | 80U059 |
| | $MV^{2+}$ | $H_2O$ | | | $1.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.60$ $\mu$s (766404); OT; [Q] $\leq 0.003$ mol/L; same $k_q$ from same lab in 78A269; $k_q = 2 \times 10^8$ L mol$^{-1}$ s$^{-1}$ at 20 °C with SS/LUM from same lab in 80N125 | 81S011 |
| | $MV^{2+}$ | $H_2O$ | | | $5.4 \times 10^8$ | LP/LUM/SST; OT; $f = 0.25$ | 82A111 |
| | $MV^{2+}$ | $H_2O$ | | | $6.2 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.59$ $\mu$s | 85N164 |
| | $MV^{2+}$ | $H_2O$ | | | $4.0 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.41$ $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | | | $4.5 \times 10^8$ | SS/LUM; $\tau_0^{air} = 0.41$ $\mu$s (SL/LUM/SPC, LP/LUM/SST); OT; [Q] = 0.005-0.03 mol/L; nonlinear S-V plot at higher [Q] | 86S150 |
| | $MV^{2+}$ | $H_2O$ | | | $4.5 \times 10^8$ | LP/LUM/AVE; OT; $f = 0.20$ | 85B030 |
| | $MV^{2+}$ | $H_2O$ | $\mu = 0$ (extrap'd) | | $1.8 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.55$ $\mu$s; OT; [Q] $\leq 0.02$ mol/L | 80N138 |
| | $MV^{2+}$ | $H_2O$ | $\mu = 0.5$ (Na$_2$SO$_4$) | | $1.4 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.41$ $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | pH 11.0; $\mu = 1.0$ (Na$_2$SO$_4$) | | $1.6 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.41$ $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 0.1 mol/L NaClO$_4$; $\mu = 0.1$ | | $2.5 \times 10^9$ | LP/LUM/SST; OT; $f = 0.20$ | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.2 mol/L Na$_2$SO$_4$; $\mu = 0.6$ | | $1.2 \times 10^9$ | LP/LUM/SST; OT; $f = 0.24$ | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L Na$_2$SO$_4$; $\mu = 1.5$ | | $1.1 \times 10^9$ | LP/LUM/SST; OT; $f = 0.22$ | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 1 mol/L Na$_2$SO$_4$; $\mu = 3.0$ | | $1.9 \times 10^9$ | LP/LUM/SST; OT; $f = 0.16$ | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L NaCl; $\mu = 0.5$ | | $1.7 \times 10^9$ | LP/LUM/SST; OT; $f = 0.24$ | 82A111 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1. $Ru(bpy)_3^{2+}$**—Continued | | | | | | | |
| | $MV^{2+}$ | $H_2O$ | 1 mol/L NaCl; $\mu$ = 1.0 | | $2.5 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.20 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 2 mol/L NaCl; $\mu$ = 2.0 | | $2.3 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.19 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L NaNO$_3$; $\mu$ = 0.5 | | $2.0 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.20 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 1 mol/L NaNO$_3$; $\mu$ = 1.0 | | $2.2 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.16 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L H$_2$SO$_4$ | | $1.7 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.24 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.001 mol/L EDTA; pH 4.7; $\mu$ = 0.5-0.6 (Na$_2$SO$_4$) | | $1.2 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.41 $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 0.01 mol/L EDTA; pH 4.7; $\mu$ = 0.5-0.6 (Na$_2$SO$_4$) | | $1.4 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.41 $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 0.1 mol/L EDTA; pH 4.7; $\mu$ = 0.5-0.6 (Na$_2$SO$_4$) | | $1.5 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.41 $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 5 $\times$ 10$^{-5}$ mol/L EDTA; pH 11.0; $\mu$ = 1.0 (Na$_2$SO$_4$) | | $1.3 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.41 $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 0.001 mol/L EDTA; pH 11.0; $\mu$ = 1.0 (Na$_2$SO$_4$) | | $1.2 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.41 $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 0.1 mol/L EDTA; pH 11.0; $\mu$ = 1.0 | | $9.5 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 0.41 $\mu$s (LP/LUM/SST); OT | 85A191 |
| | $MV^{2+}$ | $H_2O$ | 0.03 mol/L ACbuf; pH 5 | | $1.0 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 0.40 $\mu$s (LP/LUM/SST); OT | 85E687 |
| | $MV^{2+}$ | $H_2O$ | 0.1 mol/L ACbuf; pH 4.7; $\mu$ = 0.1 | | $6.5 \times 10^8$ | LP/LUM/SST; OT; $f$ = 0.25 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 1 mol/L Na$_2$SO$_4$; 0.1 mol/L ACbuf; pH 4.7; $\mu$ = 3.1 | | $1.8 \times 10^9$ | LP/LUM/SST; OT; $f$ = 0.10 | 82A111 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L ACbuf; pH 5 | | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0$ = 0.69 $\mu$s; OT; same $k_q$ from same lab in 82C019 | 80A247 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------------|------------------------------|----------|------|
| **22.1.** | **$Ru(bpy)_3^{2+}$—Continued** | | | | | | |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu = 0.009$ | | $3.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.70$ $\mu$s; OT | 82C019 |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu = 0.018$ | | $3.8 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.69$ $\mu$s; OT | 82C019 |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu = 0.053$ | | $5.7 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.69$ $\mu$s; OT | 82C019 |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu = 0.088$ | | $7.3 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.66$ $\mu$s; OT | 82C019 |
| | $MV^{2+}$ | $H_2O$ | ACbuf; pH 5; $\mu = 0.18$ | | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.64$ $\mu$s; OT | 82C019 |
| | $MV^{2+}$ | $H_2O$ | 0.05 mol/L PHTHbuf; pH 5 | | $1.2 \times 10^9$ | LP/LUM/SST; $\tau_0 = 0.61$ $\mu$s; OT; [Q] = 0.002-0.02 mol/L | 85A431 |
| | $MV^{2+}$ | $H_2O$ | 0.005 mol/L Pbuf; pH 6.9; $\mu = 0.04$ | | $4.6 \times 10^8$ | SS/LUM or LP/LUM/SST; $\tau_0 = 0.63$ $\mu$s; OT; $f = 0.4$ | 81A042 |
| | $MV^{2+}$ | $H_2O$ | 0.5 mol/L Pbuf; pH 5 | | $1.3 \times 10^9$ | SS/LUM; $\tau_0^{air} = 0.40$ $\mu$s (LP/LUM/SST); OT | 85E687 |
| | $MV^{2+}$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 2 | | $9.0 \times 10^8$ | LP/LUM/SST; $\tau_0 = 0.59$ $\mu$s; some SQ | 85N164 |
| | $MV^{2+}$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 7 | | $1.2 \times 10^{10}$ | LP/LUM/SST; $\tau_0 = 0.67$ $\mu$s; some SQ | 85N164 |
| | $MV^{2+}$ | $H_2O$ | $9.4 \times 10^{-5}$ mol/L PMA; pH 9 | | $1.4 \times 10^{10}$ | LP/LUM/SST; $\tau_0 = 0.59$ $\mu$s; some SQ | 85N164 |
| | $MV^{2+}$ | $H_2O$/AN (1/1) | | | $2.3 \times 10^8$ | SL/LUM/SPC or LP/LUM/SST; $\tau_0 = {\sim}0.9$ $\mu$s; OT; [Q] = (0.05-1) $\times$ $10^{-2}$ mol/L | 86A140 |
| | $MV^{2+}$ | $H_2O$/Acetone (9/1) | 0.022-0.072 mol/L $Cl^-$ (LiCl) | 25 | $6.5 \times 10^8$ | SS/LUM; $\tau_0 = 0.84$ $\mu$s (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (9/1) | 0.012-0.062 mol/L LiI | 25 | $3.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.84$ $\mu$s (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| | $MV^{2+}$ | $H_2O$/Acetone (4/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $4.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.95$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (4/1) | 0.012-0.062 mol/L LiI | 25 | $6.4 \times 10^9$ | SS/LUM; $\tau_0 = 0.95$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (2.3/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $3.3 \times 10^8$ | SS/LUM; $\tau_0 = 1.0$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (2.3/1) | 0.012-0.062 mol/L LiI | 25 | $5.0 \times 10^9$ | SS/LUM; $\tau_0 = 1.0$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (1.5/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $3.5 \times 10^8$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (1.5/1) | 0.012-0.062 mol/L LiI | 25 | $3.5 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (1/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $4.0 \times 10^8$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/Acetone (1/1) | 0.012-0.062 mol/L LiI | 25 | $5.5 \times 10^9$ | SS/LUM; $\tau_0 = 1.1$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1. Ru(bpy)$_3^{2+}$**—Continued | | | | | | | |
| | $MV^{2+}$ | H$_2$O/MeOH (9/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $7.3 \times 10^8$ | SS/LUM; $\tau_0$ = 0.73 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (9/1) | 0.012-0.062 mol/L LiI, KI | 25 | $4.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.73 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (4/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $5.7 \times 10^8$ | SS/LUM; $\tau_0$ = 0.80 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (4/1) | 0.012-0.062 mol/L LiI | 25 | $3.1 \times 10^9$ | SS/LUM; $\tau_0$ = 0.80 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (2.3/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $4.6 \times 10^8$ | SS/LUM; $\tau_0$ = 0.85 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (2.3/1) | 0.012-0.062 mol/L LiI | 25 | $3.2 \times 10^9$ | SS/LUM; $\tau_0$ = 0.85 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (1.5/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $4.1 \times 10^8$ | SS/LUM; $\tau_0$ = 0.89 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | H$_2$O/MeOH (1.5/1) | 0.012-0.062 mol/L LiI, KI | 25 | $2.3 \times 10^9$ | SS/LUM; $\tau_0$ = 0.89 µs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| | $MV^{2+}$ | $H_2O$/MeOH (1/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $3.8 \times 10^8$ | SS/LUM; $\tau_0 = 0.91$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | $H_2O$/MeOH (1/1) | 0.012-0.062 mol/L LiI | 25 | $2.7 \times 10^9$ | SS/LUM; $\tau_0 = 0.91$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | MeOH/$H_2O$ (9/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $7.3 \times 10^8$ | SS/LUM; $\tau_0 = 0.96$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | MeOH/$H_2O$ (4/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $5.6 \times 10^8$ | SS/LUM; $\tau_0 = 0.95$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | MeOH/$H_2O$ (4/1) | 0.012-0.062 mol/L LiI | 25 | $1.2 \times 10^9$ | SS/LUM; $\tau_0 = 0.95$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | MeOH/$H_2O$ (2.3/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $4.4 \times 10^8$ | SS/LUM; $\tau_0 = 0.95$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | MeOH/$H_2O$ (2.3/1) | 0.012-0.062 mol/L LiI, KI | 25 | $5.6 \times 10^9$ | SS/LUM; $\tau_0 = 0.95$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |
| | $MV^{2+}$ | MeOH/$H_2O$ (1.5/1) | 0.022-0.072 mol/L Cl$^-$ (LiCl) | 25 | $3.7 \times 10^8$ | SS/LUM; $\tau_0 = 0.93$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-Cl$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |

TABLE 22. Quenching of $Ru(bpy)_3^{2+}$ by $MV^{2+}$—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **22.1.** | **$Ru(bpy)_3^{2+}$**—Continued | | | | | | |
| | $MV^{2+}$ | MeOH/H$_2$O (1.5/1) | 0.012-0.062 mol/L LiI, KI | 25 | $3.3 \times 10^9$ | SS/LUM; $\tau_0 = 0.93$ μs (eval'd); OT; [Q] = 0.005 mol/L; $k_q$ for S-I$^-$ ion-pair, see Mech. [12]; S and Q as Cl$^-$ salts | 86F346 |

TABLE 23. Quenching of excited samarium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **23.1.** | **Sm$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 23.1.1. | Nd$^{3+}$ | H$_2$O | pH 5.9; μ = 0.6 | 22 | $<1 \times 10^4$ | LP/LUM/SST; ET | 80E879 |
| 23.1.2. | Sm$^{3+}$ | POCl$_3$/SnCl$_4$ (10/1) | | −10 | $4.6 \times 10^2$ | FP/LUM/SST; $\tau_0 = 3.0$ ms; ET; [Q] ≤ 0.2 mol/L; $\tau_0$ extrap'd to [S] = 0 | 79E196 |
| | Sm$^{3+}$ | POCl$_3$/SnCl$_4$ (10/1) | | 21 | $6.0 \times 10^2$ | FP/LUM/SST; $\tau_0 = 3.0$ ms; $E_a = 5.4$ kJ/mol (−10 to 55°C); ET; [Q] ≤ 0.2 mol/L; $\tau_0$ extrap'd to [S] = 0 | 79E196 |
| | Sm$^{3+}$ | POCl$_3$/SnCl$_4$ (10/1) | | 55 | $8.0 \times 10^2$ | FP/LUM/SST; $\tau_0 = 3.0$ ms; ET; [Q] ≤ 0.2 mol/L; $\tau_0$ extrap'd to [S] = 0 | 79E196 |
| | **Sm(salicylato)$^{2+}$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 2.1. | Nd(H$_2$O)$_n^{3+}$ | H$_2$O | pH 5.9; μ = 0.6; ([Sm]+[Nd])/[L] = 1000 | 22 | $3.4 \times 10^5$ | LP/LUM/SST; ET | 80E879 |
| | **Sm 5-sulfosalicylato)$^{2+}$** | | | | | | |
| | *Quenchers* | | | | | | |
| | Nd(H$_2$O)$_n^{3+}$ | H$_2$O | pH 5.9; μ = 0.6; ([Sm]+[Nd])/[L] = 1000 | 22 | $4.6 \times 10^5$ | LP/LUM/SST; ET | 80E879 |

TABLE 24. Quenching of excited terbium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.1. Tb$^{III}$-Aspartic acid** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.1.1. | Eu$^{III}$-Aspartic acid | H$_2$O | pH 3.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.6 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0$ = 0.46 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; $K^\tau_{SV}$ constant for pH 3.0-9.0 | 79E414 |
| | Eu$^{III}$-Aspartic acid | H$_2$O | pH 4.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.2 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0$ = 0.55 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; $K^\tau_{SV}$ constant for pH 3.0-9.0 | 79E414 |
| | Eu$^{III}$-Aspartic acid | H$_2$O | pH 5.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.0 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0$ = 0.59 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; some SQ; $K^\tau_{SV}$ constant for pH 3.0-9.0 | 79E414 |
| | Eu$^{III}$-Aspartic acid | H$_2$O | pH 7.0; ([Tb] + [Eu])/[L] = 0.2; [Tb] = 0.002 mol/L | | $1.5 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0$ = 0.80 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; some SQ | 79E414 |
| | Eu$^{III}$-Aspartic acid | H$_2$O | pH 9.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $9.1 \times 10^5$ (calc) | FP/LUM/SST; $\tau_0$ = 1.3 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; large SQ; $K^\tau_{SV}$ constant for pH 3.0-9.0 | 79E414 |
| **24.2. Tb$^{III}$-Citric acid** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.2.1. | Eu$^{III}$-Citric acid | H$_2$O | pH 8.5; [L]/([Tb]+[Eu]) = 10; [Tb] = 0.015 mol/L | | $1.0 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0^{air}$ = 1.4 ms (LP/LUM/SST); ET; [Q] $\leq$ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 8.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.015 mol/L | | $7.5 \times 10^4$ | SS/LUM or LP/LUM/SST; $\tau_0^{air}$ = 1.4 ms (LP/LUM/SST); ET; [Q] $\leq$ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 8.5; [L]/([Tb]+[Eu]) = 3; [Tb] = 0.015 mol/L | | $1.2 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0^{air}$ = 1.5 ms (LP/LUM/SST); ET; [Q] $\leq$ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 8.5; [L]/([Tb]+[Eu]) = 2; [Tb] = 0.015 mol/L | | $1.3 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0^{air}$ = 1.5 ms (LP/LUM/SST); ET; [Q] $\leq$ 0.004 mol/L | 83E604 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.2. Tb$^{III}$-Citric acid**—Continued | | | | | | | |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 3; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $3.3 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 0.50 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 3.5; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $7.4 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 0.53 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 4.0; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $1.0 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 0.56 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L; some SQ | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 5.5; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $3.6 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 0.69 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L; some SQ | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 6.5; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $2.4 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 0.94 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L; some SQ | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 7.0; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $1.5 \times 10^6$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 1.1 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L; some SQ | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 7.5; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $9.0 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 1.2 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L; some SQ | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 8; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $5.7 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 1.3 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 9; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $3.1 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 1.3 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 10; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $1.9 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0{}^{air}$ = 1.3 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.2. Tb$^{III}$-Citric acid**—Continued | | | | | | | |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 11; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $1.5 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0^{air}$ = 1.3 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |
| | Eu$^{III}$-Citric acid | H$_2$O | pH 12; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.015 mol/L | | $1.8 \times 10^5$ | SS/LUM or LP/LUM/SST; $\tau_0^{air}$ = 1.3 ms (LP/LUM/SST); ET; [Q] ≤ 0.004 mol/L | 83E604 |
| **24.3. Tb$^{3+}$ [$^5$D$_3$]** *Inorganic Quenchers* | | | | | | | |
| 24.3.1. | Sm$^{3+}$ | POCl$_3$/SnCl$_4$ (9/1) | | 20 | $5.3 \times 10^4$ | FP/LUM/SST; $\tau_0$ = ~0.50 ms; $E_a$ = 23 kJ/mol (−15 to +20°C); ET; [Q] ≤ 0.05 mol/L | 766551 |
| 24.3.2. | Tb$^{3+}$ | POCl$_3$/SnCl$_4$ (9/1) | | −10 | $2.2 \times 10^4$ | FP/LUM/SST; ET; [Q] ≤ ~0.05 mol/L | 74E518 |
| | Tb$^{3+}$ | POCl$_3$/SnCl$_4$ (9/1) | | 25 | $3.9 \times 10^4$ | FP/LUM/SST; $E_a$ = ~12 kJ/mol (−10 to +30°C); ET; [Q] ≤ ~0.05 mol/L | 74E518 |
| | Tb$^{3+}$ | POCl$_3$/SnCl$_4$ (9/1) | | 30 | $4.5 \times 10^4$ | FP/LUM/SST; ET; [Q] ≤ ~0.05 mol/L | 74E518 |
| **24.4. Tb$^{3+}$ [$^5$D$_4$]** *Inorganic Quenchers* | | | | | | | |
| 24.4.1. | Ce$^{4+}$ | H$_2$SO$_4$ (95%) | | 20 | $1 \times 10^6$ | FP/LUM/SST; $\tau_0$ = 2.4 ms; OT | 73E368 |
| 24.4.2. | Co(CN)$_6^{3-}$ | H$_2$O | 1 mol/L KCl | | $4.0 \times 10^6$ | LP/LUM/SST; ET | 86E832 |
| 24.4.3. | Cr(CN)$_6^{3-}$ | H$_2$O | 1 mol/L KCl | | $1.0 \times 10^8$ | LP/LUM/SST; ET | 86E832 |
| 24.4.4. | Er$^{3+}$ | Acetone | | 20 | $1.1 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.1 ms; ET; [Q] ≤ 0.1 mol/L; same $k_q$ from same lab in 68E121 | 69E237 |
| 24.4.5. | Eu$^{3+}$ | DMSO | | | $1.5 \times 10^3$ | SS/LUM; $\tau_0$ = 2.2 ms (71E390); ET; [Q] ≤ 0.5 mol/L; nonlinear S-V plot with negative deviation; EQ proposed, see Mech. [9] | 74E519 |
| | Eu$^{3+}$ | DMSO | | | $1 \times 10^3$ | SS/LUM, LIF; $\tau_0$ = 2.2 ms; [Q] ≤ 0.8 mol/L | 80E664 |
| 24.4.6. | Fe(CN)$_6^{4-}$ | H$_2$O | 1 mol/L KCl | | $6.0 \times 10^8$ | LP/LUM/SST; ET | 86E832 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4. Tb$^{3+}$ [$^5D_4$]—Continued** | | | | | | | |
| 24.4.7. | Gd$^{3+}$ | Acetone | | 20 | $<2 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.1 ms; ET; [Q] $\leq$ 0.1 mol/L | 69E237 |
| | Gd$^{3+}$ | H$_2$O | | 20 | $<8 \times 10^2$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 0.47 ms; ET | 69E237 |
| 24.4.8. | Ho$^{3+}$ | (C$_2$H$_5$)$_2$O | | 20 | $1.7 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.92 ms; ET | 71E390 |
| | Ho$^{3+}$ | 1-PrOH | | 20 | $1.4 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 1.1 ms; ET | 71E390 |
| | Ho$^{3+}$ | 2-PrOH | | 20 | $1.5 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 1.0 ms; ET | 71E390 |
| | Ho$^{3+}$ | AN | | 20 | $2 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 0.93 ms; ET | 71E390 |
| | Ho$^{3+}$ | Acetaldehyde | | 20 | $6.0 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 0.84 ms; ET | 71E390 |
| | Ho$^{3+}$ | Acetone | | 20 | $1.6 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.1 ms; ET; [Q] $\leq$ 0.1 mol/L; same $k_q$ from same lab in 68E121 | 69E237 |
| | Ho$^{3+}$ | Acetophenone | | 20 | $2.4 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 0.62 ms; ET | 71E390 |
| | Ho$^{3+}$ | Allyl alcohol | | 20 | $1.1 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 71E390 |
| | Ho$^{3+}$ | Benzaldehyde | | 20 | $1.0 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.62 ms; ET | 71E390 |
| | Ho$^{3+}$ | DMA | | 20 | $1.2 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 1.6 ms; ET | 71E390 |
| | Ho$^{3+}$ | DMF | | 20 | $9 \times 10^3$ | FP/LUM/SST; $\tau_0$ = 1.6 ms; ET | 71E390 |
| | Ho$^{3+}$ | DMSO | | 20 | $2.7 \times 10^3$ | FP/LUM/SST; $\tau_0$ = 2.2 ms; ET | 71E390 |
| | Ho$^{3+}$ | EtOH | | 20 | $9 \times 10^3$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 71E390 |
| | Ho$^{3+}$ | H$_2$O | | 20 | $3.2 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 0.47 ms; ET | 69E237 |
| | Ho$^{3+}$ | Isoamyl alcohol | | 20 | $1.8 \times 10^4$ | FP/LUM/SST; $\tau_0$ = 1.1 ms; ET | 71E390 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4. Tb$^{3+}$ [$^5$D$_4$]**—Continued | | | | | | | |
| | Ho$^{3+}$ | MeOH | | 20 | $7.4 \times 10^3$ | FP/LUM/SST; $\tau_0 = 1.4$ ms; ET | 71E390 |
| | Ho$^{3+}$ | TBP/Toluene (2/1) | | 20 | $2.9 \times 10^3$ | FP/LUM/SST; $\tau_0 = 2.1$ ms; ET | 71E390 |
| | Ho$^{3+}$ | $n$-Amyl alcohol | | 20 | $1.3 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.3$ ms; ET | 71E390 |
| | Ho$^{3+}$ | $n$-BuOH | | 20 | $1.6 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 71E390 |
| 24.4.9. | La$^{3+}$ | Acetone | | 20 | $<2 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0 = 1.1$ ms; ET; [Q] $\leq 0.1$ mol/L | 69E237 |
| 24.4.10. | Nd$^{3+}$ | (C$_2$H$_5$)$_2$O | | 20 | $1.7 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.92$ ms; ET | 71E390 |
| | Nd$^{3+}$ | 1-PrOH | | 20 | $7.7 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.1$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | 2-PrOH | | 20 | $1.0 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 71E390 |
| | Nd$^{3+}$ | AN | | 20 | $2.1 \times 10^5$ | FP/LUM/SST; $\tau_0 = 0.93$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | Acetaldehyde | | 20 | $3.3 \times 10^5$ | FP/LUM/SST; $\tau_0 = 0.84$ ms; ET | 71E390 |
| | Nd$^{3+}$ | Acetone | | 20 | $1.2 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0 = 1.1$ ms; ET; [Q] $\leq 0.025$ mol/L; same $k_q$ from same lab in 68E121 | 69E237 |
| | Nd$^{3+}$ | Acetophenone | | 20 | $2.4 \times 10^5$ | FP/LUM/SST; $\tau_0 = 0.62$ ms; ET | 71E390 |
| | Nd$^{3+}$ | Allyl alcohol | | 20 | $5.3 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 71E390 |
| | Nd$^{3+}$ | Benzaldehyde | | 20 | $7.5 \times 10^5$ | FP/LUM/SST; $\tau_0 = 0.62$ ms; ET | 71E390 |
| | Nd$^{3+}$ | Benzonitrile | | 20 | $>3.4 \times 10^5$ | FP/LUM/SST; $\tau_0 = 0.75$ ms; ET | 71E390 |
| | Nd$^{3+}$ | DMA | | 20 | $4.3 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.6$ ms; ET | 71E390 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4. Tb$^{3+}$ [$^5$D$_4$]—Continued** | | | | | | | |
| | Nd$^{3+}$ | DMF | | 20 | $6.5 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.6$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | DMSO | | 20 | $1.0 \times 10^4$ | FP/LUM/SST; $\tau_0 = 2.2$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | EtOH | | 20 | $3.8 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | H$_2$O | | 20 | $4.5 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0 = 0.47$ ms; ET | 69E237 |
| | Nd$^{3+}$ | H$_2$O | pH 5.9; $\mu = 0.6$ | 22 | $7 \times 10^3$ | LP/LUM/SST; ET | 80E879 |
| | Nd$^{3+}$ | Isoamyl alcohol | | 20 | $1.3 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.1$ ms; ET | 71E390 |
| | Nd$^{3+}$ | MeOH | | 20 | $2.4 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.4$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | TBP/Toluene (2/1) | | 20 | $9.6 \times 10^3$ | FP/LUM/SST; $\tau_0 = 2.1$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| | Nd$^{3+}$ | $n$-Amyl alcohol | | 20 | $9.8 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.3$ ms; ET | 71E390 |
| | Nd$^{3+}$ | $n$-BuOH | | 20 | $1.0 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 71E390 |
| | Nd$^{3+}$ | py | | 20 | $1.6 \times 10^4$ | FP/LUM/SST; $\tau_0 = 0.97$ ms; ET; same $k_q$ from same lab in 72E319 | 71E390 |
| 24.4.11. | O$_3$ | H$_2$SO$_4$ (66%) | | 25 | $6.9 \times 10^6$ | SS/LUM; $\tau_0 = {\sim}0.55$ ms (60E010); [Q] $\leq 4 \times 10^{-4}$ mol/L | 77E799 |
| | O$_3$ | H$_2$SO$_4$ (98%) | | 25 | $7.5 \times 10^6$ | SS/LUM; $\tau_0 = {\sim}1.5$ ms (60E010); $E_a = 32$ kJ/mol (14-63$^\circ$C); [Q] $\leq 4 \times 10^{-4}$ mol/L | 77E799 |
| 24.4.12. | Pr$^{3+}$ | Acetone | | 20 | $1.6 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0 = 1.1$ ms; ET; [Q] $\leq 0.1$ mol/L; same $k_q$ from same lab in 68E121 | 69E237 |

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TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4.** | **Tb$^{3+}$** **[$^5$D$_4$]**—Continued | | | | | | |
| 24.4.13. | Pt(CN)$_4$$^{2-}$ | H$_2$O | $\mu$ = 1 (LiCl) | | 1.4 × 10$^4$ | FP/LUM/SST; RT; [Q] ≤ 0.01 mol/L | 79E868 |
| 24.4.14. | PtCl$_4$$^{2-}$ | H$_2$O | $\mu$ = 1 (LiCl) | | 1.3 × 10$^7$ | FP/LUM/SST; RT; [Q] ≤ 8 × 10$^{-4}$ mol/L | 79E868 |
| 24.4.15. | Pt(NH$_3$)$_4$$^{2+}$ | H$_2$O | $\mu$ = 1 (LiCl) | | 1.1 × 10$^4$ | FP/LUM/SST; RT; [Q] ≤ 0.007 mol/L | 79E868 |
| 24.4.16. | Pt(NH$_3$)Cl$_3$$^-$ | H$_2$O | $\mu$ = 1 (LiCl) | | 5.1 × 10$^6$ | FP/LUM/SST; RT; [Q] ≤ 8 × 10$^{-4}$ mol/L | 79E868 |
| 24.4.17. | cis-Pt(NH$_3$)$_2$Cl$_2$ | H$_2$O | $\mu$ = 1 (LiCl) | | 1.2 × 10$^5$ | FP/LUM/SST; RT; [Q] ≤ 8 × 10$^{-4}$ mol/L | 79E868 |
| 24.4.18. | trans-Pt(NH$_3$)$_2$Cl$_2$ | H$_2$O | $\mu$ = 1 (LiCl) | | 7.5 × 10$^5$ | FP/LUM/SST; RT; [Q] ≤ 8 × 10$^{-4}$ mol/L | 79E868 |
| 24.4.19. | Pt(NH$_3$)$_3$Cl$^+$ | H$_2$O | $\mu$ = 1 (LiCl) | | 2.9 × 10$^4$ | FP/LUM/SST; RT; [Q] ≤ 0.007 mol/L | 79E868 |
| 24.4.20. | Ru(CN)$_6$$^{4-}$ | H$_2$O | 1 mol/L KCl | | 5.0 × 10$^5$ | LP/LUM/SST; ET | 86E832 |
| 24.4.21. | SO$_2$ | H$_2$SO$_4$ (98%) | | 75 | 6.2 × 10$^3$ | SS/LUM; $\tau_0$ = ~0.25 ms (60E011); $E_a$ = 63 kJ/mol (30-75°C) | 77E799 |
| 24.4.22. | Sm$^{3+}$ | Acetone | | 20 | 8.5 × 10$^3$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.1 ms; ET; [Q] ≤ 0.1 mol/L; same $k_q$ from same lab in 68E121 | 69E237 |
| | Sm$^{3+}$ | POCl$_3$/SnCl$_4$ (9/1) | | 20 | 2.4 × 10$^3$ | FP/LUM/SST; $\tau_0$ = ~3.0 ms; $E_a$ = 13 kJ/mol (−15 to +10°C); ET; [Q] ≤ 0.05 mol/L | 766551 |
| *Organic Quenchers* | | | | | | | |
| 24.4.23. | 2-Acetylanthracene | 1-PrOH | | 20 | 3.2 × 10$^5$ | FP/LUM/SST; $\tau_0$ = 1.4 ms; $E_a$ = 20 kJ/mol (−25 to +60°C); ET | 75E531 |
| | 2-Acetylanthracene | AN | | 20 | 1.0 × 10$^7$ | FP/LUM/SST; $\tau_0$ = 1.7 ms; $E_a$ = 13 kJ/mol (−25 to +60°C); ET | 75E531 |
| | 2-Acetylanthracene | Acetone | | 20 | 3.4 × 10$^6$ | FP/LUM/SST; $\tau_0$ = 1.7 ms; $E_a$ = 13 kJ/mol (−25 to +60°C); ET | 75E531 |
| | 2-Acetylanthracene | DMSO | | 20 | 7.2 × 10$^4$ | FP/LUM/SST; $\tau_0$ = 2.6 ms; $E_a$ = 8.4 kJ/mol (−25 to +60°C); ET | 75E531 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **24.4. Tb$^{3+}$ [$^5$D$_4$]**—Continued | | | | | | | |
| | 2-Acetylanthracene | Ethyl acetate | | 20 | $1.9 \times 10^6$ | FP/LUM/SST; $\tau_0 = 1.8$ ms; $E_a = 17$ kJ/mol ($-25$ to $+60°$C); ET | 75E531 |
| | 2-Acetylanthracene | MeOH | | 20 | $2.1 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.4$ ms; $E_a = 21$ kJ/mol ($-25$ to $+60°$C); ET | 75E531 |
| | 2-Acetylanthracene | TBP | | 20 | $2.4 \times 10^4$ | FP/LUM/SST; $\tau_0 = 2.4$ ms; ET | 75E531 |
| | 2-Acetylanthracene | TMP | | 20 | $3.2 \times 10^4$ | FP/LUM/SST; $\tau_0 = 2.7$ ms; ET | 75E531 |
| | 2-Acetylanthracene | py | | 20 | $1.9 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.3$ ms; $E_a = 23$ kJ/mol ($-25$ to $+60°$C); ET | 75E531 |
| 24.4.24. | 2-Acetylnaphthalene | 1-PrOH | | | $1.2 \times 10^6$ | FP/LUM/SST; $\tau_0^{air} = 1.1$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | AN | | | $1.5 \times 10^7$ | FP/LUM/SST; $\tau_0^{air} = 0.93$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | Acetone | | 20 | $2.1 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0 = 1.0$ ms; ET; [Q] $\leq 0.005$ mol/L; same $k_q$ from same lab in 73F674 | 706153 |
| | 2-Acetylnaphthalene | DMF | | | $3.0 \times 10^5$ | FP/LUM/SST; $\tau_0^{air} = 1.4$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | DMSO | | | $7.1 \times 10^4$ | FP/LUM/SST; $\tau_0^{air} = 2.1$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | EtOH | | | $1.1 \times 10^6$ | FP/LUM/SST; $\tau_0^{air} = 0.74$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | Ethyl acetate | | | $2.0 \times 10^6$ | FP/LUM/SST; $\tau_0^{air} = 0.87$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | H$_2$O | | | $2.0 \times 10^6$ | FP/LUM/SST; $\tau_0^{air} = 0.47$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | MeOH | | | $7.0 \times 10^6$ | FP/LUM/SST; $\tau_0^{air} = 1.1$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | TBP | | | $9.0 \times 10^3$ | FP/LUM/SST; $\tau_0^{air} = 2.1$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | THF | | | $5.0 \times 10^9$ | FP/LUM/SST; $\tau_0^{air} = 0.41$ ms; ET | 73F674 |
| | 2-Acetylnaphthalene | py | | | $2.0 \times 10^5$ | FP/LUM/SST; $\tau_0^{air} = 0.94$ ms; ET | 73F674 |

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TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4. Tb$^{3+}$ [$^5$D$_4$]—Continued** | | | | | | | |
| 24.4.25. | Acid Fuchsin | H$_2$O | | 20 | $2.0 \times 10^8$ | FP/LUM/SST; $\tau_0 = 0.45$ ms; ET | 73E367 |
| | Acid Fuchsin | H$_2$O | ~1 mol/L NaAC | 20 | $3.2 \times 10^7$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq 1$ mol/L | 73E367 |
| 24.4.26. | Acridine | Acetone | | 20 | $1.6 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.27. | 1-Aminonaphthalene | Acetone | | 20 | $2.7 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.28. | Aniline Bright Red B | H$_2$O | | 20 | $7.1 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.45$ ms; ET | 73E367 |
| | Aniline Bright Red B | H$_2$O | ~1 mol/L NaAC | 20 | $2.3 \times 10^7$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq 1$ mol/L | 73E367 |
| 24.4.29. | Anthracene | 1-PrOH | | 20 | $9.5 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.4$ ms; ET | 75E531 |
| | Anthracene | AN | | 20 | $1.4 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.7$ ms; ET | 75E531 |
| | Anthracene | Acetone | | 20 | $1.8 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.7$ ms; ET | 75E531 |
| | Anthracene | DMSO | | 20 | $7.2 \times 10^4$ | FP/LUM/SST; $\tau_0 = 2.6$ ms; $E_a = 8.4$ kJ/mol ($-25$ to $+60°$C); ET | 75E531 |
| | Anthracene | MeOH | | 20 | $1.1 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.4$ ms; ET | 75E531 |
| | Anthracene | TBP | | 20 | $4.2 \times 10^4$ | FP/LUM/SST; $\tau_0 = 2.4$ ms; ET | 75E531 |
| | Anthracene | TMP | | 20 | $3.2 \times 10^4$ | FP/LUM/SST; $\tau_0 = 2.7$ ms; ET | 75E531 |
| | Anthracene | py | | 20 | $1.1 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.3$ ms; ET | 75E531 |
| 24.4.30. | Bis(2-naphthyl)amine | Acetone | | 20 | $1.4 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.31. | 1-Chloronaphthalene | Acetone | | 20 | $2.6 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.32. | 1,5-Dibenzoylnaphthalene | Acetone | | 20 | $6.9 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4. Tb$^{3+}$ [$^5$D$_4$]—Continued** | | | | | | | |
| 24.4.33. | 1,1'-Diethylisocyanine cation | MeOH | | 20 | $3.7 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 72E317 |
| 24.4.34. | 3,3'-Diethyl-9-methylthiacarbocyanine cation | MeOH | | 20 | $5.5 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 72E317 |
| 24.4.35. | 9,10-Diphenylanthracene cation radical | H$_2$SO$_4$ (95%)/DMF (5/1) | | 20 | $3.6 \times 10^7$ | FP/LUM/SST; $\tau_0 = 2.4$ ms; ET; [Q] $\leq 8 \times 10^{-5}$ mol/L | 73E368 |
| 24.4.36. | Eosin | H$_2$O | | 20 | $2.8 \times 10^8$ | FP/LUM/SST; $\tau_0 = 0.45$ ms; ET | 73E367 |
| | Eosin | H$_2$O | ~1 mol/L NaAC | 20 | $4.7 \times 10^7$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq 1$ mol/L | 73E367 |
| 24.4.37. | Erythrosin | H$_2$O | | 20 | $3.6 \times 10^8$ | FP/LUM/SST; $\tau_0 = 0.45$ ms; ET | 73E367 |
| | Erythrosin | H$_2$O | ~1 mol/L NaAC | 20 | $1.1 \times 10^8$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq 1$ mol/L | 73E367 |
| 24.4.38. | 9-Fluorenone | Acetone | | 20 | $1.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0 = 1.0$ ms; ET | 706153 |
| 24.4.39. | Fuchsin | H$_2$O | | 20 | $8.6 \times 10^7$ | FP/LUM/SST; $\tau_0 = 0.45$ ms; ET | 73E367 |
| | Fuchsin | H$_2$O | ~1 mol/L NaAC | 20 | $2.7 \times 10^8$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq 1$ mol/L | 73E367 |
| | Fuchsin | MeOH | | 20 | $4.5 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET; [Q] $\leq 2.5 \times 10^{-5}$ mol/L | 72E317 |
| 24.4.40. | Magdala Red | MeOH | | 20 | $1.3 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.2$ ms; ET | 72E317 |
| 24.4.41. | 2-Methoxynaphthalene | Acetone | | 20 | $1.1 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0 = 1.0$ ms; ET | 706153 |
| 24.4.42. | Morin | H$_2$O | pH 2 (HClO$_4$); $\mu = 1.0$ (NaClO$_4$) | 25 | $7.4 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.44$ ms; $E_a = 19$ kJ/mol (4-40°C); ET; [Q] = (5-10) $\times 10^{-5}$ mol/L; some SQ | 79E768 |
| | Morin | H$_2$O | pH 5 (HClO$_4$); $\mu = 1.0$ (NaClO$_4$) | 25 | $9.5 \times 10^6$ | FP/LUM/SST; $\tau_0 = 0.44$ ms; $E_a = 20$ kJ/mol (4-40°C); ET; [Q] = (5-10) $\times 10^{-5}$ mol/L; some SQ | 79E768 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4. Tb$^{3+}$ [$^5$D$_4$]—Continued** | | | | | | | |
| 24.4.43. | Naphthacene cation radical | H$_2$SO$_4$ (95%) | | 20 | $6.5 \times 10^6$ | FP/LUM/SST; $\tau_0$ = 2.4 ms; ET | 73E368 |
| 24.4.44. | Naphthacene, protonated | H$_2$SO$_4$ (95%) | | 20 | $1.9 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 2.4 ms; ET | 73E368 |
| 24.4.45. | Naphthalene | Acetone | | 20 | $1.6 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.46. | 1-Naphthoic acid | Acetone | | 20 | $8.5 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.47. | 1-Naphthylacetic acid | Acetone | | 20 | $8.2 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.48. | 2-Naphthyl benzoate | Acetone | | 20 | $2.3 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.49. | 2-Naphthyl diphenyl ketone | Acetone | | 20 | $3.0 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.50. | 2-Naphthylphenylamine | Acetone | | 20 | $7.0 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.51. | New Fuchsin | H$_2$O | | 20 | $3.9 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 0.45 ms; ET | 73E367 |
| | New Fuchsin | H$_2$O | ~1 mol/L NaAC | 20 | $1.1 \times 10^8$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq$ 1 mol/L | 73E367 |
| 24.4.52. | 1-Nitronaphthalene | Acetone | | 20 | $8.6 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.53. | Perylene cation radical | H$_2$SO$_4$ (95%) | | 20 | $1.2 \times 10^8$ | FP/LUM/SST; $\tau_0$ = 2.4 ms; ET; [Q] $\leq$ 4 $\times$ 10$^{-5}$ mol/L | 73E368 |
| 24.4.54. | Phenazine | Acetone | | 20 | $6.6 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 1.0 ms; ET | 706153 |
| 24.4.55. | Phenosafranine | H$_2$O | | 20 | $3.6 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 0.45 ms; ET | 73E367 |
| | Phenosafranine | H$_2$O | ~1 mol/L NaAC | 20 | $1.5 \times 10^8$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] $\geq$ 1 mol/L | 73E367 |
| 24.4.56. | Quercetin | H$_2$O | pH 2 (HClO$_4$); $\mu$ = 1.0 (NaClO$_4$) | 25 | $1.3 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 0.44 ms; $E_a$ = 19 kJ/mol (4-40°C); ET; [Q] = (1-3) $\times$ 10$^{-5}$ mol/L; some SQ | 79E768 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.4.** | **Tb$^{3+}$ [$^5$D$_4$]—Continued** | | | | | | |
| | Quercetin | H$_2$O | pH 5 (HClO$_4$); $\mu$ = 1.0 (NaClO$_4$) | 25 | $3.6 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 0.44 ms; $E_a$ = 16 kJ/mol (4-40°C); ET; [Q] = (1-3) × 10$^{-5}$ mol/L; some SQ | 79E768 |
| 24.4.57. | Rose Bengal | H$_2$O | | 20 | $6.0 \times 10^8$ | FP/LUM/SST; $\tau_0$ = 0.45 ms; ET | 73E367 |
| | Rose Bengal | H$_2$O | ~1 mol/L NaAC | 20 | $1.4 \times 10^8$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] ≥ 1 mol/L | 73E367 |
| 24.4.58. | Rutin | H$_2$O | pH 2 (HClO$_4$); $\mu$ = 1.0 (NaClO$_4$) | 25 | $9.5 \times 10^5$ | FP/LUM/SST; $\tau_0$ = 0.44 ms; $E_a$ = 18 kJ/mol (4-40°C); ET; [Q] = (5-15) × 10$^{-5}$ mol/L; some SQ | 79E768 |
| | Rutin | H$_2$O | pH 5 (HClO$_4$); $\mu$ = 1.0 (NaClO$_4$) | 25 | $5.2 \times 10^6$ | FP/LUM/SST; $\tau_0$ = 0.44 ms; $E_a$ = 19 kJ/mol (4-40°C); ET; [Q] = (5-15) × 10$^{-5}$ mol/L; some SQ | 79E768 |
| 24.4.59. | Safranine T | H$_2$O | | 20 | $2.9 \times 10^7$ | FP/LUM/SST; $\tau_0$ = 0.45 ms; ET | 73E367 |
| | Safranine T | H$_2$O | ~1 mol/L NaAC | 20 | $8.6 \times 10^7$ | FP/LUM/SST; ET; $k_q$ independent of [NaAC] ≥ 1 mol/L | 73E367 |
| | Safranine T | MeOH | | 20 | $2.1 \times 10^8$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 72E317 |
| 24.4.60. | 3,3′,9-Triethyl-5,5′-dichlorothiacarbocyanine cation | MeOH | | 20 | $5.3 \times 10^8$ | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET | 72E317 |
| **24.5.** | **Tb$^{III}$-Dipicolinic acid** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 24.5.1. | Eu$^{III}$-Dipicolinic acid | H$_2$O | 0.06 mol/L NaClO$_4$; pH 2.5; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.0091 mol/L | | $2.2 \times 10^5$ | SS/LUM; $\tau_0$ = 1.8 ms (FP/LUM/SST); ET; [Q] ≤ 7 × 10$^{-4}$ mol/L | 81E788 |
| | Eu$^{III}$-Dipicolinic acid | H$_2$O | 0.06 mol/L NaClO$_4$; pH 4.4; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.0091 mol/L | | $3.0 \times 10^5$ | SS/LUM; $\tau_0$ = 1.8 ms (FP/LUM/SST); ET; [Q] ≤ 7 × 10$^{-4}$ mol/L | 81E788 |

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| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.5. Tb$^{III}$-Dipicolinic acid—Continued** | | | | | | | |
| | Eu$^{III}$-Dipicolinic acid | $H_2O$ | 0.06 mol/L NaClO$_4$; pH 6.2; [L]/([Tb]+[Eu]) = 1; [Tb] = 0.0091 mol/L | | $3.9 \times 10^5$ | SS/LUM; $\tau_0$ = 1.7 ms (FP/LUM/SST); ET; [Q] $\leq$ 7 $\times$ 10$^{-4}$ mol/L | 81E788 |
| **24.6. Tb$^{III}$(Dipicolinic acid)$_3$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.6.1. | Eu$^{III}$(Dipicolinic acid)$_3$ | $H_2O$ | pH 2.5; [L]/([Tb]+[Eu]) = 5 or 10; [Tb] = 0.002 mol/L | | $2.4 \times 10^5$ | SS/LUM; $\tau_0$ = 1.7 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$(Dipicolinic acid)$_3$ | $H_2O$ | pH 4.5; [L]/([Tb]+[Eu]) = 5 or 10; [Tb] = 0.002 mol/L | | $3.7 \times 10^4$ | SS/LUM; $\tau_0$ = ~2.6 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| **24.7. Tb(EDTA)$^-$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.7.1. | Co(EDTA)$^-$ | $H_2O$ | $\mu$ = 0 (extrap'd, NaClO$_4$) | 25 | $8.4 \times 10^6$ | LP/LUM/SPC; ET; [Q] = ~0.001 mol/L | 81E787 |
| 24.7.2. | Cu(EDTA)$^{2-}$ | $H_2O$ | $\mu$ = 0 (extrap'd, NaClO$_4$) | 25 | $3.2 \times 10^6$ | LP/LUM/SPC; ET; [Q] = ~0.001 mol/L | 81E787 |
| **24.8. Tb$^{III}$-Hemimellitic acid** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.8.1. | Eu$^{III}$-Hemimellitic acid | $H_2O$ | pH 3.0; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $2.4 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0$ = 0.46 ms; ET; some SQ | 79M270 |
| | Eu$^{III}$-Hemimellitic acid | $H_2O$ | pH 5.0; ([Tb] + [Eu])/[L] = 0.2; [Eu] < [Tb] | | $9.5 \times 10^5$ (calc) | FP/LUM/SST; $\tau_0$ = 0.64 ms; ET; some SQ | 79M270 |
| | Eu$^{III}$-Hemimellitic acid | $H_2O$ | pH 6.5; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $2.9 \times 10^5$ (calc) | FP/LUM/SST; $\tau_0$ = 1.2 ms; ET; extensive SQ | 79M270 |
| | Eu$^{III}$-Hemimellitic acid | $H_2O$ | pH 8.5; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $2.7 \times 10^5$ (calc) | FP/LUM/SST; $\tau_0$ = 1.5 ms; ET; extensive SQ | 79M270 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.9. Tb$^{III}$-Malic acid** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.9.1. | Eu$^{III}$-Malic acid | H$_2$O | pH 2.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.4 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.50 ms; ET; [Q] ≤ 3 × 10$^{-4}$ mol/L; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 5.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.4 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.84 ms; ET; [Q] ≤ 3 × 10$^{-4}$ mol/L; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 5.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.4 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.86 ms; ET; [Q] ≤ 3 × 10$^{-4}$ mol/L; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 7.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.3 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.92 ms; ET; [Q] ≤ 3 × 10$^{-4}$ mol/L; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 7.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.3 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.96 ms; [Q] ≤ 3 × 10$^{-4}$ mol/L; some SQ; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 9.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.0 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 1.2 ms; [Q] ≤ 3 × 10$^{-4}$ mol/L; some SQ; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 10.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 1.2 ms; [Q] ≤ 3 × 10$^{-4}$ mol/L; large SQ; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| | Eu$^{III}$-Malic acid | H$_2$O | pH 11.5; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.8 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.66 ms; [Q] ≤ 3 × 10$^{-4}$ mol/L; large SQ; $K_{SV}^\tau$ constant for pH 2.5-11.5 | 79E969 |
| **24.10. Tb$^{III}$-L-Malic acid** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.10.1. | Eu$^{III}$-L-Malic acid | H$_2$O | pH 4; [L]/([Tb]+[Eu]) = 3 | | $7.5 \times 10^5$ | LP/LUM/SST; $\tau_0^{air}$ = 0.81 ms; ET; [Q] ≤ 0.012 mol/L | 80E072 |
| | Eu$^{III}$-L-Malic acid | H$_2$O | pH 6; [L]/([Tb]+[Eu]) = 3 | | $3.3 \times 10^5$ | LP/LUM/SST; $\tau_0^{air}$ = 0.93 ms; ET; [Q] ≤ 0.012 mol/L | 80E072 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.10.** | **Tb$^{III}$-L-Malic acid**—Continued | | | | | | |
| | Eu$^{III}$-L-Malic acid | H$_2$O | pH 8; [L]/([Tb]+[Eu]) = 3 | | $1.3 \times 10^5$ | LP/LUM/SST; $\tau_0^{air}$ = 1.2 ms; ET; [Q] $\leq$ 0.012 mol/L | 80E072 |
| | Eu$^{III}$-L-Malic acid | H$_2$O | pH 9; [L]/([Tb]+[Eu]) = 3 | | $4.7 \times 10^4$ | LP/LUM/SST; $\tau_0^{air}$ = 1.3 ms; ET; [Q] $\leq$ 0.012 mol/L | 80E072 |
| | Eu$^{III}$-L-Malic acid | H$_2$O | pH 10; [L]/([Tb]+[Eu]) = 3 | | $9.7 \times 10^3$ | LP/LUM/SST; $\tau_0^{air}$ = 1.4 ms; ET; [Q] $\leq$ 0.012 mol/L | 80E072 |
| **24.11.** | **Tb$^{III}$-Phthalic acid** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 24.11.1. | Eu$^{III}$-Phthalic acid | H$_2$O | pH 3; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $2.7 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0$ = 0.48 ms; ET; some SQ | 79M270 |
| | Eu$^{III}$-Phthalic acid | H$_2$O | pH 5; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $1.5 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0$ = 0.61 ms; ET; some SQ | 79M270 |
| | Eu$^{III}$-Phthalic acid | H$_2$O | pH 6.0; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $1.1 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0$ = 0.63 ms; ET; extensive SQ | 79M270 |
| | Eu$^{III}$-Phthalic acid | H$_2$O | pH 8.0; [L]/([Tb]+[Eu]) = 5; [Eu] < [Tb] | | $9.9 \times 10^5$ (calc) | FP/LUM/SST; $\tau_0$ = 0.81 ms; ET; extensive SQ | 79M270 |
| **24.12.** | **Tb$^{III}$-Picolinic acid** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 24.12.1. | Eu$^{III}$-Picolinic acid | H$_2$O | pH 5.2; [L]/([Tb]+[Eu]) = 10; [Tb] = 0.002 mol/L | | $7.4 \times 10^5$ | SS/LUM; $\tau_0$ = 0.59 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 6.2; [L]/([Tb]+[Eu]) = 10; [Tb] = 0.002 mol/L | | $7.5 \times 10^5$ | SS/LUM; $\tau_0$ = 0.66 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 8.3; [L]/([Tb]+[Eu]) = 10; [Tb] = 0.002 mol/L | | $2.6 \times 10^6$ | SS/LUM; $\tau_0$ = 0.95 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.12.** | **Tb$^{III}$-Picolinic acid**—Continued | | | | | | |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 9.0; [L]/([Tb]+[Eu]) = 10; [Tb] = 0.002 mol/L | | $6.1 \times 10^5$ | SS/LUM; $\tau_0$ = 1.3 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 5.2; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.0 \times 10^6$ | SS/LUM; $\tau_0$ = 0.53 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 6.2; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.8 \times 10^6$ | SS/LUM; $\tau_0$ = 0.56 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 8.3; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $3.0 \times 10^6$ | SS/LUM; $\tau_0$ = 0.82 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| | Eu$^{III}$-Picolinic acid | H$_2$O | pH 9.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $1.1 \times 10^6$ | SS/LUM; $\tau_0$ = 1.1 ms (FP/LUM/SST); ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L | 78E890 |
| **24.13.** | **Tb$^{III}$-Pyromellitic acid** *Inorganic Quenchers* | | | | | | |
| 24.13.1. | Eu$^{III}$-Pyromellitic acid | H$_2$O | pH 1.6; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.7 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.42 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; $K_{SV}^{\tau}$ constant for pH 1.6-3.2 | 79M271 |
| | Eu$^{III}$-Pyromellitic acid | H$_2$O | pH 2.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.6 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.43 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; $K_{SV}^{\tau}$ constant for pH 1.6-3.2 | 79M271 |
| | Eu$^{III}$-Pyromellitic acid | H$_2$O | pH 2.4; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.5 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.44 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; some SQ; $K_{SV}^{\tau}$ constant for pH 1.6-3.2 | 79M271 |
| | Eu$^{III}$-Pyromellitic acid | H$_2$O | pH 2.8; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.4 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.46 ms; ET; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; some SQ; $K_{SV}^{\tau}$ constant for pH 1.6-3.2 | 79M271 |

| No. | Quencher | Solvent | Solution Medium | $T$/°C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.13.** **Tb$^{III}$-Pyromellitic acid**—Continued | | | | | | | |
| | Eu$^{III}$-Pyromellitic acid | H$_2$O | pH 3.2; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.3 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.48 ms; ET; [Q] ≤ 3 × 10$^{-4}$ mol/L; some SQ; $K_{SV}^\tau$ constant for pH 1.6-3.2 | 79M271 |
| **24.14.** **Tb$^{III}$-Trimellitic acid** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.14.1. | Eu$^{III}$-Trimellitic acid | H$_2$O | pH 1.6; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.7 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.41 ms; ET; $K_{SV}^\tau$ constant for pH 1.6-3.0 | 79M271 |
| | Eu$^{III}$-Trimellitic acid | H$_2$O | pH 2.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.6 \times 10^6$ (calc) | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.43 ms; ET; [Q] ≤ 3 × 10$^{-4}$ mol/L; $K_{SV}^\tau$ constant for pH 1.6-3.0 | 79M271 |
| | Eu$^{III}$-Trimellitic acid | H$_2$O | pH 2.4; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.4 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.46 ms; ET; some SQ; $K_{SV}^\tau$ constant for pH 1.6-3.0 | 79M271 |
| | Eu$^{III}$-Trimellitic acid | H$_2$O | pH 3.0; [L]/([Tb]+[Eu]) = 5; [Tb] = 0.002 mol/L | | $2.2 \times 10^6$ (calc) | FP/LUM/SST; $\tau_0^{air}$ = 0.49 ms; ET; some SQ; $K_{SV}^\tau$ constant for pH 1.6-3.0 | 79M271 |
| **24.15.** **Tb(acetylacetonato)$_3$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.15.1. | Dy(acac)$_3$ | $n$-BuOH | [S] + [Q] = 0.005 mol/L | 20 | ~$5 \times 10^4$ | FP/LUM/AVE, SS/LUM; $\tau_0$ = 0.79 ms; ET; [Q] ≤ 0.004 mol/L | 756252 |
| 24.15.2. | Er(acac)$_3$ | $n$-BuOH | [S] + [Q] = 0.005 mol/L | 20 | $1.5 \times 10^5$ | FP/LUM/AVE, SS/LUM; $\tau_0$ = 0.79 ms; ET | 756252 |
| 24.15.3. | Eu(acac)$_3$ | AN | [S] + [Q] = 0.005 mol/L | 20 | $3.3 \times 10^5$ | FP/LUM/AVE; $\tau_0$ = 0.93 ms; ET; quenching involves dimers; some SQ | 766073 |
| | Eu(acac)$_3$ | Acetone | [S] + [Q] = 0.005 mol/L | 20 | $3.3 \times 10^5$ | FP/LUM/AVE; $\tau_0$ = 0.80 ms; ET; quenching involves dimers; some SQ | 766073 |
| | Eu(acac)$_3$ | Benzonitrile | [S] + [Q] = 0.005 mol/L | 20 | $3.3 \times 10^5$ | FP/LUM/AVE; $\tau_0$ = 0.83 ms; ET; quenching involves dimers; some SQ | 766073 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.15. Tb(acetylacetonato)$_3$**—Continued | | | | | | | |
| | Eu(acac)$_3$ | Ethylene glycol | [S] + [Q] = 0.005 mol/L | 20 | $1.5 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.70$ ms; ET; quenching involves dimers; some SQ | 766073 |
| | Eu(acac)$_3$ | n-BuOH | [S] + [Q] = 0.005 mol/L | 20 | $3.3 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.79$ ms; $E_a = 23$ kJ/mol (0-50°C); ET; [Q] $\leq$ 0.004 mol/L; quenching involves dimers; some SQ | 766073 |
| 24.15.4. | Ho(acac)$_3$ | n-BuOH | [S] + [Q] = 0.005 mol/L | 20 | $2.0 \times 10^5$ | FP/LUM/AVE, SS/LUM; $\tau_0$ = 0.79 ms; ET; [Q] $\leq$ 0.004 mol/L | 756252 |
| 24.15.5. | Nd(acac)$_3$ | n-BuOH | [S] + [Q] = 0.005 mol/L | 20 | $4.9 \times 10^5$ | FP/LUM/AVE, SS/LUM; $\tau_0$ = 0.79 ms; ET | 756252 |
| 24.15.6. | Pr(acac)$_3$ | n-BuOH | [S] + [Q] = 0.005 mol/L | 20 | $4.7 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.79$ ms; ET; [Q] $\leq$ 0.004 mol/L; some SQ | 756252 |
| 24.15.7. | Sm(acac)$_3$ | AN | [S] + [Q] = 0.005 mol/L | 20 | $3.8 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.93$ ms; ET; quenching involves dimers; some SQ | 766073 |
| | Sm(acac)$_3$ | Acetone | [S] + [Q] = 0.005 mol/L | 20 | $3.9 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.80$ ms; ET; quenching involves dimers; some SQ | 766073 |
| | Sm(acac)$_3$ | Benzene | [S] + [Q] = 0.005 mol/L | 20 | $<1 \times 10^4$ | FP/LUM/AVE; $\tau_0 = 0.90$ ms; quenching involves dimers; some SQ | 766073 |
| | Sm(acac)$_3$ | Benzonitrile | [S] + [Q] = 0.005 mol/L | 20 | $1.3 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.83$ ms; ET; quenching involves dimers; some SQ | 766073 |
| | Sm(acac)$_3$ | CCl$_4$ | [S] + [Q] = 0.005 mol/L | 20 | $<1 \times 10^4$ | FP/LUM/AVE; $\tau_0 = 0.83$ ms; quenching involves dimers; some SQ | 766073 |
| | Sm(acac)$_3$ | Ethylene glycol | [S] + [Q] = 0.005 mol/L | 20 | $1.5 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.70$ ms; ET; quenching involves dimers; some SQ | 766073 |
| | Sm(acac)$_3$ | n-BuOH | [S] + [Q] = 0.005 mol/L | 20 | $4.9 \times 10^5$ | FP/LUM/AVE; $\tau_0 = 0.79$ ms; $E_a = 23$ kJ/mol (0-50°C); ET; [Q] $\leq$ 0.004 mol/L; quenching involves dimers; some SQ | 766073 |

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.15.** | **Tb(acetylacetonato)$_3$**—Continued | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 24.15.8. | 2-Acetylnaphthalene | Acetone | | 20 | $1.9 \times 10^5$ | FP/LUM/SST, SS/LUM; ET | 706153 |
| 24.15.9. | Naphthalene | Acetone | | 20 | $2.0 \times 10^4$ | FP/LUM/SST; ET; also EQ | 706153 |
| | Naphthalene | Toluene | | 20 | $3.2 \times 10^4$ | FP/LUM/SST; ET; [Q] $\leq$ 0.3 mol/L; also EQ | 706153 |
| **24.16.** | **Tb(anthranilato)$^{2+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 24.16.1. | Nd(H$_2$O)$_n^{3+}$ | H$_2$O | pH 5.9; $\mu = 0.6$; ([Tb]+[Nd])/[L] = 1000 | 22 | $1.5 \times 10^4$ | LP/LUM/SST; ET | 80E879 |
| **24.17.** | **Tb(crypt)$^{3+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 24.17.1. | Co(CN)$_6^{3-}$ | H$_2$O | 1 mol/L KCl | | $4.0 \times 10^5$ | LP/LUM/SST; ET | 86E832 |
| 24.17.2. | Cr(CN)$_6^{3-}$ | H$_2$O | 1 mol/L KCl | | $\sim 2 \times 10^6$ | LP/LUM/SST; ET | 86E832 |
| 24.17.3. | Fe(CN)$_6^{4-}$ | H$_2$O | 1 mol/L KCl | | $7.0 \times 10^5$ | LP/LUM/SST; ET | 86E832 |
| 24.17.4. | Ru(CN)$_6^{4-}$ | H$_2$O | 1 mol/L KCl | | $<1 \times 10^4$ | LP/LUM/SST | 86E832 |
| **24.18.** | **Tb[$N$-(2-hydroxyethyl)EDTA]** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 24.18.1. | Co(EDTA)$^-$ | H$_2$O | | 25 | $8.4 \times 10^6$ | LP/LUM/SPC; $\tau_0 = 1.0$ ms; ET; [Q] = $\sim 0.001$ mol/L | 81E787 |
| **24.19.** | **Tb(salicylato)$_3$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 24.19.1. | Acid Fuchsin | MeOH | | 20 | $2.5 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; some SQ | 72E317 |
| 24.19.2. | Acridine Orange | MeOH | | 20 | $1.3 \times 10^7$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; same $k_q$ from same lab in 72E320 | 72E317 |
| 24.19.3. | Acridine Yellow | MeOH | | 20 | $2.9 \times 10^6$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.4. | Auramine | MeOH | | 20 | $1.3 \times 10^6$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.5. | Aurin | MeOH | | 20 | $2.3 \times 10^7$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; some SQ | 72E317 |
| 24.19.6. | Chrysoidin | MeOH | | 20 | $9.7 \times 10^6$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; same $k_q$ from same lab in 72E320 | 72E317 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.19. Tb(salicylato)₃—Continued** | | | | | | | |
| 24.19.7. | Coryphosphine | MeOH | | 20 | $1.1 \times 10^7$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; same $k_q$ from same lab in 72E320 | 72E317 |
| 24.19.8. | Coumarin | MeOH | | 20 | $3.4 \times 10^5$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.9. | 4,4'-Diaminobiphenyl | MeOH | | 20 | $2.7 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.10. | 1,1'-Diethylisocyanine cation | MeOH | | 20 | $4.2 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.11. | 3,3'-Diethyl-9-methylthiacarbocyanine cation | MeOH | | 20 | $5.6 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; $[Q] \leq 3.5 \times 10^{-5}$ mol/L | 72E317 |
| 24.19.12. | 1,1'-Dimethyl-5,6-naphthopseudoisocyanine cation | MeOH | | 20 | $4.5 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; $[Q] \leq 4.5 \times 10^{-5}$ mol/L | 72E317 |
| 24.19.13. | Fluorene | MeOH | | 20 | $<1 \times 10^3$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.14. | Fuchsin | MeOH | | 20 | $3.1 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; $[Q] \leq 6.5 \times 10^{-5}$ mol/L; same $k_q$ from same lab in 72E320 | 72E317 |
| 24.19.15. | Magdala Red | MeOH | | 20 | $8.3 \times 10^7$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; same $k_q$ from same lab in 72E320 | 72E317 |
| 24.19.16. | New Fuchsin | MeOH | | 20 | $2.2 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; same $k_q$ from same lab in 72E320 | 72E317 |
| 24.19.17. | Phenanthrene | MeOH | | 20 | $1.7 \times 10^4$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |
| 24.19.18. | Safranine T | MeOH | | 20 | $1.2 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; same $k_q$ from same lab in 72E320 | 72E317 |
| 24.19.19. | 3,3',9-Triethyl-5,5'-dichlorothiacarbocyanine cation | MeOH | | 20 | $5.0 \times 10^8$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET; $[Q] \leq 5.2 \times 10^{-5}$ mol/L | 72E317 |
| 24.19.20. | Tryphaflavin | MeOH | | 20 | $3.9 \times 10^6$ | FP/LUM/SST; $\tau_0 = 1.0$ ms; ET | 72E317 |

TABLE 24. Quenching of excited terbium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **24.20.** | **Tb(2,2,6,6-tetramethyl-3,5-heptanedionato)$_3$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 24.20.1. | Eu(thd)$_3$ | 1-PrOH | | | $9.9 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.76 ms; ET | 776186 |
| | Eu(thd)$_3$ | 2-PrOH | | | $1.1 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.69 ms; ET | 776186 |
| | Eu(thd)$_3$ | Benzene | | | $1.0 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.83 ms; ET | 776186 |
| | Eu(thd)$_3$ | CCl$_4$ | | | $3.7 \times 10^4$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.96 ms; ET; [Q] $\leq$ 0.003 mol/L | 776186 |
| | Eu(thd)$_3$ | CHCl$_3$ | | | $9.5 \times 10^4$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.91 ms; ET; [Q] $\leq$ 0.004 mol/L | 776186 |
| | Eu(thd)$_3$ | EtOH | | | $7.5 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.60 ms; ET | 776186 |
| | Eu(thd)$_3$ | MeOH | | | $2.0 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.68 ms; ET; [Q] $\leq$ 0.0035 mol/L | 776186 |
| | Eu(thd)$_3$ | n-BuOH | | | $3.4 \times 10^5$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.75 ms; ET; [Q] $\leq$ 0.0035 mol/L | 776186 |

TABLE 25. Quenching of excited tin complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **25.1.** | **Sn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]Cl$_2$$^{4+}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 25.1.1. | Fe$^{3+}$ | H$_2$O | | | $\sim 1 \times 10^6$ | FP/ABS/SST; $\tau_0 = 0.90$ ms; OT | 83A133 |
| 25.1.2. | S$_2$O$_8$$^{2-}$ | H$_2$O | | | $1.0 \times 10^7$ | FP/ABS/SST; $\tau_0 = 0.90$ ms; OT | 83A133 |
| | *Organic Quenchers* | | | | | | |
| 25.1.3. | MV$^{2+}$ | H$_2$O | | | $< 1 \times 10^4$ | FP/ABS/SST; $\tau_0 = 0.90$ ms; OT | 83A133 |
| **25.2.** | **Sn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]Cl$_2$$^{4-}$** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 25.2.1. | S$_2$O$_8$$^{2-}$ | H$_2$O | | | $\sim 1 \times 10^5$ | FP/ABS/SST; $\tau_0 = 1.0$ ms; OT | 83A133 |
| | *Organic Quenchers* | | | | | | |
| 25.2.2. | MV$^{2+}$ | H$_2$O | | | $< 1 \times 10^4$ | FP/ABS/SST; $\tau_0 = 1.0$ ms; OT | 83A133 |
| **25.3.** | **Sn(5,10,15,20-tetraphenylporphyrin)(OH)$_2$** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 25.3.1. | MV$^{2+}$ | AN/H$_2$O (19/1) | $5 \times 10^{-4}$ mol/L KOH | | $2.9 \times 10^5$ | SS/QYP; $\tau_0 = 2.0$ ms (FP/ABS/SST); OT; see Mech. [7] | 85F328 |

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TABLE 26. Quenching of excited titanium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **26.1.** | **Ti(oxo)(5,10,15,20-tetraphenylporphyrin)** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 26.1.1. | Ethanol, protonated | EtOH | $\leq 1.5 \times 10^{-4}$ mol/L HCl | | $3.4 \times 10^9$ | LP/ABS/SST; $\tau_0 = 35$ μs; PT; [Q] $\leq 1.5 \times 10^{-4}$ mol/L; HCl assumed to be completely dissociated | 84B008 |

TABLE 27. Quenching of excited tungsten complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **27.1.** | **W(CO)$_5$(4-cyanopyridine)** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 27.1.1. | Anthracene | MeCH | 0.1 mol/L EtOH | 25 | $4.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 0.36 μs; ET?; [Q] $\leq$ 0.005 mol/L | 80F384 |

TABLE 28. Quenching of excited uranium complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1. UO$_2$$^{2+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 28.1.1. | Ag$^+$ | H$_2$O | $\mu$ = 0.019 (NaNO$_3$) | 25 | 9.7 × 10$^8$ | SL/LUM/SPC; $\tau_0^{und}$ = 1.3 $\mu$s; $E_a$ = 22 kJ/mol (6-20 °C); RT; [Q] ≤ 3 × 10$^{-4}$ mol/L; S as NO$_3^-$ salt | 80A331 |
| | Ag$^+$ | H$_2$O | $\mu$ = 0.034 (NaNO$_3$) | 25 | 1.0 × 10$^9$ | SL/LUM/SPC; $\tau_0^{und}$ = 1.3 $\mu$s; $E_a$ = 21 kJ/mol (16-36 °C); RT; [Q] ≤ 4 × 10$^{-4}$ mol/L; S as NO$_3^-$ salt | 80A331 |
| | Ag$^+$ | H$_2$O | $\mu$ = 0.06 (NaNO$_3$) | 25 | 1.2 × 10$^9$ | SL/LUM/SPC; $\tau_0^{und}$ = 1.2 $\mu$s; $E_a$ = 20 kJ/mol (16-34 °C); RT; [Q] ≤ 4 × 10$^{-4}$ mol/L; S as NO$_3^-$ salt | 80A331 |
| | Ag$^+$ | H$_2$O | $\mu$ = 0.1 (NaNO$_3$) | 25 | 1.6 × 10$^9$ | SL/LUM/SPC; $\tau_0^{und}$ = 1.2 $\mu$s; $E_a$ = 19 kJ/mol (16-36 °C); RT; [Q] ≤ 4 × 10$^{-4}$ mol/L; S as NO$_3^-$ salt | 80A331 |
| | Ag$^+$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | 4.3 × 10$^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 11 $\mu$s; RT | 77E693 |
| | Ag$^+$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | 4.9 × 10$^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; RT | 77E693 |
| | Ag$^+$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | 3.3 × 10$^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 6.8 $\mu$s; RT | 77E693 |
| | Ag$^+$ | H$_2$O | pH 2.3; $\mu$ = 0.007 | | 1.2 × 10$^9$ | LP/LUM/SST; $\tau_0^{air}$ = 1.5 $\mu$s; RT; S as NO$_3^-$ salt | 81F325 |
| | Ag$^+$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | 3.5 × 10$^9$ | SS/LUM; $\tau_0^{air}$ = 1.2 $\mu$s (747132); RT; S as NO$_3^-$ salt | 766020 |
| | Ag$^+$ | H$_2$O | 1 mol/L H$_3$PO$_4$; $\mu$ = 0.09 | | 3.9 × 10$^9$ | LP/LUM/SST; $\tau_0^{air}$ = 0.16 ms; RT; S as NO$_3^-$ salt | 81F325 |
| | Ag$^+$ | H$_2$O | 1 mol/L HNO$_3$; $\mu$ = 1 | | 1.9 × 10$^9$ | LP/LUM/SST; $\tau_0^{air}$ = 2.8 $\mu$s; RT; S as NO$_3^-$ salt | 81F325 |
| 28.1.2. | Ba$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | 2.3 × 10$^4$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms | 77E693 |
| | Ba$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | <4 × 10$^3$ | SS/LUM; $\tau_0^{air}$ = 1.2 $\mu$s (747132); S as NO$_3^-$ salt | 766020 |
| 28.1.3. | Br$^-$ | H$_2$O | $\mu$ = 0 (extrap'd, HClO$_4$) | 25 | 3.5 × 10$^{10}$ | FP/LUM/SST, SS/LUM; RT | 766201 |
| | Br$^-$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | 4.8 × 10$^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{und}$ = 6.8 $\mu$s; RT | 766201 |

QUENCHING OF EXCITED METAL COMPLEXES IN FLUID SOLUTION

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TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** **UO$_2$$^{2+}$**—Continued | | | | | | | |
| | Br$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $8.5 \times 10^8$ | FP/LUM/SST, SS/LUM; $\tau_0^{und} = 0.19$ ms; RT | 766201 |
| | Br$^-$ | H$_2$O | pH 2.3; $\mu = 0.007$ | | $1.0 \times 10^{10}$ | LP/LUM/SST; $\tau_0^{air} = 1.5$ $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| | Br$^-$ | H$_2$O | 1 mol/L HNO$_3$; $\mu = 1$ | | $6.6 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 2.8$ $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| | Br$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$; $\mu = 0.09$ | | $1.9 \times 10^9$ | LP/LUM/SST; $\tau_0^{air} = 0.16$ ms; RT; S as NO$_3$$^-$ salt | 81F325 |
| 28.1.4. | Ce$^{IV}$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $3.5 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 6.8$ $\mu$s; ET | 77E693 |
| | Ce$^{IV}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $3.5 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms; ET | 77E693 |
| 28.1.5. | Ce$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.1 \times 10^8$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms; RT | 77E693 |
| | Ce$^{3+}$ | H$_2$O | | | $2.0 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.4$ $\mu$s; RT; [Q] = 0.008-0.04 mol/L; S as NO$_3$$^-$ salt | 82A353 |
| | Ce$^{3+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $3.1 \times 10^5$ | SS/LUM; $\tau_0^{air} = 1.2$ $\mu$s (747132); RT?; S as NO$_3$$^-$ salt | 766020 |
| | Ce$^{3+}$ | H$_2$O | 0.09 mol/L H$_2$SO$_4$ | | $1.1 \times 10^8$ | LP/ABS/SST; $\tau_0 = 2.4$ $\mu$s; RT; $\tau_0$ depends on [S]; S as SO$_4$$^{2-}$ salt | 82A353 |
| | Ce$^{3+}$ | H$_2$O | 0.4-0.5 mol/L H$_2$SO$_4$ | | $5.0 \times 10^7$ | LP/ABS/SST; $\tau_0 = 4.3$ $\mu$s; RT; $\tau_0$ depends on [S]; S as SO$_4$$^{2-}$ salt | 82A353 |
| | Ce$^{3+}$ | H$_2$O | 0.2-2 mol/L HNO$_3$ | | $\sim 1 \times 10^7$ | LP/ABS/SST; $\tau_0 = \sim 2.0$ $\mu$s; RT; [Q] = 0.008-0.04 mol/L; S as NO$_3$$^-$ salt | 82A353 |
| | Ce$^{3+}$ | H$_2$O | 0.5 mol/L HClO$_4$ | | $1.3 \times 10^6$ | LP/ABS/SST; $\tau_0 = 3.4$ $\mu$s; RT; [Q] = 0.41 mol/L; S as ClO$_4$$^-$ salt | 82A353 |
| | Ce$^{3+}$ | H$_2$O | 1 mol/L HClO$_4$ | | $2.6 \times 10^6$ | LP/ABS/SST; $\tau_0 = 5.6$ $\mu$s; RT; [Q] = 0.45 mol/L; S as ClO$_4$$^-$ salt | 82A353 |
| | Ce$^{3+}$ | H$_2$O | 2 mol/L HClO$_4$ | | $3.4 \times 10^6$ | LP/ABS/SST; $\tau_0 = 6.7$ $\mu$s; RT; [Q] = 0.45 mol/L; S as ClO$_4$$^-$ salt | 82A353 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1. UO$_2$$^{2+}$**—Continued | | | | | | | |
| 28.1.6. | Cl$^-$ | H$_2$O | $\mu$ = 0 (extrap'd, HClO$_4$) | 25 | $1.4 \times 10^{10}$ | FP/LUM/SST, SS/LUM; RT | 766201 |
| | Cl$^-$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $1.7 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{und}$ = 6.8 $\mu$s; RT | 766201 |
| | Cl$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $8.0 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{und}$ = 0.19 ms; RT | 766201 |
| | Cl$^-$ | H$_2$O | pH 2.3; $\mu$ = 0.007 | | $2.8 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 1.5 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| | Cl$^-$ | H$_2$O | 0.05 mol/L HClO$_4$; 0.05 mol/L F$^-$; $\mu$ = 0 (extrap'd, NaClO$_4$) | | $6.0 \times 10^7$ | FP/LUM/SST; RT; S mainly as UO$_2$F$_2$ | 77E694 |
| | Cl$^-$ | H$_2$O | 0.05 mol/L HClO$_4$; 0.05 mol/L SO$_4$$^{2-}$; $\mu$ = 0 (extrap'd, NaClO$_4$) | | $2.0 \times 10^8$ | FP/LUM/SST; RT; S mainly as UO$_2$SO$_4$ | 77E694 |
| | Cl$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$; $\mu$ = 0.09 | | $8.0 \times 10^7$ | LP/LUM/SST; $\tau_0^{air}$ = 0.16 ms; RT; S as NO$_3$$^-$ salt | 81F325 |
| | Cl$^-$ | H$_2$O | 1 mol/L HNO$_3$; $\mu$ = 1 | | $1.4 \times 10^9$ | LP/LUM/SST; $\tau_0^{air}$ = 2.8 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| 28.1.7. | Co$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.0 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; RT, ET | 77E693 |
| | Co$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $9.7 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 1.2 $\mu$s (747132); RT; S as NO$_3$$^-$ salt | 766020 |
| 28.1.8. | Co(DMG)$_2$(C$_2$H$_5$)(H$_2$O) | H$_2$O | 0.01 mol/L HClO$_4$ | | $1.2 \times 10^9$ | LP/LUM/SST; ET; S as NO$_3$$^-$ salt | 83E223 |
| 28.1.9. | Cr$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $3.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; ET | 77E693 |
| 28.1.10. | Cr(CO)$_6$ | Acetone or AN or THF | | | $4.2 \times 10^7$ | LP/LUM/SST, SS/LUM; RT; [Q] $\leq$ 3 $\times$ 10$^{-4}$ mol/L; S as NO$_3$$^-$ salt | 79F334 |
| 28.1.11. | Cr$_2$O$_7$$^{2-}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.3 \times 10^7$ | FP/LUM/SST; $\tau_0^{air}$ = 0.18 ms; ET | 77E693 |
| 28.1.12. | Cu$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $4.9 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; ET | 77E693 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1. UO$_2$$^{2+}$**—Continued | | | | | | | |
| | Cu$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $2.7 \times 10^6$ | SS/LUM; $\tau_0^{air}$ = 1.2 μs (747132); RT; S as NO$_3^-$ salt | 766020 |
| 28.1.13. | Er$^{3+}$ | H$_2$SO$_4$ (66%) | | 20 | $9.7 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 42 μs; ET; [Q] $\leq$ 0.005 mol/L | 68E121 |
| 28.1.14. | Eu$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; ET | 77E693 |
| | Eu$^{3+}$ | H$_2$O | 0.5 mol/L H$_3$PO$_4$ | | $6.8 \times 10^6$ | LP/LUM/SPC; $\tau_0^{und}$ = 0.19 ms; ET; [Q] = 0.0018-0.0051 mol/L | 84E828 |
| | Eu$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $4.2 \times 10^6$ | LP/LUM/SPC; $\tau_0^{und}$ = 0.19 ms; ET; [Q] = (8.8-51) $\times 10^{-4}$ mol/L | 84E828 |
| | Eu$^{3+}$ | H$_2$O | 2 mol/L H$_3$PO$_4$ | | $2.5 \times 10^6$ | LP/LUM/SPC; $\tau_0^{und}$ = 0.21 ms; ET; [Q] = 0.0018-0.0051 mol/L | 84E828 |
| | Eu$^{3+}$ | H$_2$O | 5 mol/L H$_3$PO$_4$ | | $1.0 \times 10^6$ | LP/LUM/SPC; $\tau_0^{und}$ = 0.21 ms; ET; [Q] = 0.0018-0.0051 mol/L | 84E828 |
| | Eu$^{3+}$ | H$_2$SO$_4$ (66%) | | 20 | $1.5 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 42 μs; ET; [Q] $\leq$ 0.005 mol/L | 68E121 |
| 28.1.15. | Fe$^{2+}$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $1.0 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 6.8 μs; RT | 77E693 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $1.8 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 11 μs; RT | 77E693 |
| | Fe$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.0 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; RT | 77E693 |
| | Fe$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $6.7 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 1.2 μs (747132); RT, ET; S as NO$_3^-$ salt | 766020 |
| | Fe$^{2+}$ | H$_2$O | 0.5 mol/L H$_3$PO$_4$ | | $4 \times 10^7$ | FP/LUM/SST, FP/ABS/SST; RT; [Q] = 1 $\times 10^{-4}$ mol/L | 727386 |
| 28.1.16. | Fe$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.5 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; ET | 77E693 |
| | Fe$^{3+}$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $2.2 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 6.8 μs; ET | 77E693 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2$$^{2+}$**—Continued | | | | | | |
| | Fe$^{3+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $<5 \times 10^7$ | SS/LUM; $\tau_0^{air}$ = 1.2 μs (747132); S as NO$_3^-$ salt | 766020 |
| 28.1.17. | Fe(C$_5$H$_5$)$_2$ | Acetone | | | $1.6 \times 10^{10}$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 μs; RT; S as NO$_3^-$ salt | 78E300 |
| 28.1.18. | Fe(C$_5$H$_5$)[C$_5$H$_4$C(O)CH$_3$] | Acetone | | | $4.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 μs; RT; S as NO$_3^-$ salt | 78E300 |
| 28.1.19. | Fe(C$_5$H$_5$)[C$_5$H$_4$C(O)C$_6$H$_5$] | Acetone | | | $4.5 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 μs; RT; S as NO$_3^-$ salt | 78E300 |
| 28.1.20. | Fe[C$_5$H$_4$C(O)CH$_3$]$_2$ | Acetone | | | $1.0 \times 10^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 μs; RT; S as NO$_3^-$ salt | 78E300 |
| 28.1.21. | Fe(CN)$_6$$^{3-}$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $9.8 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 6.8 μs | 77E693 |
| 28.1.22. | Fe(CN)$_6$$^{4-}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.2 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; RT | 77E693 |
| 28.1.23. | Fe(CO)$_5$ | Acetone or AN or THF | | | $4.8 \times 10^7$ | LP/LUM/SST, SS/LUM; RT; S as NO$_3^-$ salt | 79F334 |
| 28.1.24. | Ga$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $5.4 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms | 77E693 |
| 28.1.25. | Gd$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $4.7 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms | 77E693 |
| 28.1.26. | Ge(CH$_3$)$_4$ | Acetone | | | $1.8 \times 10^7$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.27. | Ge(C$_2$H$_5$)$_4$ | Acetone | | | $4.3 \times 10^7$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.28. | Hg$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.8 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms | 77E693 |
| | Hg$^{2+}$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $8.2 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 6.8 μs | 77E693 |
| 28.1.29. | Hg$_2$$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.8 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; RT | 77E693 |
| | Hg$_2$$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $1.0 \times 10^9$ | SS/LUM; $\tau_0^{air}$ = 1.2 μs (747132); RT; S as NO$_3^-$ salt | 766020 |
| | Hg$_2$$^{2+}$ | H$_2$O | pH 2.3; μ = 0.007 | | $2.3 \times 10^8$ | LP/LUM/SST; $\tau_0^{air}$ = 1.5 μs; RT; S as NO$_3^-$ salt | 81F325 |

TABLE 28. Quenching of excited uranium complexes—Continued

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| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2$$^{2+}$—Continued** | | | | | | |
| | Hg$_2$$^{2+}$ | H$_2$O | 1 mol/L HNO$_3$; $\mu$ = 1 | | $1.0 \times 10^9$ | LP/LUM/SST; $\tau_0$$^{air}$ = 2.8 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| | Hg$_2$$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$; $\mu$ = 0.09 | | $3.4 \times 10^9$ | LP/LUM/SST; $\tau_0$$^{air}$ = 0.16 ms; RT; S as NO$_3$$^-$ salt | 81F325 |
| 28.1.30. | Ho$^{3+}$ | H$_2$SO$_4$ (66%) | | 20 | $1.1 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 42 $\mu$s; ET; [Q] $\leq$ 0.005 mol/L | 68E121 |
| 28.1.31. | I$^-$ | H$_2$O | $\mu$ = 0 (extrap'd, HClO$_4$) | 25 | $5.6 \times 10^{10}$ | FP/LUM/SST, SS/LUM; RT | 766201 |
| | I$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.1 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0$$^{und}$ = 0.19 ms; RT | 766201 |
| | I$^-$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $6.9 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0$$^{und}$ = 6.8 $\mu$s; RT | 766201 |
| | I$^-$ | H$_2$O | pH 2.3; $\mu$ = 0.007 | | $1.4 \times 10^{10}$ | LP/LUM/SST; $\tau_0$$^{air}$ = 1.5 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| | I$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$; $\mu$ = 0.09 | | $2.1 \times 10^9$ | LP/LUM/SST; $\tau_0$$^{air}$ = 0.16 ms; RT; S as NO$_3$$^-$ salt; $k_q$ = 8 $\times$ 10$^8$ L mol$^{-1}$ s$^{-1}$ with FP/ABS/SST, FP/LUM/SST and $\tau_0$$^{air}$ = 0.17 $\mu$s from same lab in 767278 | 81F325 |
| | I$^-$ | H$_2$O | 1 mol/L HNO$_3$; $\mu$ = 1 | | $7.3 \times 10^9$ | LP/LUM/SST; $\tau_0$$^{air}$ = 2.8 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| 28.1.32. | In$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.7 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 0.18 ms | 77E693 |
| 28.1.33. | Mn$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.9 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 0.18 ms; RT, ET | 77E693 |
| | Mn$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $3.4 \times 10^6$ | SS/LUM; $\tau_0$$^{air}$ = 1.2 $\mu$s (747132); RT; S as NO$_3$$^-$ salt | 766020 |
| 28.1.34. | Mn$_2$(CO)$_{10}$ | Acetone or AN or THF | | | $3.8 \times 10^7$ | LP/LUM/SST, SS/LUM; RT; S as NO$_3$$^-$ salt | 79F334 |
| 28.1.35. | MnO$_4$$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.1 \times 10^8$ | FP/LUM/SST; $\tau_0$$^{air}$ = 0.18 ms; ET | 77E693 |
| 28.1.36. | Mo$^{VI}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $3.8 \times 10^4$ | FP/LUM/SST, SS/LUM; $\tau_0$$^{air}$ = 0.18 ms | 77E693 |
| 28.1.37. | Mo(CO)$_6$ | Acetone or AN or THF | | | $4.2 \times 10^7$ | LP/LUM/SST, SS/LUM; RT; S as NO$_3$$^-$ salt | 79F334 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2$$^{2+}$—Continued** | | | | | | |
| 28.1.38. | N$_2$H$_4$ | H$_2$O | 1.5 mol/L HNO$_3$ | | $7.6 \times 10^6$ | LP/LUM/SST, SS/LUM; $\tau_0^{und} = 1.3$ μs; RT; [Q] ≤ 0.25 mol/L; S as NO$_3^-$ salt | 84F157 |
| | N$_2$H$_4$ | H$_2$O | 3 mol/L HNO$_3$ | | $4.8 \times 10^6$ | LP/LUM/SST, SS/LUM; $\tau_0^{und} = 1.3$ μs; RT; [Q] ≤ 0.25 mol/L; S as NO$_3^-$ salt | 84F157 |
| 28.1.39. | Nd$^{3+}$ | H$_2$SO$_4$ (66%) | | 20 | $1.7 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 42 μs; ET; [Q] ≤ 0.005 mol/L | 68E121 |
| 28.1.40. | Ni$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $9.4 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms; ET | 77E693 |
| | Ni$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $5.5 \times 10^6$ | SS/LUM; $\tau_0^{air} = 1.2$ μs (747132); RT; S as NO$_3^-$ salt | 766020 |
| 28.1.41. | Ni(CO)$_4$ | Acetone or AN or THF | | | $1.6 \times 10^8$ | LP/LUM/SST, SS/LUM; RT; S as NO$_3^-$ salt | 79F334 |
| 28.1.42. | Os(C$_5$H$_5$)$_2$ | Acetone | | | $4.2 \times 10^7$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 μs; RT; S as NO$_3^-$ salt | 78E300 |
| 28.1.43. | Pb$^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.0 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms; RT | 77E693 |
| | Pb$^{2+}$ | H$_2$O | pH 2.0-2.5 (HNO$_3$) | | $3.2 \times 10^7$ | SS/LUM; $\tau_0^{air} = 1.2$ μs (747132); RT; S as NO$_3^-$ salt | 766020 |
| 28.1.44. | Pb(CH$_3$)$_4$ | Acetone | | | $2.8 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.45. | Pb(C$_2$H$_5$)$_4$ | Acetone | | | $5.7 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.46. | Pb(CH$_3$)(C$_2$H$_5$)$_3$ | Acetone | | | $5.5 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.47. | Pb(CH$_3$)$_2$(C$_2$H$_5$)$_2$ | Acetone | | | $5.5 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.48. | Pb(CH$_3$)$_3$(C$_2$H$_5$) | Acetone | | | $3.7 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.49. | Pr$^{3+}$ | H$_2$SO$_4$ (66%) | | 20 | $4.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 42 μs; ET; [Q] ≤ 0.005 mol/L | 68E121 |
| 28.1.50. | Pt(CN)$_4$$^{2-}$ | H$_2$O | μ = 2 (HClO$_4$ or H$_2$SO$_4$) | | $1 \times 10^9$ | EMI; RT | 85A469 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2$$^{2+}$**—Continued | | | | | | |
| 28.1.51. | Pt(C$_2$O$_4$)$_2$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$ or H$_2$SO$_4$) | | 8 × 10$^8$ | EMI; RT | 85A469 |
| 28.1.52. | Pt(en)$_2$$^{2+}$ | H$_2$O | $\mu$ = 2 (HClO$_4$ or H$_2$SO$_4$) | | 3 × 10$^9$ | EMI; RT | 85A469 |
| 28.1.53. | Pt(NH$_3$)$_4$$^{2+}$ | H$_2$O | $\mu$ = 2 (HClO$_4$ or H$_2$SO$_4$) | | 2 × 10$^9$ | EMI; RT | 85A469 |
| 28.1.54. | Pt(NO$_2$)$_4$$^{2-}$ | H$_2$O | $\mu$ = 2 (HClO$_4$ or H$_2$SO$_4$) | | 8 × 10$^8$ | EMI; RT | 85A469 |
| 28.1.55. | Ru(bpy)$_3$$^{2+}$ | H$_2$O | pH 2 (HNO$_3$) | | 3.7 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 3.2 $\mu$s; RT | 80A291 |
| | Ru(bpy)$_3$$^{2+}$ | H$_2$O | 2 mol/L H$_3$PO$_4$ | | 2.2 × 10$^9$ | LP/LUM/SST; $\tau_0$ = 30 $\mu$s; RT | 80A291 |
| 28.1.56. | Ru(C$_5$H$_5$)$_2$ | Acetone | | | 2.1 × 10$^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 $\mu$s; RT; [Q] ≤ 3 × 10$^{-5}$ mol/L; S as NO$_3$$^-$ salt | 78E300 |
| 28.1.57. | Ru(C$_5$H$_5$)[C$_5$H$_4$CH(OH)C$_6$H$_5$] | Acetone | | | 1.3 × 10$^9$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 $\mu$s; RT; S as NO$_3$$^-$ salt | 78E300 |
| 28.1.58. | Ru(C$_5$H$_5$)[C$_5$H$_4$C(O)C$_6$H$_5$] | Acetone | | | 5.7 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 $\mu$s; RT; S as NO$_3$$^-$ salt | 78E300 |
| 28.1.59. | Ru[C$_5$H$_4$C(O)C$_6$H$_5$]$_2$ | Acetone | | | 3.0 × 10$^8$ | LP/LUM/SST, SS/LUM; $\tau_0$ = 1.2 $\mu$s; RT; S as NO$_3$$^-$ salt | 78E300 |
| 28.1.60. | SCN$^-$ | H$_2$O | pH 2.3; $\mu$ = 0.007 | | 1.1 × 10$^{10}$ | LP/LUM/SST; $\tau_0$$^{air}$ = 1.5 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| | SCN$^-$ | H$_2$O | 1 mol/L H$_3$PO$_4$; $\mu$ = 0.09 | | 2.0 × 10$^9$ | LP/LUM/SST; $\tau_0$$^{air}$ = 0.16 ms; RT; S as NO$_3$$^-$ salt | 81F325 |
| | SCN$^-$ | H$_2$O | 1 mol/L HNO$_3$; $\mu$ = 1 | | 7.4 × 10$^9$ | LP/LUM/SST; $\tau_0$$^{air}$ = 2.8 $\mu$s; RT; S as NO$_3$$^-$ salt | 81F325 |
| 28.1.61. | Si(CH$_3$)$_1$ | Acetone | | | <2 × 10$^6$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.62. | Si(C$_2$H$_5$)$_1$ | Acetone | | | ~2 × 10$^7$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.63. | Si(CH$_3$)$_3$[C(CH$_3$)$_3$] | Acetone | | | 5.9 × 10$^7$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.64. | Si(CH$_3$)$_3$(C$_2$H$_5$) | Acetone | | | 9.6 × 10$^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L $mol^{-1}$ $s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **$UO_2^{2+}$—Continued** | | | | | | |
| 28.1.65. | $Sm^{3+}$ | $H_2SO_4$ (66%) | | 20 | $5.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 42 μs; ET; [Q] ≤ 0.005 mol/L | 68E121 |
| 28.1.66. | $Sn^{IV}$ | $H_2O$ | 1 mol/L $HClO_4$ | 25 | $1.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 6.8 μs | 77E693 |
| | $Sn^{IV}$ | $H_2O$ | 1 mol/L $H_3PO_4$ | 25 | $1.0 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms | 77E693 |
| 28.1.67. | $Sn^{2+}$ | $H_2O$ | 1 mol/L $H_3PO_4$ | 25 | $8.9 \times 10^8$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms; RT | 77E693 |
| 28.1.68. | $Sn(CH_3)_4$ | Acetone | | | $1.6 \times 10^8$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.69. | $Sn(C_2H_5)_4$ | Acetone | | | $1.7 \times 10^9$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.70. | $Sn[CH(CH_3)_2]_4$ | Acetone | | | $4.6 \times 10^9$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.71. | $Sn(CH_3)_3(C_2H_5)$ | Acetone | | | $5.6 \times 10^8$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.72. | $Sn(CH_2CH_2CH_3)_4$ | Acetone | | | $1.4 \times 10^9$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.73. | $Sn[CH(CH_3)CH_2CH_3]_4$ | Acetone | | | $3.0 \times 10^9$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.74. | $Sn(CH_2CH_2CH_2CH_3)_4$ | Acetone | | | $1.7 \times 10^9$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.75. | $Sn(CH_3)_3(CH_2CH_2CH_2CH_3)$ | Acetone | | | $8.0 \times 10^8$ | LF/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.76. | $Sr^{2+}$ | $H_2O$ | 1 mol/L $H_3PO_4$ | 25 | $1.5 \times 10^4$ | FF/LUM/SST, SS/LUM; $\tau_0^{air}$ = 0.18 ms | 77E693 |
| 28.1.77. | $Th^{IV}$ | $H_2O$ | 1 mol/L $H_2SO_4$ | 25 | $1.5 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0^{air}$ = 11 μs | 77E693 |
| 28.1.78. | $Tl^+$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 10 | $4.1 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 27 μs; [Q] = (1-20) × $10^{-5}$ mol/L; S as $SO_4^{2-}$ salt | 74F655 |
| | $Tl^+$ | $H_2O$ | 0.01 mol/L $HNO_3$; μ = 0.034 | 22 | $1.7 \times 10^9$ | LIF; $\tau_0^{und}$ = 1.6 μs; [Q] ≤ 1.5 × $10^{-4}$ mol/L | 81E789 |
| | $Tl^+$ | $H_2O$ | 0.5 mol/L $H_2SO_4$ | 22 | $5.2 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 12 μs; [Q] = (1-20) × $10^{-5}$ mol/L; S as $SO_4^{2-}$ salt | 74F655 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2^{2+}$**—Continued | | | | | | |
| | Tl$^+$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $4.5 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 6.8$ μs; RT | 77E693 |
| | Tl$^+$ | H$_2$O | 1 mol/L H$_2$SO$_4$ | 25 | $5.4 \times 10^3$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 11$ μs; RT | 77E693 |
| | Tl$^+$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $6.1 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms; RT | 77E693 |
| | Tl$^+$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 30 | $6.8 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 6.8 μs; [Q] = (1-20) $\times$ $10^{-5}$ mol/L; S as SO$_4^{2-}$ salt | 74F655 |
| | Tl$^+$ | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 40 | $8.6 \times 10^9$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 3.5 μs; [Q] = (1-20) $\times$ $10^{-5}$ mol/L; S as SO$_4^{2-}$ salt | 74F655 |
| | Tl$^+$ | H$_2$O | pH 2.3; μ = 0.007 | | $1.6 \times 10^6$ | LP/LUM/SST; $\tau_0^{air} = 1.5$ μs; RT; S as NO$_3^-$ salt | 81F325 |
| | Tl$^+$ | H$_2$O | 1 mol/L HNO$_3$; μ = 1 | | $2.3 \times 10^6$ | LP/LUM/SST; $\tau_0^{air} = 2.8$ μs; RT; S as NO$_3^-$ salt | 81F325 |
| | Tl$^+$ | H$_2$O | 1 mol/L H$_3$PO$_4$; μ = 0.09 | | $4.0 \times 10^6$ | LP/LUM/SST; $\tau_0^{air} = 0.16$ ms; RT; S as NO$_3^-$ salt | 81F325 |
| 28.1.79. | Tl$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $8.7 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms | 77E693 |
| | Tl$^{3+}$ | H$_2$O | 1 mol/L HClO$_4$ | 25 | $8.7 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 6.8$ μs | 77E693 |
| 28.1.80. | UO$_2^+$ | H$_2$O | 0.4 mol/L HClO$_4$; 2 mol/L LiClO$_4$ | 14 | $5 \times 10^9$ | SS/LUM; $\tau_0$ = 1.3 μs (747132); [Q] $\leq 2.7 \times 10^{-4}$ mol/L; Q formed in situ by the red'n of S with Eu$^{2+}$, see Mech. [4] | 75E452 |
| 28.1.81. | UO$_2^{2+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $3.4 \times 10^4$ | FP/LUM/SST | 77E693 |
| | UO$_2^{2+}$ | H$_2$O | 0.23 mol/L HClO$_4$ | | $4.0 \times 10^5$ | LP/ABS/SST; $\tau_0^{air} = 6.6$ μs; [Q] $\leq 2.0$ mol/L; $\tau_0$ extrap'd to [S] = 0; S as NO$_3^-$ salt | 75E295 |
| 28.1.82. | V$^V$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $2.4 \times 10^7$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms; ET | 77E693 |
| 28.1.83. | V(CO)$_6$ | Acetone or AN or THF | | | $5.8 \times 10^4$ | LP/LUM/SST, SS/LUM; RT; nonlinear S-V plot; S as NO$_3^-$ salt | 79F334 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1. UO$_2^{2+}$**—Continued | | | | | | | |
| 28.1.84. | W$^{VI}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $1.6 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms | 77E693 |
| 28.1.85. | W(CO)$_6$ | Acetone or AN or THF | | | $4.2 \times 10^7$ | LP/LUM/SST, SS/LUM; RT; S as NO$_3^-$ salt | 79F334 |
| 28.1.86. | Yb$^{3+}$ | H$_2$O | 1 mol/L H$_3$PO$_4$ | 25 | $6.5 \times 10^5$ | FP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.18$ ms | 77E693 |
| *Organic Quenchers* | | | | | | | |
| 28.1.87. | 2-Acetylthiophene | Acetone | 0.3 mol/L HClO$_4$ | | $7.9 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.88. | 3-Acetylthiophene | Acetone | 0.3 mol/L HClO$_4$ | | $5.3 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.89. | 2-Aminonaphthalene | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $6.4 \times 10^8$ | FP/ABS/SST; $\tau_0^{air} = 0.17$ ms; RT (30%) | 767278 |
| 28.1.90. | Aniline | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $8.7 \times 10^8$ | FP/ABS/SST; $\tau_0^{air} = 0.17$ ms | 767278 |
| 28.1.91. | Ascorbic acid | H$_2$O | 0.5 mol/L H$_3$PO$_4$ | | $1 \times 10^8$ | FP/LUM/SST, FP/ABS/SST; RT; [Q] = 5 $\times 10^{-5}$ mol/L | 727386 |
| | Ascorbic acid | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.8 \times 10^8$ | FP/ABS/SST; $\tau_0^{air} = 0.17$ ms; RT (29%) | 767278 |
| 28.1.92. | D-Asparagine | H$_2$O | 0.2 mol/L HClO$_4$ | | $2.5 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 86A101 |
| 28.1.93. | Benzene | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.6 \times 10^9$ | FP/ABS/SST; $\tau_0^{air} = 0.17$ ms | 767278 |
| 28.1.94. | Bromoform | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $\sim 2 \times 10^7$ | LP/LUM/SST; S as ClO$_4^-$ salt | 84A465 |
| 28.1.95. | 3-Bromopropionic acid | H$_2$O | 0.38 mol/L HClO$_4$ | | $1.1 \times 10^8$ | LP/ABS/SST; $\tau_0^{und} = 2.5$ µs; $k_q = 3.6 \times 10^7$ with SS/LUM; S as NO$_3^-$ salt | 756411 |
| 28.1.96. | Butanethiol | Acetone | 0.3 mol/L HClO$_4$ | | $1.8 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.97. | *tert*-Butyl alcohol | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $8.0 \times 10^7$ | FP/ABS/SST; $\tau_0^{air} = 0.17$ ms; [Q] = (1-10) $\times 10^{-3}$ mol/L; same $k_q$ from same lab in 747153 and 74A003 | 767278 |
| 28.1.98. | 1-Butyl bromide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $3.1 \times 10^7$ | LP/LUM/SST; S as ClO$_4^-$ salt | 84A465 |
| 28.1.99. | 2-Butyl bromide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $4.5 \times 10^7$ | LP/LUM/SST; S as ClO$_4^-$ salt | 84A465 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2$$^{2+}$**—Continued | | | | | | |
| 28.1.100. | 1-Butyl iodide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $1.1 \times 10^6$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.101. | CDTA | H$_2$O | 0.2 mol/L HClO$_4$ | | $6.2 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.102. | Chrysoidin | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $4 \times 10^9$ | FP/ABS/SST; $\tau_0^{air}$ = 0.17 ms | 767278 |
| 28.1.103. | Cyclobutanecarboxylic acid | H$_2$O | 0.23 mol/L HClO$_4$ | | $8.2 \times 10^6$ | LP/ABS/SST; $\tau_0^{und}$ = 2.5 µs; [Q] ≤ 0.3 mol/L; $k_q$ = 6.7 $\times$ 10$^6$ with SS/LUM; S as NO$_3$$^-$ salt | 756411 |
| 28.1.104. | Cyclohexanecarboxylic acid | H$_2$O | 0.23 mol/L HClO$_4$ | | $6.7 \times 10^7$ | LP/ABS/SST; $\tau_0^{und}$ = 2.5 µs; $k_q$ = 3.6 $\times$ 10$^7$ with SS/LUM; S as NO$_3$$^-$ salt | 756411 |
| 28.1.105. | Cyclohexanol | H$_2$O | | | $2.9 \times 10^8$ | LP/ABS/SST; $\tau_0^{und}$ = 1.2 µs; HA; S as ClO$_4$$^-$ salt | 747132 |
| 28.1.106. | Cyclohexanol-$d_{11}$ | D$_2$O | | | $1.3 \times 10^8$ | LP/ABS/SST; $\tau_0^{und}$ = 2.4 µs; HA; S as ClO$_4$$^-$ salt | 747132 |
| 28.1.107. | Cyclohexene | H$_2$O/Acetone (1.1/1) | 0.38 mol/L HClO$_4$ | | $1.6 \times 10^6$ | LP/ABS/SST, SS/LUM; $\tau_0^{und}$ = 0.88 µs; EX; S as NO$_3$$^-$ salt | 756411 |
| 28.1.108. | Cyclopentanecarboxylic acid | H$_2$O | 0.23 mol/L HClO$_4$ | | $3.8 \times 10^7$ | LP/ABS/SST; $\tau_0^{und}$ = 2.5 µs; $k_q$ = 1.5 $\times$ 10$^7$ with SS/LUM; S as NO$_3$$^-$ salt | 756411 |
| 28.1.109. | Cyclopropanecarboxylic acid | H$_2$O | 0.23 mol/L HClO$_4$ | | $2.6 \times 10^6$ | LP/ABS/SST, SS/LUM; $\tau_0^{und}$ = 2.5 µs; S as NO$_3$$^-$ salt | 756411 |
| 28.1.110. | Cysteine | H$_2$O | 0.2 mol/L HClO$_4$ | | $7.5 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.111. | L-Cystine | H$_2$O | 0.2 mol/L HClO$_4$ | | $5.7 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.112. | Di-$n$-butyl sulfide | AN/H$_2$O (3/1) | 0.1 mol/L HClO$_4$ | | $9.6 \times 10^8$ | LP/LUM/SST; RT; S as NO$_3$$^-$ salt; some SQ | 86F357 |
| | Di-$n$-butyl sulfide | Acetone | 0.3 mol/L HClO$_4$ | | $1.4 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| | Di-$n$-butyl sulfide | Acetone/H$_2$O (1.3/1) | 0.1 mol/L H$_2$SO$_4$ | | $3.1 \times 10^8$ | SS/LUM; $\tau_0^{und}$ = 3.5 µs (LP/LUM/SST); RT; S as CH$_3$CO$_2$$^-$ salt | 86F357 |
| 28.1.113. | Diethyl sulfide | AN/H$_2$O (3/1) | 0.1 mol/L HClO$_4$ | | $1.7 \times 10^6$ | LP/LUM/SST; RT; S as NO$_3$$^-$ salt; some SQ | 86F357 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **28.1.** | **UO$_2$$^{2+}$**—Continued | | | | | | |
| | Diethyl sulfide | Acetone/H$_2$O (9/1) | 0.1 mol/L H$_2$SO$_4$ | | $4.0 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 3.5 μs; RT; S as CH$_3$CO$_2^-$ salt; $K_{SV}$ from 84F346; $k_q$ may not have been corrected for SQ | 86F357 |
| 28.1.114. | 1,4-Dihydroxybenzene | H$_2$O | 0.5 mol/L H$_3$PO$_4$ | | $8 \times 10^8$ | FP/LUM/SST, FP/ABS/SST; RT; [Q] = 1 $\times$ 10$^{-5}$ mol/L | 727386 |
| | 1,4-Dihydroxybenzene | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.0 \times 10^9$ | FP/ABS/SST, FP/LUM/SST; $\tau_0^{air}$ = 0.17 ms | 767278 |
| 28.1.115. | Dimethyl disulfide | Acetone | 0.3 mol/L HClO$_4$ | | $2.8 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.116. | Dimethyl sulfide | AN/H$_2$O (3/1) | 0.1 mol/L HClO$_4$ | | $4.1 \times 10^9$ | LP/LUM/SST; RT; S as NO$_3^-$ salt; some SQ | 86F357 |
| 28.1.117. | 1,4-Dioxane | H$_2$O | 0.38 mol/L HClO$_4$ | | $1.6 \times 10^8$ | LP/ABS/SST; $\tau_0^{und}$ = 2.5 μs; $k_q$ = 9.7 $\times$ 10$^7$ with SS/LUM; S as NO$_3^-$ salt | 756411 |
| 28.1.118. | Diphenylamine | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.1 \times 10^9$ | FP/ABS/SST; $\tau_0^{air}$ = 0.17 ms; RT | 767278 |
| 28.1.119. | Di-$n$-propyl sulfide | AN/H$_2$O (3/1) | 0.1 mol/L HClO$_4$ | | $1.2 \times 10^9$ | LP/LUM/SST; RT; [Q] $\leq$ 8 $\times$ 10$^{-4}$ mol/L; S as NO$_3^-$ salt; some SQ | 86F357 |
| | Di-$n$-propyl sulfide | Acetone/H$_2$O (9/1) | 0.1 mol/L H$_2$SO$_4$ | | $2.3 \times 10^8$ | SS/LUM; $\tau_0^{air}$ = 3.5 μs; RT; S as CH$_3$CO$_2^-$ salt; $K_{SV}$ from 84F346; $k_q$ may not have been corrected for SQ | 86F357 |
| 28.1.120. | 1,3-Dithiane | Acetone | 0.3 mol/L HClO$_4$ | | $2.1 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.121. | 1,4-Dithiane | Acetone | 0.3 mol/L HClO$_4$ | | $1.6 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 84A465 |
| 28.1.122. | EDTA | H$_2$O | 0.2 mol/L HClO$_4$ | | $4.8 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4^-$ salt | 86A101 |
| 28.1.123. | Ethanol | H$_2$O | 0.5 mol/L H$_3$PO$_4$ | | $2 \times 10^8$ | FP/LUM/SST, FP/ABS/SST; RT; [Q] = 3 $\times$ 10$^{-5}$ mol/L | 727386 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **UO$_2$$^{2+}$—Continued** | | | | | | |
| | Ethanol | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.4 \times 10^9$ | FP/ABS/SST, FP/LUM/SST; $\tau_0^{air}$ = 0.17 ms; RT (20%); [Q] = (1-10) $\times$ 10$^{-6}$ mol/L; same $k_q$ from same lab in 747153 and 74A003 | 767278 |
| 28.1.124. | Ethyl bromide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $3.3 \times 10^7$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.125. | Ethylene sulfide | Acetone | 0.3 mol/L HClO$_4$ | | $2.1 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.126. | Ethyl iodide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $8.5 \times 10^8$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.127. | 2-Ethylthiophene | Acetone | 0.3 mol/L HClO$_4$ | | $1.5 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.128. | Formic acid | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.1 \times 10^6$ | FP/ABS/SST; $\tau_0^{air}$ = 0.17 ms | 767278 |
| 28.1.129. | L-Glutamine | H$_2$O | 0.2 mol/L HClO$_4$ | | $2.5 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.130. | Histidine | H$_2$O | 0.2 mol/L HClO$_4$ | | $1.8 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.131. | Isoleucine | H$_2$O | 0.2 mol/L HClO$_4$ | | $4.8 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.132. | Lactic acid | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 10 | $2.8 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 27 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO$_4$$^{2-}$ salt | 74F655 |
| | Lactic acid | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 22 | $4.1 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 12 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO$_4$$^{2-}$ salt | 74F655 |
| | Lactic acid | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 30 | $5.6 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 6.8 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO$_4$$^{2-}$ salt | 74F655 |
| | Lactic acid | H$_2$O | 0.5 mol/L H$_2$SO$_4$ | 40 | $8.2 \times 10^6$ | FP/LUM/SST, SS/LUM; $\tau_0$ = 3.5 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO$_4$$^{2-}$ salt | 74F655 |
| 28.1.133. | DL-Leucine | H$_2$O | 0.2 mol/L HClO$_4$ | | $5.7 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1. $UO_2{}^{2+}$**—Continued | | | | | | | |
| 28.1.134. Methanol | | $H_2O$ | | | $6.4 \times 10^6$ | LP/ABS/SST; $\tau_0{}^{und} = 1.2$ µs; HA; [Q] $\leq$ 0.5 mol/L; $k_q = 4.5 \times 10^6$ with SL/LUM/SPC; S as $ClO_4{}^-$ salt | 747132 |
| | Methanol | $H_2O$ | 1 mol/L $H_2SO_4$ | | $1.5 \times 10^6$ | FP/ABS/SST; $\tau_0{}^{air} = 67$ µs; RT (13%); [Q] = (1-10) $\times 10^{-6}$ mol/L; same $k_q$ from same lab in 747153 | 767278 |
| | Methanol | $H_2O$ | 1 mol/L $H_3PO_4$ | | $7.1 \times 10^6$ | FP/ABS/SST; $\tau_0{}^{air} = 0.17$ ms; RT (20%); [Q] = (1-10) $\times 10^{-6}$ mol/L; same $k_q$ from same lab in 747153 and 7 | 767278 |
| | Methanol | $H_2O$ | 1 mol/L $HClO_4$ | | $5.3 \times 10^6$ | FP/ABS/SST; $\tau_0{}^{air} = 17$ µs; RT (72%); [Q] = (1-10) $\times 10^{-6}$ mol/L; same $k_q$ from same lab in 747153 | 767278 |
| 28.1.135. Methanol-$d_1$ | | $D_2O$ | | | $6.5 \times 10^6$ | LP/ABS/SST; $\tau_0{}^{und} = 2.4$ µs; HA; S as $ClO_4{}^-$ salt | 747132 |
| 28.1.136. Methanol-$d_3$ | | $H_2O$ | | | $2.3 \times 10^6$ | LP/ABS/SST; $\tau_0{}^{und} = 1.2$ µs; HA; [Q] $\leq$ 2.2 mol/L; $k_q = 1.7 \times 10^6$ with SL/LUM/SPC; S as $ClO_4{}^-$ salt | 747132 |
| 28.1.137. Methanol-$d_1$ | | $D_2O$ | | | $2.7 \times 10^6$ | LP/ABS/SST; $\tau_0{}^{und} = 2.4$ µs; HA; S as $ClO_4{}^-$ salt | 747132 |
| 28.1.138. DL-Methionine | | $H_2O$ | 0.2 mol/L $HClO_4$ | | $1.3 \times 10^9$ | LP/LUM/SST; RT; S as $ClO_4{}^-$ salt | 86A101 |
| 28.1.139. Methyl iodide | | $H_2O$/Acetone (1/1) | 0.3 mol/L $HClO_4$ | | $5.1 \times 10^8$ | LP/LUM/SST; S as $ClO_4{}^-$ salt | 84A465 |
| 28.1.140. Methylthioacetonitrile | | Acetone | 0.3 mol/L $HClO_4$ | | $1.8 \times 10^9$ | LP/LUM/SST; RT; S as $ClO_4{}^-$ salt | 84A465 |
| 28.1.141. Methyl thiocyanate | | Acetone | 0.3 mol/L $HClO_4$ | | $3.9 \times 10^8$ | LP/LUM/SST; RT; S as $ClO_4{}^-$ salt | 84A465 |
| 28.1.142. 2-Naphthol | | $H_2O$ | 1 mol/L $H_3PO_4$ | | $9.9 \times 10^7$ | FP/ABS/SST; $\tau_0{}^{air} = 0.17$ ms; RT | 767278 |
| 28.1.143. Oxalic acid | | $H_2O$ | 1 mol/L $H_3PO_4$ | | $1.6 \times 10^5$ | FP/ABS/SST; $\tau_0{}^{air} = 0.17$ ms | 767278 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1. UO$_2$$^{2+}$**—Continued | | | | | | | |
| 28.1.144. | Pentamethylene sulfide | Acetone | 0.3 mol/L HClO$_4$ | | $1.7 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.145. | Pent-4-enoic acid | H$_2$O/Acetone (1.1/1) | 0.38 mol/L HClO$_4$ | | $1.2 \times 10^9$ | LP/ABS/SST; $\tau_0$$^{und}$ = 0.88 $\mu$s; $k_q$ = 1.7 $\times$ 10$^9$ with SS/LUM; S as NO$_3$$^-$ salt | 756411 |
| 28.1.146. | Phenol | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $1.7 \times 10^8$ | FP/ABS/SST; $\tau_0$$^{air}$ = 0.17 ms; RT (35%) | 767278 |
| 28.1.147. | L-Phenylalanine | H$_2$O | 0.2 mol/L HClO$_4$ | | $7.9 \times 10^8$ | LP/LUM/SST; RT; [Q] $\leq$ 0.0035 mol/L; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.148. | Propanethiol | Acetone | 0.3 mol/L HClO$_4$ | | $1.4 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.149. | 2-Propanol | H$_2$O | | | $8.5 \times 10^7$ | LP/ABS/SST; $\tau_0$$^{und}$ = 1.2 $\mu$s; HA; S as ClO$_4$$^-$ salt | 747132 |
| | 2-Propanol | H$_2$O | 1 mol/L H$_3$PO$_4$ | | $2.3 \times 10^9$ | FP/ABS/SST; $\tau_0$$^{air}$ = 0.17 ms; RT (23%); [Q] = (1-10) $\times$ 10$^{-6}$ mol/L; same $k_q$ from same lab in 747153 and 7 | 767278 |
| 28.1.150. | 2-Propanol-2-d | H$_2$O | | | $3.5 \times 10^7$ | LP/ABS/SST; $\tau_0$$^{und}$ = 1.2 $\mu$s; HA; S as ClO$_4$$^-$ salt | 747132 |
| 28.1.151. | 1-Propyl bromide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $2.7 \times 10^7$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.152. | 2-Propyl bromide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $3.9 \times 10^7$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.153. | 1-Propyl iodide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $1.1 \times 10^9$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.154. | 2-Propyl iodide | H$_2$O/Acetone (1/1) | 0.3 mol/L HClO$_4$ | | $1.3 \times 10^9$ | LP/LUM/SST; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.155. | 2-Propylthiophene | Acetone | 0.3 mol/L HClO$_4$ | | $1.9 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.156. | Serine | H$_2$O | 0.2 mol/L HClO$_4$ | | $1.9 \times 10^6$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 86A101 |
| 28.1.157. | Tetramethylene sulfide | Acetone | 0.3 mol/L HClO$_4$ | | $1.8 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.158. | Thiolacetic acid | Acetone | 0.3 mol/L HClO$_4$ | | $4.8 \times 10^8$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |
| 28.1.159. | Thiophene | Acetone | 0.3 mol/L HClO$_4$ | | $1.5 \times 10^9$ | LP/LUM/SST; RT; S as ClO$_4$$^-$ salt | 84A465 |

TABLE 28. Quenching of excited uranium complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L $mol^{-1}$ $s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **28.1.** | **$UO_2^{2+}$—Continued** | | | | | | |
| 28.1.160. | Thiophene-2-carbonitrile | Acetone | 0.3 mol/L $HClO_4$ | | $2.4 \times 10^8$ | LP/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.161. | Threonine | $H_2O$ | 0.2 mol/L $HClO_4$ | | $4.3 \times 10^6$ | LP/LUM/SST; RT; S as $ClO_4^-$ salt | 86A101 |
| 28.1.162. | Trimethylene sulfide | Acetone | 0.3 mol/L $HClO_4$ | | $2.8 \times 10^9$ | LP/LUM/SST; RT; S as $ClO_4^-$ salt | 84A465 |
| 28.1.163. | Triton X-100 | $H_2O$ | | 22 | $1.5 \times 10^9$ | LP/LUM/SST; [Q] $\leq 2 \times 10^{-4}$ mol/L; [Q] below CMC; S as $NO_3^-$ salt | 85N143 |
| 28.1.164. | L-Tryptophan | $H_2O$ | 0.2 mol/L $HClO_4$ | | $3.0 \times 10^9$ | LP/LUM/SST; RT; S as $ClO_4^-$ salt | 86A101 |
| 28.1.165. | Tyrosine | $H_2O$ | 0.2 mol/L $HClO_4$ | | $1.7 \times 10^9$ | LP/LUM/SST; RT; S as $ClO_4^-$ salt | 86A101 |
| 28.1.166. | DL-Valine | $H_2O$ | 0.2 mol/L $HClO_4$ | | $1.1 \times 10^6$ | LP/LUM/SST; RT; S as $ClO_4^-$ salt | 86A101 |

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TABLE 29. Quenching of excited zinc complexes

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.1. Zn(etioporphyrin I)(pyridine) [singlet]** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.1.1. | *cis*-4-Nitrostilbene | Benzene | 0.005 mol/L py | | $4.2 \times 10^9$ | SS/LUM; $\tau_0 = 4$ ns (assumed); EX; nonlinear S-V plot at high [Q] | 707320 |
| **29.2. Zn(etioporphyrin I)(pyridine) [triplet]** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.2.1. | *cis*-4-Nitrostilbene | Benzene | 0.005 mol/L py | | $2.6 \times 10^7$ | FP/ABS/SST; EX | 707320 |
| **29.3. Zn(etioporphyrin I) [singlet]** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.3.1. | 1,4-Benzoquinone | Benzene | | | $1.3 \times 10^{10}$ (calc) | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX | 68A001 |
| 29.3.2. | 1-Methoxy-4-nitrobenzene | EtOH | | | $6.0 \times 10^9$ (calc) | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX | 68A001 |
| 29.3.3. | 4-Nitroaniline | Benzene | | | $4.9 \times 10^9$ (calc) | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX | 68A001 |
| 29.3.4. | Nitrobenzene | Benzene | | | $3.4 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX | 68A001 |
| | Nitrobenzene | Benzene | 1 mol/L PPh$_3$ | | $2.8 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX; S partially bound to PPh$_3$ | 68A001 |
| | Nitrobenzene | EtOH | | | $7.3 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX; [Q] ≤ 0.20 mol/L | 68A001 |
| | Nitrobenzene | MeCH | | | $4.8 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX | 68A001 |
| | Nitrobenzene | Piperidine | | | $3.4 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX; [Q] ≤ 0.20 mol/L | 68A001 |
| 29.3.5. | *cis*-4-Nitrostilbene | Benzene | | | $3.7 \times 10^9$ | SS/LUM; $\tau_0 = 4$ ns (LP/LUM/SST); EX; nonlinear S-V plot at high [Q]; $K_{SV} = 29$ L/mol in 68A001 | 707320 |
| 29.3.6. | *trans*-4-Nitrostilbene | Benzene | | | $8.9 \times 10^9$ | SS/LUM; $\tau_0 = 4$ ns (LP/LUM/SST); EX; nonlinear S-V plot at high [Q] | 707320 |
| 29.3.7. | 4-Nitrotoluene | EtOH | | | $7.2 \times 10^9$ (calc) | SS/LUM; $\tau_0 = 4.3$ ns (assumed); EX | 68A001 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.4.** | **Zn(etioporphyrin I) [triplet]** | | | | | | |
| | *Organic Quenchers* | | | | | | |
| 29.4.1. | Azulene | Benzene | 0.01 mol/L 4-nitrotoluene | | $2.6 \times 10^9$ | FP/ABS/SST; ET; S* is an exciplex with nitrotoluene | 72E284 |
| 29.4.2. | α-Bromo-4-nitrotoluene | Benzene | | 25 | $1.5 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.4.3. | Carbon tetrachloride | Benzene | | 25 | $3 \times 10^7$ | FP/ABS/SST; $E_a$ = 14 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −54 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| | Carbon tetrachloride | Benzene | | 25 | $\leq 2 \times 10^5$ | FP/ABS/SST; see also 85E593 | 82A389 |
| 29.4.4. | 1-Chloro-4-nitrobenzene | Benzene | | 25 | $2.4 \times 10^9$ | FP/ABS/SST; $E_a$ = 1.9 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −71 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.4.5. | DDT | Benzene | | 25 | $8.2 \times 10^7$ | FP/ABS/SST; $E_a$ = 5.9 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −96 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; τ constant at higher [Q] | 747293 |
| | DDT | Benzene | | 25 | $\leq 1 \times 10^6$ | FP/ABS/SST; see also 85E593 | 82A389 |
| 29.4.6. | 1,4-Dichlorobenzene | Benzene | | 25 | $4 \times 10^7$ | FP/ABS/SST; $E_a$ = 13 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −67 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; τ increases at higher [Q] | 747293 |
| 29.4.7. | 1,4-Dinitrobenzene | Benzene | | 25 | $4.2 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.4.8. | cis-4,4′-Dinitrostilbene | Benzene | | 25 | $3.1 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; same $k_q$ from same lab in 707320; τ increases at higher [Q] | 747293 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.4.** | **Zn(etioporphyrin I) [triplet]**—Continued | | | | | | |
| 29.4.9. | *trans*-4,4'-Dinitrostilbene | Benzene | | | $2.7 \times 10^9$ | FP/ABS/SST; EX | 707320 |
| 29.4.10. | Hexachlorobenzene | Benzene | | 25 | $6.7 \times 10^7$ | FP/ABS/SST; $E_a$ = 6.3 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −88 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; $\tau$ increases at higher [Q] | 747293 |
| | Hexachlorobenzene | Benzene | | 25 | $\leq 5 \times 10^3$ | FP/ABS/SST; see also 85E593 | 82A389 |
| 29.4.11. | Hexachloroethane | Benzene | | 25 | $1.4 \times 10^8$ | FP/ABS/SST; $E_a$ = 5.0 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −100 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; $\tau$ constant at higher [Q] | 747293 |
| | Hexachloroethane | Benzene | | 25 | $3.8 \times 10^4$ | FP/ABS/SST; see also 85E593 | 82A389 |
| 29.4.12. | 1-Methoxy-4-nitrobenzene | Benzene | | 25 | $1.0 \times 10^9$ | FP/ABS/SST; $E_a$ = 2.1 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −59 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; $\tau$ increases at higher [Q] | 747293 |
| 29.4.13. | Naphthacene | Benzene | 0.01 mol/L 4-nitrotoluene | | $5.1 \times 10^8$ | FP/ABS/SST; ET; S* is an exciplex with nitrotoluene | 72E284 |
| 29.4.14. | 4-Nitroaniline | Benzene | | 25 | $1.2 \times 10^8$ | FP/ABS/SST; $E_a$ = 3.1 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −71 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.4.15. | 9-Nitroanthracene | Benzene | | 25 | $4.5 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.4.16. | 4-Nitrobenzaldehyde | Benzene | | 25 | $3.4 \times 10^9$ | FP/ABS/SST; $E_a$ = 1.5 kJ/mol (20-78°C); $\Delta S^\ddagger$ = −71 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.4. Zn(etioporphyrin I) [triplet]—Continued** | | | | | | | |
| 29.4.17. | Nitrobenzene | Benzene | | 25 | $2.0 \times 10^9$ | FP/ABS/SST; $E_a$ = 3.9 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −67 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; $\tau$ constant at higher [Q] | 747293 |
| 29.4.18. | *trans*-4-Nitro-β-methylstilbene | Benzene | | 25 | $2.0 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.4.19. | *cis*-4-Nitrostilbene | Benzene | | | $1.7 \times 10^9$ | FP/ABS/SST; EX | 707320 |
| 29.4.20. | *trans*-4-Nitrostilbene | Benzene | | 25 | $1.6 \times 10^9$ | FP/ABS/SST; $E_a$ = 5.6 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; same $k_q$ from same lab in 707320; $\tau$ increases at higher [Q] | 747293 |
| 29.4.21. | 4-Nitrotoluene | Benzene | | 25 | $3.0 \times 10^9$ | FP/ABS/SST; $E_a$ = 2.0 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10$^{-5}$ mol/L; same $k_q$ from same lab in 72E284; $\tau$ increases at higher [Q] | 747293 |
| | 4-Nitrotoluene | Benzene | | 25 | $3.3 \times 10^9$ | FP/ABS/SST; EX?; see also 85E593 | 82A389 |
| | 4-Nitrotoluene | Benzene | 0.01 mol/L MF | | $2 \times 10^8$ | FP/ABS/SST; OT? | 72E284 |
| | 4-Nitrotoluene | MF | | | $1.3 \times 10^8$ | FP/ABS/SST; OT? | 72E284 |
| 29.4.22. | Perylene | Benzene | 0.01 mol/L 4-nitrotoluene | | $1.3 \times 10^9$ | FP/ABS/SST; ET; S* is an exciplex with nitrotoluene | 72E284 |
| 29.4.23. | 1,2,4,5-Tetrachlorobenzene | Benzene | | 25 | $\leq 1 \times 10^3$ | FP/ABS/SST; see also 85E593 | 82A389 |
| **29.5. Zn(mesoporphyrin IX dimethyl ester) [singlet]** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.5.1. | *cis*-4,4'-Dinitrostilbene | Benzene | | | $8.1 \times 10^9$ | SS/LUM; $\tau_0$ = 4.3 ns (67E121); EX; nonlinear S-V plot at high [Q] | 707320 |
| | *cis*-4,4'-Dinitrostilbene | EtOH | | | $1.3 \times 10^{10}$ | SS/LUM; $\tau_0$ = 4.3 ns (67E121); EX; nonlinear S-V plot at high [Q] | 707320 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.5.** | **Zn(mesoporphyrin IX dimethyl ester) [singlet]—Continued** | | | | | | |
| 29.5.2. | cis-4-Nitrostilbene | Benzene | | | $3.9 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (67E121); EX; nonlinear S-V plot at high [Q] | 707320 |
| | cis-4-Nitrostilbene | EtOH | | | $7.2 \times 10^9$ | SS/LUM; $\tau_0 = 4.3$ ns (67E121); EX; nonlinear S-V plot at high [Q] | 707320 |
| **29.6.** | **Zn(mesoporphyrin IX dimethyl ester) [triplet]** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.6.1. | $O_2$ | Toluene | | | $3.4 \times 10^9$ | LP/ABS/SST; ET; [Q] = 0.0011 mol/L | 81E738 |
| **29.7.** | **Zn[5-(1-methylpyridinium-4-yl)-10,15,20-tris(4-tolyl)porphyrin]$^+$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.7.1. | $MV^{2+}$ | EtOH | | | $2.1 \times 10^7$ | FP/ABS/SST; $\tau_0 = 0.57$ ms; OT; $f = 0.11$ | 82A161 |
| **29.8.** | **Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [singlet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.8.1. | Acrylamide | AN | | | $5.7 \times 10^8$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM) | 84F091 |
| 29.8.2. | 1-Aminonaphthalene | AN | | | $2.5 \times 10^9$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); RT | 84F091 |
| 29.8.3. | 2-Aminophenol | AN | | | $3.5 \times 10^9$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); RT | 84F091 |
| 29.8.4. | 9,10-Anthraquinone | Toluene | | | $2.0 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 1.9$ ns (MS/LUM/PM) | 84F091 |
| 29.8.5. | Benzaldehyde | AN | | | $1.6 \times 10^9$ | SS/LUM, MS/LUM/PM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); OT | 84F091 |
| | Benzaldehyde | Toluene | | | $1.0 \times 10^9$ | SS/LUM; $\tau_0^{air} = 1.9$ ns (MS/LUM/PM) | 84F091 |
| 29.8.6. | Benzoic acid | AN | | | $7 \times 10^8$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM) | 84F091 |
| 29.8.7. | 1,4-Benzoquinone | AN | | | $1.8 \times 10^{10}$ | SS/LUM, MS/LUM/PM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); OT | 84F091 |
| | 1,4-Benzoquinone | Toluene | | | $2.2 \times 10^{10}$ | SS/LUM, MS/LUM/PM; $\tau_0^{air} = 1.9$ ns (MS/LUM/PM) | 84F091 |
| 29.8.8. | 1,4-Diaminobenzene | AN | | | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); RT | 84F091 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.8.** | **Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [singlet]—Continued** | | | | | | |
| 29.8.9. | N,N-Diethylaniline | AN | | | $7 \times 10^8$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); RT? | 84F091 |
| | N,N-Diethylaniline | Toluene | | | $6 \times 10^8$ | SS/LUM; $\tau_0^{air} = 1.9$ ns (MS/LUM/PM) | 84F091 |
| 29.8.10. | 1,4-Dihydroxybenzene | AN | | | $1.7 \times 10^9$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM) | 84F091 |
| 29.8.11. | 3,4-Dimethylphenol | AN | | | $1.8 \times 10^9$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); RT | 84F091 |
| 29.8.12. | Naphthalene | AN | | | $<1 \times 10^7$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM) | 84F091 |
| 29.8.13. | 1-Naphthol | AN | | | $1.3 \times 10^9$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM) | 84F091 |
| 29.8.14. | 1,4-Naphthoquinone | AN | | | $2.0 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); OT | 84F091 |
| | 1,4-Naphthoquinone | Toluene | | | $1.7 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 1.9$ ns (MS/LUM/PM) | 84F091 |
| 29.8.15. | Phenol | AN | | | $3.3 \times 10^8$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM) | 84F091 |
| 29.8.16. | Tetramethyl-1,4-benzoquinone | AN | | | $1.6 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 2.1$ ns (MS/LUM/PM); OT | 84F091 |
| | Tetramethyl-1,4-benzoquinone | Toluene | | | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 1.9$ ns (MS/LUM/PM) | 84F091 |
| **29.9.** | **Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet]** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.9.1. | Zn(OEP) | $1,2\text{-}C_2H_4Cl_2$ | | 25 | $2.0 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | 1,2-Dichloro-benzene | | 25 | $2.7 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | 1-Chloro-naphthalene | | 25 | $2.0 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | AN | | 25 | $2.0 \times 10^8$ | LP/ECM/AVE; $\tau_0 = \sim16$ ms; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Anisole | | 25 | $2.3 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Benzene | | 25 | $\sim2 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **29.9.** | **Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet]—Continued** | | | | | | |
| | Zn(OEP) | Butyronitrile | | 25 | $2.2 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | DMSO | | 25 | $4.0 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Di-$i$-propyl ether | | 25 | $2.3 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Di-$n$-pentyl ether | | 25 | $1.8 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Di-$n$-butyl ether | | 25 | $1.8 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Diethyl ether | | 25 | $2.0 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Ethyl acetate | | 25 | $1.6 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | MP | | 25 | $1.4 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Propionitrile | | 25 | $2.3 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | THF | | 25 | $1.6 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| | Zn(OEP) | Toluene | | 24 | $1.1 \times 10^7$ | LP/ABS/SST (decay of delayed fluorescence); [Q] $\leq$ $9 \times 10^{-6}$ mol/L; $k_q =$ ~2 $\times 10^8$ L mol$^-$ s$^-$ at 25 °C with LP/ECM/AVE (see Mech. [8] in 80A023) | 82E152 |
| | Zn(OEP) | $N$-Methyl valeronitrile | | 25 | $2.2 \times 10^8$ | LP/ECM/AVE; OT or RT; see Mech. [8] | 80A023 |
| *Organic Quenchers* | | | | | | | |
| 29.9.2. | 1,4-Benzoquinone | Toluene | | −50 | $3.0 \times 10^9$ | LP/ABS/SST (decay of delayed fluorescence); OT; [Q] = (9.5-25) $\times 10^{-8}$ mol/L | 82E152 |
| | 1,4-Benzoquinone | Toluene | | −25 | $5.0 \times 10^9$ | LP/ABS/SST (decay of delayed fluorescence); OT; [Q] = (9.5-25) $\times 10^{-8}$ mol/L | 82E152 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ $/L\ mol^{-1}\ s^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.9.** | **Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet]—Continued** | | | | | | |
| | 1,4-Benzoquinone | Toluene | | 0 | $6.7 \times 10^9$ | LP/ABS/SST (decay of delayed fluorescence); OT; [Q] = (9.5-25) × $10^{-8}$ mol/L | 82E152 |
| | 1,4-Benzoquinone | Toluene | | 24 | $9.0 \times 10^9$ | LP/ABS/SST (decay of delayed fluorescence); $E_a$ = 9.4 kJ/mol (−50 to 24°C); OT; [Q] = (9.5-25) × $10^{-8}$ mol/L | 82E152 |
| 29.9.3. | 1-Chloro-4-nitrobenzene | Benzene | | 25 | $1.3 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × $10^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.9.4. | DDT | Benzene | | 25 | $3 \times 10^7$ | FP/ABS/SST; $E_a$ = 13 kJ/mol (20-78°C); $\Delta S^‡$ = −67 J/mol·K; EX; [Q] = (1-50) × $10^{-5}$ mol/L; $\tau$ constant at higher [Q] | 747293 |
| 29.9.5. | Hexachlorobenzene | Benzene | | 25 | $4 \times 10^7$ | FP/ABS/SST; $E_a$ = 46 kJ/mol (20-78°C); EX; [Q] = (1-50) × $10^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.9.6. | Hexachloroethane | Benzene | | 25 | $7.1 \times 10^8$ | FP/ABS/SST; EX; [Q] = (1-50) × $10^{-5}$ mol/L; $\tau$ constant at higher [Q] | 747293 |
| 29.9.7. | 1-Methoxy-4-nitrobenzene | Benzene | | 25 | $8 \times 10^8$ | FP/ABS/SST; EX; [Q] = (1-50) × $10^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.9.8. | 4-Nitroaniline | Benzene | | 25 | $6 \times 10^7$ | FP/ABS/SST; EX; [Q] = (1-50) × $10^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |
| 29.9.9. | 4-Nitrotoluene | Benzene | | 25 | $1.9 \times 10^9$ | FP/ABS/SST; EX; [Q] = (1-50) × $10^{-5}$ mol/L; nonlinear S-V plot at higher [Q] | 747293 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.10.** | **Zn[5-phenyl-10,15,20-tris(4-sulfonatophenyl)porphyrin]$^{3-}$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.10.1. | $N,N'$-Bis(3-sulfonato-1-propyl)-(v.o$^{2+}$) zwitterion | $H_2O$ | $\mu = 0$ (extrap'd; NaCl) | | $2.6 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.6$ ms; OT; [Q] = $4.9 \times 10^{-4}$ mol/L | 85A101 |
| 29.10.2. | $N,N'$-Dimethyl-bpy$^{2+}$ | $H_2O$ | 0.02 mol/L Pbuf; pH 7.0 | | $2.5 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.6$ ms (84A184); OT | 85F030 |
| 29.10.3. | DQ$^{2+}$ | $H_2O$ | 0.02 mol/L Pbuf; pH 7.0 | | $9.9 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.6$ ms (84A184); OT | 85F030 |
| 29.10.4. | 2-Mercaptoethanol | $H_2O$ | | | $\sim5 \times 10^4$ | LP/ABS/SST; $\tau_0 = 1.6$ ms; RT? | 85A101 |
| 29.10.5. | MV$^{2+}$ | $H_2O$ | $\mu = 0$ (extrap'd; NaCl) | | $1.5 \times 10^{10}$ | LP/ABS/SST; $\tau_0 = 1.6$ ms; OT; [Q] = $4.9 \times 10^{-5}$ mol/L | 85A101 |
| | MV$^{2+}$ | $H_2O$ | 0.02 mol/L Pbuf; pH 7.0 | | $1.5 \times 10^{10}$ | LP/ABS/SST; $\tau_0 = 1.6$ ms (84A184); OT | 85F030 |
| 29.10.6. | $N,N'$-(Tetramethylene)-bpy$^{2+}$ | $H_2O$ | 0.02 mol/L Pbuf; pH 7.0 | | $5.3 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.6$ ms (84A184); OT | 85F030 |
| 29.10.7. | $N,N'$-(Trimethylene)-bpy$^{2+}$ | $H_2O$ | 0.02 mol/L Pbuf; pH 7.0 | | $8.7 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.6$ ms (84A184); OT | 85F030 |
| **29.11.** | **Zn(phthalocyanine)** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.11.1. | Co(bpy)$_3^{2+}$ | DMA/H$_2$O (2.3/1) | | $\sim15$ | $2.2 \times 10^7$ | LP/ABS/AVE; ET?; [Q] < 0.001 mol/L | 84A122 |
| 29.11.2. | Co(bpy)$_3^{3+}$ | DMA/H$_2$O (2.3/1) | | $\sim15$ | $2.8 \times 10^8$ | LP/ABS/AVE; OT; $f$ = 0.51; [Q] < $2 \times 10^{-4}$ mol/L | 84A122 |
| 29.11.3. | Co(phen)$_3^{2+}$ | DMA/H$_2$O (2.3/1) | | $\sim15$ | $3.3 \times 10^7$ | LP/ABS/AVE; ET?; [Q] < 0.001 mol/L | 84A122 |
| 29.11.4. | Co(phen)$_3^{3+}$ | DMA/H$_2$O (2.3/1) | | $\sim15$ | $3.4 \times 10^8$ | LP/ABS/AVE; OT; $f$ = 0.56; [Q] < $2 \times 10^{-4}$ mol/L | 84A122 |
| 29.11.5. | Co(terpy)$_2^{2+}$ | DMA/H$_2$O (2.3/1) | | $\sim15$ | $1.3 \times 10^8$ | LP/ABS/AVE; ET?; [Q] < 0.001 mol/L | 84A122 |
| 29.11.6. | Co(terpy)$_2^{3+}$ | DMA/H$_2$O (2.3/1) | | $\sim15$ | $5.0 \times 10^8$ | LP/ABS/AVE; OT; $f$ = 0.75; [Q] < $2 \times 10^{-4}$ mol/L | 84A122 |
| | Co(terpy)$_2^{3+}$ | DMA/H$_2$O (2.3/1) | $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | $5.3 \times 10^8$ | LP/ABS/SST; $\tau_0 = 0.20$ ms; OT; $f$ = 0.70 | 82A290 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.11.** | **Zn(phthalocyanine)**—Continued | | | | | | |
| | Co(terpy)$_2$$^{3+}$ | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 1.4 × 10$^8$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0.37 | 82A290 |
| 29.11.7. | Fe(C$_5$H$_5$)$_2$$^+$ | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 1.0 × 10$^9$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0 | 82A290 |
| 29.11.8. | Fe(CN)$_6$$^{3-}$ | DMA/H$_2$O (2.3/1) | $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 1.9 × 10$^7$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0 | 82A290 |
| | Fe(CN)$_6$$^{3-}$ | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 2.9 × 10$^8$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0 | 82A290 |
| *Organic Quenchers* | | | | | | | |
| 29.11.9. | 1,4-Benzoquinone | DMA/H$_2$O (2.3/1) | $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 5.0 × 10$^8$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0.78 | 82A290 |
| | 1,4-Benzoquinone | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 5.0 × 10$^8$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0.90 | 82A290 |
| 29.11.10. | MV$^{2+}$ | DMA/H$_2$O (2.3/1) | $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 3.6 × 10$^6$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 1.0 | 82A290 |
| | MV$^{2+}$ | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 5 × 10$^5$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0.43 | 82A290 |
| | MV$^{2+}$ | DMF/H$_2$O (9/1) | | | 5.5 × 10$^7$ | LP/ABS/AVE; $\tau_0$ = 0.18 ms; OT; $f$ = 0.62 | 84A272 |
| 29.11.11. | 1,4-Naphthoquinone | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 3 × 10$^7$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT | 82A290 |
| 29.11.12. | Tetrachloro-1,4-benzoquinone | DMA/H$_2$O (2.3/1) | $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 8.3 × 10$^8$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0.75 | 82A290 |
| | Tetrachloro-1,4-benzoquinone | DMA/H$_2$O (2.3/1) | 0.01 mcl/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | 1.3 × 10$^9$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0.27 | 82A290 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^{\circ}C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.11.** | **Zn(phthalocyanine)—Continued** | | | | | | |
| 29.11.13. | 2,4,7-Trinitro-9-fluorenone | DMA/H$_2$O (2.3/1) | 0.01 mol/L HClO$_4$; $\mu$ = 1-1.5 (MgCl$_2$ or NaClO$_4$) | | $1.0 \times 10^9$ | LP/ABS/SST; $\tau_0$ = 0.20 ms; OT; $f$ = 0 | 82A290 |
| **29.12.** | **Zn(protoporphyrin)** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.12.1. | O$_2$ | EtOH/H$_2$O (1.2/1) | 0.001 mol/L Pbuf; pH 8 | | $8 \times 10^9$ | LP/LUM/AVE (decay of delayed fluorescence); $\tau_0$ = 1.3 ms; [Q] = (2-12) $\times$ 10$^{-7}$ mol/L | 86E020 |
| 29.12.2. | Zn(protoporphyrin) | EtOH/H$_2$O (1.2/1) | 0.001 mol/L Pbuf; pH 8 | | $4 \times 10^7$ | LP/LUM/AVE (decay of delayed fluorescence); $\tau_0$ = ~3 ms; $\tau_0$ extrap'd to [S] = 0 | 86E020 |
| *Organic Quenchers* | | | | | | | |
| 29.12.3. | 1,4-Benzoquinone | EtOH | | | $7 \times 10^9$ | LP/LUM/AVE (decay of delayed fluorescence); $\tau_0$ = 0.28 ms | 86E020 |
| 29.12.4. | Naphthoquinone sulfonate | EtOH/H$_2$O (1.2/1) | 0.001 mol/L Pbuf; pH 8 | | $8 \times 10^8$ | LP/LUM/AVE (decay of delayed fluorescence); $\tau_0$ = 1.3 ms | 86E020 |
| **29.13.** | **Zn(tetrabenzoporphyrin)** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.13.1. | Yb(etioporphyrin I)$^+$ | py | | | $4 \times 10^7$ | FP/ABS/SST; ET | 76E693 |
| **29.14.** | **Zn[tetrakis(4-*tert*-butyl)phthalocyanine]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.14.1. | Tetrachloro-1,4-benzoquinone | Hexane | | | $8 \times 10^9$ | FP/ABS/SST | 80F472 |
| **29.15.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.15.1. | Co(EDTA)$^-$ | H$_2$O | | | $5.4 \times 10^9$ | LP/ABS/SST; $f$ = 0.04; [Q] = (2-5) $\times$ 10$^{-4}$ mol/L; OT? | 85A430 |
| 29.15.2. | Co(EDTA)$^{2-}$ | H$_2$O | | | $1.5 \times 10^9$ | LP/ABS/SST; [Q] = (2-8) $\times$ 10$^{-4}$ mol/L | 85A430 |
| 29.15.3. | Cu$^{2+}$ | H$_2$O | | | $1.5 \times 10^6$ | LP/ABS/SST; $\tau_0$ = 1.8 ms; CD; [Q] = 0.001-0.008 mol/L | 84A264 |
| 29.15.4. | Fe$^{3+}$ | H$_2$O | 0.02 mol/L HCl; 0.02 mol/L KCl; pH 1.8 | | $6.3 \times 10^7$ | LP/ABS/SST; OT; $f$ = 1; [Q] = 0.001 mol/L | 85A430 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|-----|----------|---------|-----------------|--------|------------------------------|----------|------|
| **29.15.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$—Continued** | | | | | | |
| 29.15.5. | $O_2$ | $H_2O$ | | | $1.2 \times 10^9$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; $p_Q = 2 \times 10^4$ Pa | 84A264 |
| *Organic Quenchers* | | | | | | | |
| 29.15.6. | $N,N'$-Diheptyl-vio$^{2+}$ | $H_2O$ | | | $5.0 \times 10^6$ | LP/ABS/SST; OT; [Q] = 0.001, 0.002 mol/L; nonlinear S-V plot; $k_q$ cal'd from the initial slope | 85A430 |
| 29.15.7. | EDTA | $H_2O$ | | | $3.7 \times 10^5$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; RT; [Q] = 0.005 mol/L | 84A264 |
| 29.15.8. | MV$^{2+}$ | $H_2O$ | | | $2.0 \times 10^6$ | LP/ABS/SST; $\tau_0 = 1.9$ ms; OT; [Q] = (2-50) × 10$^{-4}$ mol/L; nonlinear S-V plot at higher [Q] | 86A174 |
| | MV$^{2+}$ | $H_2O$ | $\mu = 0$ (extrap'd) | | $1.0 \times 10^6$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = (5-100) × 10$^{-4}$ mol/L | 84A264 |
| | MV$^{2+}$ | $H_2O$ | $\mu = 0$ (extrap'd, NaCl) | | $1.9 \times 10^6$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = 0.001 mol/L | 84A264 |
| | MV$^{2+}$ | $H_2O$ | 0.01 mol/L NaCl | | $4.8 \times 10^6$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = 0.001 mol/L | 84A264 |
| | MV$^{2+}$ | $H_2O$ | 0.02 mol/L NaCl | | $7.6 \times 10^6$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = 0.001 mol/L | 84A264 |
| | MV$^{2+}$ | $H_2O$ | 0.05 mol/L NaCl | | $1.2 \times 10^7$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = 0.001 mol/L | 84A264 |
| | MV$^{2+}$ | $H_2O$ | 0.08 mol/L NaCl | | $2.2 \times 10^7$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = 0.001 mol/L | 84A264 |
| | MV$^{2+}$ | $H_2O$ | 0.1 mol/L NaCl | | $2.4 \times 10^7$ | LP/ABS/SST; $\tau_0 = 1.8$ ms; OT; [Q] = 0.001 mol/L | 84A264 |
| | MV$^{2-}$ | $H_2O$ | 6% dextran | | $2.0 \times 10^6$ | LP/ABS/SST; $\tau_0 = 0.85$ ms; OT; [Q] = (2-200) × 10$^{-4}$ mol/L | 86A174 |
| | MV$^{2-}$ | $H_2O$ | 20% dextran | | $1.4 \times 10^6$ | LP/ABS/SST; $\tau_0 = 0.79$ ms; OT; [Q] = (2-200) × 10$^{-4}$ mol/L | 86A174 |
| | MV$^{2-}$ | $H_2O$ | 42% dextran | | $4.2 \times 10^5$ | LP/ABS/SST; $\tau_0 = 1.3$ ms; OT; [Q] = (2-200) × 10$^{-4}$ mol/L | 86A174 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.15.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$—Continued** | | | | | | |
| | MV$^{2+}$ | $H_2O$ | 45% dextran | | $1.9 \times 10^5$ | LP/ABS/SST; $\tau_0$ = 1.4 ms; OT; [Q] = (2-200) $\times$ 10$^{-4}$ mol/L | 86A174 |
| | MV$^{2+}$ | $H_2O$ | 47% dextran | | $1.9 \times 10^5$ | LP/ABS/SST; $\tau_0$ = 1.5 ms; OT; [Q] = (2-200) $\times$ 10$^{-4}$ mol/L | 86A174 |
| **29.16.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [singlet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.16.1. | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | | 25 | $7.1 \times 10^{10}$ | SS/LUM; OT | 86N075 |
| **29.17.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.17.1. | Co(NH$_3$)$_5$Cl$^{2+}$ | $H_2O$ | | | $1.5 \times 10^8$ | FP/ABS/SST; $\tau_0$ = 1.2 ms; OT; same $k_q$ at pH 5 with FP/ABS/SST and $\tau_0$ = 0.66 ms from same lab in 82A199 | 83A133 |
| 29.17.2. | Fe$^{3+}$ | $H_2O$ | | | $1.9 \times 10^8$ | FP/ABS/SST; $\tau_0$ = 1.2 ms; OT; $k_q$ = 2.2 $\times$ 10$^8$ L mol$^{-1}$ s$^{-1}$ at pH 5 with FP/ABS/SST and $\tau_0$ = 0.66 ms from same lab in 82A199 | 83A133 |
| | Fe$^{3+}$ | $H_2O$ | pH 2; $\mu$ = 0.01 | | $1.3 \times 10^{10}$ | LP/ABS/SST; OT; $f$ = 1 | 81S157 |
| 29.17.3. | S$_2$O$_8^{2-}$ | $H_2O$ | | | $9.0 \times 10^8$ | FP/ABS/SST; $\tau_0$ = 1.2 ms; OT; same $k_q$ at pH 5 with FP/ABS/SST and $\tau_0$ = 0.66 ms from same lab in 82A199 | 83A133 |
| *Organic Quenchers* | | | | | | | |
| 29.17.4. | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | | 25 | $2.5 \times 10^8$ | LP/ABS/SST; OT; [Q] = (5-40) $\times$ 10$^{-6}$ mol/L | 86N075 |
| | $N,N'$-Bis(3-sulfonato-1-propyl)-(vio$^{2+}$) zwitterion | $H_2O$ | | | $2.0 \times 10^8$ | FP/ABS/SST; $\tau_0^{und}$ = 3 ms; OT | 84N212 |
| 29.17.5. | $N,N'$-Didodecyl-vio$^{2+}$ | $H_2O$ | | | $2 \times 10^6$ | FP/ABS/SST; $\tau_0^{und}$ = 3 ns; OT | 84N212 |
| 29.17.6. | $N,N'$-Dihexyl-vio$^{2+}$ | $H_2O$ | | | $3 \times 10^6$ | FP/ABS/SST; $\tau_0^{und}$ = 3 ns; OT; [Q] $\leq$ 0.015 mol/L | 84N212 |
| 29.17.7. | $N,N'$-Dipropyl-vio$^{2+}$ | $H_2O$ | | | $3 \times 10^6$ | FP/ABS/SST; $\tau_0^{und}$ = 3 ms; OT | 84N212 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.17. Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]—Continued** | | | | | | | |
| 29.17.8. | EDTA | $H_2O$ | PHTHbuf; pH 5; $\mu$ = 0.05 (NaCl) | | $1.7 \times 10^5$ | FP/ABS/SST; $\tau_0$ = 0.66 ms; RT | 81F164 |
| | EDTA | $H_2O$ | | | $4 \times 10^5$ | LP/ABS/SST; $\tau_0$ = 1.3 ms; RT; [Q] = 0.02 mol/L; Q mainly as monoprotonated anion | 80A074 |
| 29.17.9. | N-Methyl-N'-tetradecyl-vio$^{2+}$ | $H_2O$ | 0.05 mol/L TEOA; pH 7.8 | 23 | $5 \times 10^7$ | LP/ABS/SST; OT | 83N158 |
| | N-Methyl-N'-tetradecyl-vio$^{2+}$ | $H_2O$ | | | $1.8 \times 10^7$ | LP/ABS/SST; $\tau_0$ = 1.3 ms; OT; $k_q$ at low [Q], where effects of $\mu$ are negligible | 81N002 |
| 29.17.10. | MV$^{2+}$ | $H_2O$ | | | $2 \times 10^6$ | LP/ABS/SST; $\tau_0$ = 1.3 ms; OT; [Q] = 0.005 mol/L | 80A074 |
| | MV$^{2+}$ | $H_2O$ | | | $1.8 \times 10^7$ | FP/ABS/SST; $\tau_0$ = 1.2 ms; OT; same $k_q$ with FP/ABS/SST and $\tau_0$ = 0.56 ms ($f$ = 0.83) from same lab in 82A161 | 83A133 |
| | MV$^{2+}$ | $H_2O$ | | | $2 \times 10^6$ | FP/ABS/SST; $\tau_0^{und}$ = 3 ms; OT | 84N212 |
| | MV$^{2+}$ | $H_2O$ | $\mu$ = 0 (calc'd) | | $2.7 \times 10^5$ | FP/ABS/SST; OT | 82A161 |
| | MV$^{2+}$ | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $1.6 \times 10^6$ | LP/ABS/SST; OT | 86A072 |
| | MV$^{2+}$ | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $1.4 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.57 | 86A072 |
| | MV$^{2+}$ | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $2.0 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.60; $k_q$ = 2.9 $\times$ 10$^7$ L mol$^{-1}$ s$^{-1}$ with LP/ABS/SST and [Q] = (1-10) $\times$ 10$^{-4}$ mol/L from same lab in 86S027 | 86A072 |
| | MV$^{2+}$ | $H_2O$ | 0.001 mol/L AQN; Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $1.1 \times 10^6$ | LP/ABS/SST; OT | 86A072 |
| | MV$^{2+}$ | $H_2O$ | 0.001 mol/L AQN; Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $3.0 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.54 | 86A072 |
| | MV$^{2+}$ | $H_2O$ | PHTHbuf; pH 5; $\mu$ = 0.05 (NaCl) | | $1.8 \times 10^7$ | FP/ABS/SST; $\tau_0$ = 0.66 ms; OT; $f$ = ~0.8; $\phi$ = 0.9 | 81F164 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.17.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]—Continued** | | | | | | |
| 29.17.11. PolyVio3 | | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $2.5 \times 10^6$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio3 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $1.1 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.61; [Q] based on viologen units | 86A072 |
| | PolyVio3 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $2.4 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.86; [Q] based on viologen units | 86A072 |
| 29.17.12. PolyVio4 | | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $1.3 \times 10^6$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio4 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $2.1 \times 10^7$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio4 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $3.6 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.85; [Q] based on viologen units | 86A072 |
| 29.17.13. PolyVio5 | | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $4.6 \times 10^5$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio5 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $2.0 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.77; [Q] based on viologen units | 86A072 |
| 29.17.14. PolyVio6 | | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $4.9 \times 10^5$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio6 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $6.3 \times 10^6$ | LP/ABS/SST; OT; $f$ = 0.83; [Q] based on viologen units | 86A072 |
| | PolyVio6 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $1.3 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.96; [Q] based on viologen units | 86A072 |
| 29.17.15. PolyVio7 | | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $4.4 \times 10^6$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio7 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $1.2 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.62; [Q] based on viologen units | 86A072 |
| | PolyVio7 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $3.0 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.70; [Q] based on viologen units | 86A072 |
| 29.17.16. PolyVio8 | | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $4.4 \times 10^6$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.17.** | **Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]—Continued** | | | | | | |
| | PolyVio8 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $1.0 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.46; [Q] based on viologen units | 86A072 |
| | PolyVio8 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $2.6 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.53; [Q] based on viologen units | 86A072 |
| 29.17.17. | PolyVio9 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0 (calc'd) | | $2.1 \times 10^6$ | LP/ABS/SST; OT; [Q] based on viologen units | 86A072 |
| | PolyVio9 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.05 (NaCl) | | $7.3 \times 10^6$ | LP/ABS/SST; OT; $f$ = 0.82; [Q] based on viologen units | 86A072 |
| | PolyVio9 | $H_2O$ | Pbuf; pH 6.9; $\mu$ = 0.1 (NaCl) | | $1.2 \times 10^7$ | LP/ABS/SST; OT; $f$ = 0.93; [Q] based on viologen units | 86A072 |
| 29.17.18. | Triethanolamine | $H_2O$ | pH 7.8; $\mu$ = 0.50 (TMAC) | 23 | $4 \times 10^3$ | LP/ABS/SST; RT; [Q] = 0.05-1.0 mol/L | 83N158 |
| | Triethanolamine | $H_2O$ | | 25 | $3.6 \times 10^5$ | LP/ABS/SST; RT; [Q] = 0.002-0.004 mol/L | 86N075 |
| **29.18.** | **Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [singlet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.18.1. | Nitrobenzene | $H_2O$ | | ~22 | $4.7 \times 10^{10}$ | SS/LUM; $\tau_0$ = 1.7 ns (84A048); OT; [Q] $\leq$ 0.008 mol/L | 85F141 |
| 29.18.2. | Tetramethyl-1,4-benzoquinone | Benzene | 0.1 mol/L BHDC | | $1.9 \times 10^9$ | LIF; OT; in presence of reversed micelles; S at the interface | 86N292 |
| | Tetramethyl-1,4-benzoquinone | Benzene | 0.1 mol/L BHDC, 1.5 mol/L $H_2O$ | | $1.5 \times 10^9$ | LIF; OT; in presence of reversed micelles; S at the interface | 86N292 |
| **29.19.** | **Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [triplet]** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.19.1. | $Br_2^-$ | $H_2O$ | 0.001 mol/L Pbuf, 0.1 mol/L NaBr, $N_2O$ satur'd; pH 7 | | $5 \times 10^9$ | LP/ABS/SST; OT; Q produced *in situ* by electron pulse after the laser pulse | 82A279 |
| 29.19.2. | $Cd^+$ | $H_2O$ | 0.01 mol/L $CdSO_4$, $N_2$ satur'd | | $1 \times 10^{10}$ | LP/ABS/SST; RT; Q produced *in situ* by electron pulse after the laser pulse | 82A279 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.19.** | **Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [triplet]—Continued** | | | | | | |
| 29.19.3. | H | $H_2O$ | 0.001 mol/L Pbuf, 0.25 mol/L t-BuOH, $N_2O$ sat'd; pH 7 | | $\sim 1 \times 10^{10}$ | LP/ABS/SST; CR; Q produced in situ by electron pulse after the laser pulse | 82A279 |
| 29.19.4. | OE | $H_2O$ | 0.001 mol/L Pbuf, $N_2O$ sat'd; pH 7 | | $\sim 1 \times 10^{10}$ | LP/ABS/SST; CR; Q produced in situ by electron pulse after the laser pulse | 82A279 |
| 29.19.5. | $S_2O_8^{2-}$ | $H_2O$ | | | $6.9 \times 10^6$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT | 83A133 |
| *Organic Quenchers* | | | | | | | |
| 29.19.6. | Cysteine | $H_2O$ | 0.1 mol/L Pbuf; pH 7 | 20 | $3 \times 10^5$ | LP/ABS/SST; $\tau_0 = 0.83$ ms; RT | 82A306 |
| 29.19.7. | 2-Hydroxy-2-propyl radical | $H_2O$ | 0.001 mol/L Pbuf, 0.25 mol/L 2-PrOH, $N_2O$ satur'd; pH 7 | | $3 \times 10^9$ | LP/ABS/SST; RT; Q produced in situ by electron pulse after the laser pulse | 82A279 |
| 29.19.8. | 2-Methyl-2-hydroxypropyl radical | $H_2O$ | 0.001 mol/L Pbuf, 0.25 mol/L t-BuOH, $N_2O$ sat'd; pH 7 | | $1.8 \times 10^9$ | LP/ABS/SST; CR; Q produced in situ by electron pulse after the laser pulse | 82A279 |
| 29.19.9. | $MV^{2+}$ | $H_2O$ | 0.1 mol/L Pbuf; pH 7 | 20 | $6.9 \times 10^9$ | LP/ABS/SST; $\tau_0 = 0.83$ ms; OT; $f = 0.5$; some SQ | 82A306 |
| | $MV^{2+}$ | $H_2O$ | | | $1.4 \times 10^{10}$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT | 83A133 |
| 29.19.10. | Nitrobenzene | $H_2O$ | | $\sim 22$ | $1.6 \times 10^9$ | LP/ABS/AVE; $\tau_0 = 2.2$ ms; OT; [Q] = (1-80) × 10$^{-4}$ mol/L | 85F141 |
| 29.19.11. | Tetrathiafulvalene | MeOH | | | $1.1 \times 10^8$ | LP/ABS/AVE; $\tau_0 = 80$ μs; RT; [Q] = (1-2) × 10$^{-4}$ mol/L | 82N068 |
| **29.20.** | **Zn{5,10,15,20-tetrakis[1-(3-sulfonato-1-propyl)pyridinium-4-yl]porphyrin}** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.20.1. | 9,10-Anthraquinone-2,6-disulfonate ion | $H_2O$ | 0.02 mol/L Pbuf; 0.005 mol/L CTAB; pH 6 | | $7.5 \times 10^7$ | LP/ABS/SST; $\tau_0 = 0.50$ ms; OT; Q in micelles | 85N254 |
| 29.20.2. | 9,10-Anthraquinone-2-sulfonate ion, β-CD complex | $H_2O$ | 0.01 mol/L β-CD | | $3.3 \times 10^6$ | LP/ABS/SST; $\tau_0^{und} = 0.5$ ms; OT | 86N119 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.21. Zn{5,10,15,20-tetrakis[4-(trimethylammonio)phenyl]porphyrin}$^{4+}$** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.21.1. | Co(NH$_3$)$_5$Cl$^{2+}$ | H$_2$O | | | $1.9 \times 10^7$ | LP/ABS/SPC; $\tau_0$ = 1.2 ms; OT | 83E462 |
| 29.21.2. | Co(sep)$^{3+}$ | H$_2$O | | | $1.6 \times 10^7$ | LP/ABS/SPC; $\tau_0$ = 1.2 ms; OT | 83E462 |
| 29.21.3. | O$_2$ | H$_2$O | | | $1.3 \times 10^9$ | LP/ABS/SPC; $\tau_0$ = 1.2 ms; ET? | 83E462 |
| *Organic Quenchers* | | | | | | | |
| 29.21.4. | MV$^{2+}$ | H$_2$O | $\mu$ = <0.005 | | $5.4 \times 10^7$ | LP/ABS/SPC; $\tau_0$ = 1.2 ms; OT | 83E462 |
| | MV$^{2+}$ | H$_2$O | 0.05 mol/L ACbuf | | $2.0 \times 10^8$ | LP/ABS/SPC; $\tau_0$ = 1.2 ms; OT | 83E462 |
| **29.22. Zn($N,N',N'',N'''$-tetramethyltetra-2,3-pyridinoporphyrazine)$^{4+}$** | | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.22.1. | EDTA | H$_2$O | | | $1.4 \times 10^3$ | LP/ABS/SST; $\tau_0^{und}$ = 0.17 ms; RT | 85F520 |
| 29.22.2. | MV$^{2+}$ | H$_2$O | | | $4.0 \times 10^7$ | LP/ABS/SST; $\tau_0^{und}$ = 0.17 ms; OT | 85F520 |
| **29.23. Zn(5,10,15,20-tetraphenylporphyrin) [singlet]** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.23.1. | Eu$^{3+}$ | AN | | | $1.6 \times 10^{10}$ | FP/ABS/SST; OT, ET?; see Mech. [9] | 79A220 |
| *Organic Quenchers* | | | | | | | |
| 29.23.2. | Benzenediazonium cation | Acetone | | 25 | $1.8 \times 10^{10}$ | SS/LUM; $\tau_0$ = 1.9 ns (LP/LUM/SST); OT | 85A136 |
| 29.23.3. | 1,4-Benzoquinone | DMF | | | $2.3 \times 10^9$ | SS/LUM; EX | 79F712 |
| | 1,4-Benzoquinone | Dioxane | | | $1.0 \times 10^9$ | SS/LUM; $\tau_0$ = 3.9 ns (373002); OT; [Q] ≤ 0.1 mol/L | 67A003 |
| | 1,4-Benzoquinone | EtOH | | | $1.5 \times 10^9$ | SS/LUM; $\tau_0$ = 2.5 ns (SL/LUM/SPC); EX | 79F712 |
| | 1,4-Benzoquinone | Toluene | | | $2.2 \times 10^9$ | SS/LUM; $\tau_0$ = 2.7 ns (SL/LUM/SPC); EX | 79F712 |
| 29.23.4. | 4-Bromobenzenediazonium cation | Acetone | | 25 | $2.6 \times 10^{10}$ | SS/LUM; $\tau_0$ = 1.9 ns (LP/LUM/SST); OT | 85A136 |
| 29.23.5. | 4-Chlorobenzenediazonium cation | Acetone | | 25 | $2.3 \times 10^{10}$ | SS/LUM; $\tau_0$ = 1.9 ns (LP/LUM/SST); OT | 85A136 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.23.** | **Zn(5,10,15,20-tetraphenylporphyrin) [singlet]**—Continued | | | | | | |
| 29.23.6. | 4-(N,N-Diethylamino)benzenediazonium cation | Acetone | | 25 | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.9$ ns (LP/LUM/SST); OT; [Q] = 0.07 mol/L | 85A136 |
| 29.23.7. | 1,4-Dinitrobenzene | Dioxane | | | $3.0 \times 10^9$ | SS/LUM; $\tau_0 = 3.9$ ns (573002); OT; [Q] ≤ 0.15 mol/L | 67A003 |
| 29.23.8. | 4-Methoxybenzenediazonium cation | Acetone | | 25 | $1.2 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.9$ ns (LP/LUM/SST); OT; [Q] ≤ 0.07 mol/L | 85A136 |
| 29.23.9. | 4-Methylbenzenediazonium cation | Acetone | | 25 | $1.8 \times 10^{10}$ | SS/LUM; $\tau_0 = 1.9$ ns (LP/LUM/SST); OT; [Q] ≤ 0.07 mol/L | 85A136 |
| 29.23.10. | Nitrobenzene | Dioxane | | | $1.2 \times 10^8$ | SS/LUM; $\tau_0 = 3.9$ ns (573002); OT; [Q] ≤ 0.5 mol/L | 67A003 |
| 29.23.11. | Nitromethane | Dioxane | | | $7.5 \times 10^6$ | SS/LUM; $\tau_0 = 3.9$ ns (573002); OT | 67A003 |
| 29.23.12. | Tetramethyl-1,4-benzoquinone | Benzene | 0.1 mol/L BHDC | | $8.5 \times 10^9$ | LIF; OT; [Q] = 0.005-0.06 mol/L; in presence of reversed micelles; S at the interface | 86N292 |
| | Tetramethyl-1,4-benzoquinone | Benzene | 0.1 mol/L BHDC, 1 mol/L H$_2$O | | $3.7 \times 10^9$ | LIF; OT; [Q] = 0.005-0.06 mol/L; in presence of reversed micelles | 86N292 |
| **29.24.** | **Zn(5,10,15,20-tetraphenylporphyrin) [triplet]** | | | | | | |
| | *Inorganic Quenchers* | | | | | | |
| 29.24.1. | Ag(TPP) | Toluene | | | $3.6 \times 10^8$ | FP/ABS/SST; EX | 76E693 |
| 29.24.2. | Co$^{2+}$ | py | | | $1.4 \times 10^6$ | FP/ABS/SST; $\tau_0 = $ ~1.1 ms (60E006); Q as Cl$^-$ salt; see Mech. [10] | 60A002 |
| 29.24.3. | Cu$^{2+}$ | THF | | | $2.0 \times 10^3$ | FP/ABS/SST; $\tau_0 = 1.9$ ms; Q as Cl$^-$ salt; see Mech. [10] | 60A002 |
| | Cu$^{2+}$ | py | | | $1.2 \times 10^3$ | FP/ABS/SST; $\tau_0 = $ ~1.1 ms (60E006); Q as Cl$^-$ salt; see Mech. [10] | 60A002 |
| 29.24.4. | Eu$^{3+}$ | AN | | | $4.8 \times 10^5$ | FP/ABS/SST; OT; [Q] ≤ 0.023 mol/L | 79A220 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.24.** | **Zn(5,10,15,20-tetraphenylporphyrin) [triplet]—Continued** | | | | | | |
| | Eu$^{3+}$ | Acetone | | | $5 \times 10^5$ | FP/ABS/SST; $\tau_0 = 0.94$ ms; OT | 84E316 |
| 29.24.5. | Eu(benzo-15-crown-5)$^{3+}$ | Acetone | | | $3 \times 10^6$ | FP/ABS/SST; $\tau_0 = 0.94$ ms; OT | 84E316 |
| 29.24.6. | Ni$^{2+}$ | THF | | | $2.5 \times 10^7$ | FP/ABS/SST; $\tau_0 = 1.9$ ms; Q as Cl$^-$ salt; see Mech. [10] | 60A002 |
| | Ni$^{2+}$ | py | | | $9.8 \times 10^6$ | FP/ABS/SST; $\tau_0 = \sim 1.1$ ms (60E006); Q as Cl$^-$ salt; see Mech. [10] | 60A002 |
| 29.24.7. | O$_2$ | H$_2$O | BObuf; pH 9.2 | 20 | $1.5 \times 10^9$ | LP/ABS/SST; OT | 86A063 |
| 29.24.8. | Zn(TPP) | Toluene | | | $2 \times 10^7$ | FP/ABS/SST; $\tau_0 = \sim 1.2$ ms; [Q] = $(2.4$-$14) \times 10^{-6}$ mol/L; $\tau_0$ extrap'd to [S] = 0; see Mech. [10] | 60E006 |
| *Organic Quenchers* | | | | | | | |
| 29.24.9. | Benzenediazonium cation | Acetone | | 25 | $1.0 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT; no first-order decay due to loss of Q; $k_q$ eval'd at $t = 0$ | 85A136 |
| 29.24.10. | 1,4-Benzoquinone | Benzene | | 25 | $3.4 \times 10^9$ | FP/ABS/SST; EX?; see also 85E593 | 82A389 |
| | 1,4-Benzoquinone | DMF | | | $1.9 \times 10^9$ | FP/ABS/SST | 79F712 |
| | 1,4-Benzoquinone | Dioxane | | | $4.2 \times 10^8$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT; [Q] $\leq 1.5 \times 10^{-4}$ mol/L | 67A003 |
| | 1,4-Benzoquinone | EtOH | | | $1.2 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.2$ ms; OT; $f = 0.24$ (83F182) | 79F712 |
| | 1,4-Benzoquinone | Toluene | | 25 | $2.3 \times 10^9$ | FP/ABS/SST; EX?; see also 85E593 | 82A389 |
| | 1,4-Benzoquinone | Toluene | | | $1.3 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.3$ ms; EX | 79F712 |
| 29.24.11. | 4-Bromobenzenediazonium cation | Acetone | | 25 | $2.3 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT; no first-order decay due to loss of Q; $k_q$ eval'd at $t = 0$ | 85A136 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.24.** | **Zn(5,10,15,20-tetraphenylporphyrin)** [triplet]—Continued | | | | | | |
| 29.24.12. | 4-Chlorobenzenediazonium cation | Acetone | | 25 | $1.5 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT; no first-order decay due to loss of Q; $k_q$ eval'd at $t = 0$ | 85A136 |
| 29.24.13. | 4-($N,N$-Diethylamino)benzenediazonium cation | Acetone | | 25 | $5 \times 10^8$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT; no first-order decay due to loss of Q; $k_q$ eval'd at $t = 0$ | 85A136 |
| 29.24.14. | 1,4-Dinitrobenzene | Dioxane | | | $7.6 \times 10^7$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT; [Q] $\leq 5 \times 10^{-4}$ mol/L | 67A003 |
| 29.24.15. | 4-Methoxybenzenediazonium cation | Acetone | | 25 | $1.6 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT; no first-order decay due to loss of Q; $k_q$ eval'd at $t = 0$ | 85A136 |
| 29.24.16. | 4-Methylbenzenediazonium cation | Acetone | | 25 | $1.6 \times 10^9$ | FP/ABS/SST; $\tau_0 = 1.4$ ms; OT; no first-order decay due to loss of Q; $k_q$ eval'd at $t = 0$ | 85A136 |
| 29.24.17. | Metronidazole | H$_2$O | BObuf; pH 9.2 | 20 | $2.9 \times 10^9$ | LP/ABS/SST; OT; $f = 0.23$ | 86A063 |
| 29.24.18. | Misonidazole | H$_2$O | BObuf; pH 9.2 | 20 | $2.3 \times 10^9$ | LP/ABS/SST; OT | 86A063 |
| 29.24.19. | MV$^{2+}$ | EtOH | | | $7 \times 10^8$ | FP/ABS/SST; $\tau_0^{und} = 20$ μs; OT | 80N143 |
| 29.24.20. | Nitrobenzene | Dioxane | | | $7.6 \times 10^4$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT | 67A003 |
| 29.24.21. | Nitromethane | Dioxane | | | $1.7 \times 10^3$ | FP/ABS/SST; $\tau_0 = 0.17$ ms; OT | 67A003 |
| 29.24.22. | Tetramethyl-1,4-benzoquinone | EtOH | | | $2 \times 10^9$ | FP/ABS/SST; $\tau_0^{und} = 20$ μs; OT | 80N143 |
| **29.25.** | **Zn[4,4′,4″,4‴-tetra(sulfomorpholide)phthalocyanine]** [singlet] | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.25.1. | 4-($N,N$-Diethylamino)benzenediazonium cation | AN | | 25 | $2.3 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 2.8$ ns (LP/LUM/AVE); RT; [Q] $\leq$ 0.015 mol/L | 86A508 |
| 29.25.2. | 4-Methoxybenzenediazonium cation | AN | | 25 | $2.5 \times 10^{10}$ | SS/LUM; $\tau_0^{air} = 2.8$ ns (LP/LUM/AVE); RT; [Q] $\leq$ 0.015 mol/L | 86A508 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/^\circ$C | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.25.** | **Zn[4,4′,4″,4‴-tetra(sulfomorpholide)phthalocyanine] [singlet]—Continued** | | | | | | |
| 29.25.3. | 4-Methylbenzenediazonium cation | AN | | 25 | $2.1 \times 10^{10}$ | SS/LUM, LP/LUM/AVE; $\tau_0^{air}$ = 2.8 ns; RT; [Q] ≤ 0.015 mol/L | 86A508 |
| **29.26.** | **Zn[4,4′,4″,4‴-tetra(sulfomorpholide)phthalocyanine] [triplet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.26.1. | 4-(N,N-Diethylamino)benzenediazonium cation | AN | | 25 | $3.3 \times 10^7$ | FP/ABS/SST; $\tau_0$ = 0.25 ms; EX; [Q] ≤ 0.3 mol/L | 86A508 |
| 29.26.2. | 4-Methoxybenzenediazonium cation | AN | | 25 | $8.5 \times 10^7$ | FP/ABS/SST; $\tau_0$ = 0.25 ms; EX; [Q] ≤ 0.15 mol/L | 86A508 |
| 29.26.3. | 4-Methylbenzenediazonium cation | AN | | 25 | $1.2 \times 10^8$ | FP/ABS/SST; $\tau_0$ = 0.25 ms; EX; [Q] ≤ 0.1 mol/L | 86A508 |
| **29.27.** | **Zn(4,4′,4″,4‴-tetrasulfophthalocyanine)$^{4-}$ [singlet]** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.27.1. | MV$^{2-}$ | H$_2$O/py (19/1) | | | $1.0 \times 10^{10}$ | SS/LUM; $\tau_0$ = 2.9 ns (SL/LUM/SPC); OT; [Q] ≤ 0.0012 mol/L; same $k_q$ from same lab in 80S033; nonlinear S-V plot with negative deviation; SQ proposed, see Mech. [11] | 80E669 |
| **29.28.** | **Zn(4,4′,4″,4‴-tetrasulfophthalocyanine)$^{4-}$ [triplet]** | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.28.1. | O$_2$ | H$_2$O | 0.1 mol/L Pbuf; 0.01 mol/L CTAB; pH 7.4 | 25 | $1.6 \times 10^9$ | LP/ABS/AVE; $\tau_0$ = 0.24 ms; ET; $p_Q$ = 2 × 10$^4$ Pa | 86F214 |
| *Organic Quenchers* | | | | | | | |
| 29.28.2. | MV$^{2+}$ | H$_2$O/py (19/1) | | | $7 \times 10^6$ | FP/ABS/SST; $\tau_0^{air}$ = 0.25 ms; OT; same $k_q$ from same lab in 80S033; some SQ | 80E669 |
| **29.29.** | **Zn[5,10,15-tris(4-tolyl)-20-(4-carboxylatophenyl)porphyrin]$^-$** | | | | | | |
| *Organic Quenchers* | | | | | | | |
| 29.29.1. | MV$^{2-}$ | H$_2$O | | | $1.0 \times 10^9$ | FP/ABS/SST; $\tau_0$ = 1.5 ms; OT; $f$ = 0.04; 20% impurities in S | 82A161 |
| | MV$^{2+}$ | H$_2$O | μ = 0 (calc'd) | | $3.0 \times 10^9$ | FP/ABS/SST; OT; 20% impurities in S | 82A161 |

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.30. Zn(uroporphyrin I)** | | | | | | | |
| *Inorganic Quenchers* | | | | | | | |
| 29.30.1. | $Co(CN)_6^{3-}$ | $H_2O$ | 0.1 mol/L KCN; pH 10.8 | ~25 | $2.6 \times 10^3$ | FP/ABS/AVE; OT, ET?; $f$ = 0; 75% isomeric purity of S | 75A245 |
| 29.30.2. | $Cr(CN)_6^{3-}$ | $H_2O$ | 0.1 mol/L KCN; pH 10.8 | ~25 | $2.3 \times 10^5$ | FP/ABS/AVE; OT, ET?; $f$ = 0; 75% isomeric purity of S | 75A245 |
| 29.30.3. | $Fe(CN)_6^{3-}$ | $H_2O$ | $3.8 \times 10^{-5}$ mol/L $K_2HPO_4$; pH 7; μ = $5.0 \times 10^{-4}$ | ~25 | $1.5 \times 10^6$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | $3.8 \times 10^{-5}$ mol/L $K_2HPO_4$; pH 7; μ = $9.1 \times 10^{-4}$ (KCl) | ~25 | $2.4 \times 10^6$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; μ = 0.0013 (KCl) | ~25 | $2.2 \times 10^6$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; μ = 0.0016 (KCl) | ~25 | $2.6 \times 10^6$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; μ = 0.0021 (KCl) | ~25 | $5.7 \times 10^6$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; μ = 0.011 (KCl) | ~25 | $1.9 \times 10^7$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; 0.1 mol/L KCl; pH 7 | ~25 | $8.1 \times 10^7$ | FP/ABS/AVE; $\tau_0$ = ~3 ms; OT; $f$ = 0.97; [Q] ≤ 1.8 × $10^{-5}$ mol/L; 75% isomeric purity of S | 75A245 |
| | $Fe(CN)_6^{3-}$ | $H_2O$ | 0.1 mol/L KCN; pH 10.8 | ~25 | $1.9 \times 10^7$ | FP/ABS/AVE; OT; $f$ = 0.68; 75% isomeric purity of S | 75A245 |
| 29.30.4. | $Fe(CN)_6^{1-}$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; 0.10 mol/L KCl; pH 7 | ~25 | $3.1 \times 10^7$ | FP/ABS/AVE; $\tau_0$ = ~3 ms; RT; 75% isomeric purity of S | 75A245 |
| 29.30.5. | $Mn(CN)_6^{3-}$ | $H_2O$ | 0.1 mol/L KCN; pH 10.8 | ~25 | $4.1 \times 10^7$ | FP/ABS/AVE; OT; $f$ = 0.31; 75% isomeric purity of S | 75A245 |

TABLE 29. Quenching of excited zinc complexes—Continued

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.30.** | **Zn(uroporphyrin I)**—Continued | | | | | | |
| 29.30.6. | Zn(uroporphyrin I) | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; 0.1 mol/L KCl; pH 7 | ~25 | $3.0 \times 10^6$ | FP/ABS/AVE; 75% isomeric purity of S and Q | 75A245 |
| *Organic Quenchers* | | | | | | | |
| 29.30.7. | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $3.8 \times 10^{-5}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 3.3 \times 10^{-4}$ | ~25 | $2.1 \times 10^9$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $3.8 \times 10^{-5}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 7.4 \times 10^{-4}$ (KCl) | ~25 | $2.6 \times 10^9$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 0.0011$ (KCl) | ~25 | $1.9 \times 10^9$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 0.0016$ (KCl) | ~25 | $1.8 \times 10^9$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 0.0017$ (KCl) | ~25 | $1.7 \times 10^9$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 0.0021$ (KCl) | ~25 | $1.5 \times 10^9$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 0.011$ (KCl) | ~25 | $8.4 \times 10^8$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| | *N*-Benzyl-3-carbamyl-py$^+$ | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; 0.1 mol/L KCl; pH 7 | ~25 | $3.5 \times 10^8$ | FP/ABS/AVE; $\tau_0 = $ ~3 ms; OT; $f = 0.80$; 75% isomeric purity of S | 75A245 |
| 29.30.8. | Dihydronicotinamide adenine dinucleotide | $H_2O$ | 0.1 mol/L KCl; pH 13 (KOH) | ~25 | $1.6 \times 10^4$ | FP/ABS/AVE; RT; [Q] = 0.0023 mol/L; 75% isomeric purity of S | 75A245 |
| 29.30.9. | Nicotinamide adenine dinucleotide phosphate trianion | $H_2O$ | $3.8 \times 10^{-5}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 5.0 \times 10^{-4}$ | ~25 | $1.3 \times 10^6$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |
| 29.30.10. | Nicotinamide adenine dinucleotide anion | $H_2O$ | $3.8 \times 10^{-5}$ mol/L $K_2HPO_4$; pH 7; $\mu$ $= 5.0 \times 10^{-4}$ | ~25 | $7.8 \times 10^7$ | FP/ABS/AVE; OT; 75% isomeric purity of S | 75A245 |

TABLE 29. Quenching of excited zinc complexes—Continue

| No. | Quencher | Solvent | Solution Medium | $T/°C$ | $k_q$ /L mol$^{-1}$ s$^{-1}$ | Comments | Ref. |
|---|---|---|---|---|---|---|---|
| **29.30.** | **Zn(uroporphyrin I)**—Continued | | | | | | |
| | Nicotinamide adenine dinucleotide anion | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; 0.1 mol/L KCl; pH 7 | ~25 | $1.7 \times 10^8$ | FP/ABS/AVE; $\tau_0 = $ ~3 ms; OT; $f = 1.0$; 75% isomeric purity of S | 75A243 |
| 29.30.11. | Nicotinamide adenine dinucleotide phosphate trianion | $H_2O$ | $1.1 \times 10^{-4}$ mol/L $K_2HPO_4$; 0.1 mol/L KCl; pH 7 | ~25 | $4.3 \times 10^7$ | FP/ABS/AVE; $\tau_0 = $ ~3 ms; OT; $f = 0.96$; 75% isomeric purity of S | 75A243 |

## 9. Notes on the Tables

In some of the cases reported in this compilation, deviations from the behavior predicted by the simplest mechanism and the approximations of Sec. 2.5 of the Introduction, such as nonlinear Stern–Volmer (S–V) plots and biexponential decays, are experimentally observed, necessitating the use of alternative equations, or the introduction of additional steps to the mechanism in order for values of $k_q$ to be extracted. In other cases, conditions specific to the chemistry of the species involved have led the authors of the papers to invoke mechanisms that have unusual features. In still others, novel experimental approaches have been employed, requiring the development of new relationships between $\Lambda$ and the concentration of the species.

In the discussions that follow, the details of these other equations and mechanisms are presented in sufficient detail in order to enable the reader to appreciate the basis for the values of $k_q$ in those cases. The specific treatments are preceded by the number of the mechanism (e.g., Mech. [1]) which appears in the Comments column of the tables. Within a particular treatment, there are references to specific papers in which variations on the general theme appear.

For the general treatment of the kinetics of quenching, and the definitions of most of the symbols used here, see Sec. 2 of the Introduction.

*Mech.* [1] *Nonlinear Stern–Volmer plots*

If the experimental plots of $I_l^0/I_l$ or $m_2$ vs [Q] show a negative deviation from linearity, the approximate equations (25) or (31) of Sec. 2.5 can no longer be applied; rather the general equations (1) or (2) [equations (24) and (30) of Sec. 2.5] should be used:

$$\frac{I_l^0}{I_l} = \frac{1 + \{k_d k_{de}[Q]/k_0(k_{-d} + k_{de})\}}{1 + \gamma\{(k_d[Q]/(k_{-d} + k_{de})\}}, \qquad (1)$$

$$m_2 = \tfrac{1}{2}(k_0 + k_{de} + k_{-d} + k_d[Q]) - \tfrac{1}{2}R^{1/2}, \qquad (2)$$

where

$$R = (k_0 + k_{de} + k_{-d} + k_d[Q])^2$$
$$- 4(k_0 k_{-d} + k_0 k_{de} + k_{de} k_d[Q]).$$

*Reference 79E349.* This is the only case presented in which a nonlinear plot of emission intensity is reported. With the assumption that $k_{-d} \gg k_{de}$, Eq. (1) reduces to Eq. (3). Values of $k_0$ and $k_{de}$ were obtained independently from lifetime measurements at [Q] = 0 and at very high [Q], respectively; $\gamma$ was evaluated through a best-fitting procedure of the experimental data to Eq. (3) and $k_q$ was calulated by use of the reduced form of Eq. (7) of Sec. 2.3: $k_q = k_d k_{de}/k_{-d}$.

$$\frac{I_l^0}{I_l} = \frac{1 + (k_d k_{de}[Q]/k_{-d}k_0)}{1 + \gamma(k_d[Q]/k_{-d})}. \qquad (3)$$

*Reference 84E308.* The nonlinear dependence on [Q] of the rate constant $k_A$ for the decay of the excited-state absorbance after a flash excitation was interpreted by means of Eq. (4), which is analogous to Eq. (1). Equation (4) was rearranged to Eq. (5). With $k_0$ known from lifetime measurements at [Q] = 0, $k_q$ was obtained as the intercept/slope ratio of the linear plot of $k_A$ vs $(k_A - k_0)/[Q]$.

$$k_A = k_0 + \frac{k_d[Q](k_{de} - k_0)/(k_{-d} + k_{de})}{1 + k_d[Q]/(k_{-d} + k_{de})}, \qquad (4)$$

$$k_A = k_{de} - \left[\frac{k_{-d} + k_{de}}{k_d}\right]\left[\frac{k_A - k_0}{[Q]}\right]. \qquad (5)$$

*Reference 85A013.* Results analogous to the previous ones were explained by assuming mechanism 6 in which irreversible quenching and the reversible formation of an exciplex are involved:

$$*S \xrightarrow{k_0} S,$$

$$*S + Q \xrightarrow{k_1} \text{quenching},$$

$$*S + Q \underset{k_3}{\overset{k_2}{\rightleftharpoons}} *(S{-}Q),$$

$$*(S{-}Q) \xrightarrow{k_4} S + Q \text{ and/or } S^+ + Q^-. \qquad (6)$$
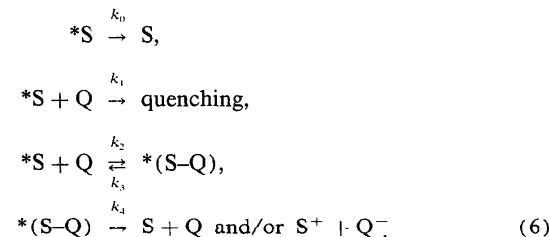
By assuming that equilibration between *S and *(S–Q) exists during the decay [$k_2[Q], k_3 \gg (k_0 + k_1[Q])$, $k_4$] and $\epsilon(*S) = \epsilon[*(S{-}Q)]$ at the monitoring wavelength, Eq. (7) was obtained, which rearranges to Eq. (8),

$$k_A = \frac{k_0 + [(k_2 k_4/k_3) + k_1][Q]}{1 + (k_2/k_3)[Q]}, \qquad (7)$$

$$Y = \frac{k_A - k_0}{[Q]} = \left[\frac{k_2 k_4}{k_3}\right] + k_1 - \left[\frac{k_2}{k_3}\right]k_A. \qquad (8)$$

From decay measurements at various [Q], a linear plot of $Y$ vs $k_A$ was obtained; values of $k_2/k_3$ and $[(k_2 k_4/k_3) + k_1]$ were obtained from the slope and intercept, respectively. The value of $k_3$ and upper limits for $k_1$ and $k_4$ were then calculated by assuming that $k_2$ is at the diffusion-controlled limit ($\sim 10^{10}$ L mol$^{-1}$ s$^{-1}$). The value of the overall quenching constant

$$k_q = k_1 + [k_2 k_4/(k_3 + k_4)]$$

was calculated by us for this compilation by using the values of the specific rate constants quoted in the original paper.

*Mech.* [2] *Biexponential decay*

*References 82E636 and 83A101.* In these papers, biexponential decays were reported for the quenching of metalloporphyrins and similar complexes. The optical absorbance of the excited state was found to decrease after the flash according to Eq. (9), where $(\Delta A)_t$ is the difference between the absorbances of the solution at time $t$ after the flash and before the flash, and $A_1$ and $A_2$ are preexponential factors.

$$(\Delta A)_t = A_1 \exp(-m_1 t) + A_2 \exp(-m_2 t). \qquad (9)$$

A best-fitting procedure was used to evaluate $m_1$, $m_2$, $A_1$, and $A_2$; the limiting value of $m_2$ at high [Q] $m_2(\lim)$ was also obtained. By assuming that the quenching occurs via mechanism 6, the following relationships were written:

$$m_1 + m_2 = a + b[Q],$$

where

$$a = k_0 + k_3 + k_4, \quad b = k_1 + k_2,$$

and

$$m_2(\lim) = k_4 + [k_1 k_3/(k_1 + k_2)].$$

The analysis of numerous pieces of data led the authors to suggest that $k_1 \ll k_2$ whenever $m_2(\text{lim}) < k_0$. Under these conditions, therefore, they assumed that $k_2 = b$, $k_4 = m_2(\text{lim})$, and $k_3 = [a - k_0 - m_2(\text{lim})]$. The $k_q$ values presented in this compilation were calculated by us, using Eq. (7) of Sec. 2.3, and the values of $k_2( = k_d)$, $k_3( = k_{-d})$, and $k_4( = k_{de})$ quoted in the original papers.

When $m_2(\text{lim}) > k_0$, $k_1$ was considered to be no longer negligible with respect to $k_2$. This latter rate constant was evaluated [see E. I. Kapinus, M. M. Aleksankina, V. P. Staryi, V. I. Boghillo, and I. I. Dilung, J. Chem. Soc. Faraday Trans. 2 **81**, 631 (1985)] from the preexponential factors at various [Q] by means of Eq. (10), assuming $\epsilon^*(\text{S--Q}) = \epsilon(^*\text{S})$. The values of the other rate constants could then be obtained from $a$, $b$, and $m_2(\text{lim})$. However, the resulting values of $k_q$ then become so uncertain that they have not been included in this compilation.

$$\left[ \frac{A_1 m_2 + A_2 m_1}{A_1 + A_2} \right] = k_2[\text{Q}] \left[ \frac{\epsilon^*(\text{S--Q})}{\epsilon(^*\text{S})} \right] + k_3 + k_4. \quad (10)$$

*Mech.* [3] *Self-quenching (ground-state quenching)*

*Reference 86E677.* In this case Q is S and the emission from *S must be measured as a function of [S]. Obviously, $I_a$ is no longer a constant value throughout a set of experiments, but must be evaluated using the Beer–Lambert Law [Eq. (11)], where $\epsilon$ is the molar absorptivity of S at the excitation wavelength, $l$ is the optical path length, and $I_0$ is the intensity of the incident light.

$$I_a = I_0[1 - \exp(-2.303\epsilon l\,[\text{S}])]. \quad (11)$$

By assuming that quenching occurs via reaction (5) of Sec. 2.3, and by introducing Eq. (11) into the steady-state treatment, one obtains, Eq. (12), where $\alpha$ is an instrumental factor.

$$\frac{1}{I_l} = \frac{1}{\alpha \beta k_{rd} I_0 \eta^*} \left[ \frac{k_0}{1 - \exp(-2.303\epsilon l\,[\text{S}])} \right.$$
$$\left. + \frac{k_q[\text{S}]}{1 - \exp(-2.303\epsilon l\,[\text{S}])} \right]. \quad (12)$$

Equation (12) predicts that a plot of $1/I_l$ vs [S] will be nonlinear; however, if the absorbance of the solution is $< 0.1$ for all [S] used, Eq. (11) reduces to $I_a = I_0(2.303\epsilon l\,[\text{S}])$, leading to Eq. (13), which predicts a linear relationship between $1/I_l$ and $1/[\text{S}]$ with an intercept/slope ratio of $k_q/k_0 = K_{SV}$. The lifetime used to convert $K_{SV}$ to $k_q$ must be the limiting value of $\tau$ as $[\text{S}] \to 0$, obtained by extrapolation, for example, from a plot of $1/\tau$ vs [S]. Note that a linear S–V plot should be obtained from decay measurements of self-quenching, inasmuch as the decay kinetics are not affected by the amount of light absorbed by S.

$$\frac{1}{I_l} = \frac{1}{2.303\epsilon l\alpha\beta k_{rd} I_0 \eta^*} \left[ \frac{k_0}{[\text{S}]} + k_q \right]. \quad (13)$$

*Mech.* [4] *Quenching by an unstable quencher*

*Reference 756452.* The quencher ($\text{UO}^{2+}$) was produced *in situ* from the substrate ($\text{UO}_2^+$) by means of the following fast reaction:

$$\text{UO}_2^{2+} + \text{Eu}^{2+} \to \text{UO}_2^+ + \text{Eu}^{3+}.$$
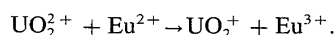
Addition of $\text{Eu}^{2+}$ to the solution caused an almost instantaneous decrease of the intensity of $\text{O}_2^+$ emission; a slow recovery of the intensity was then observed, which was due to the following disproportionation reaction:

$$2\text{UO}_2^+ \to \text{UO}_2^{2+} + \text{U}^{4+}.$$

A S–V plot was constructed from the emission intensities measured at various times during the recovery; the corresponding [Q] values were calculated from the initial concentration of $\text{UO}_2^+$ (equal to the concentration of added $\text{Eu}^{2+}$) and the known rate constant for the disproportionation reaction. $K_{SV}$ was evaluated from the slope of this linear plot.

*Mech.* [5] *Quenching of the photoreaction of* *S

If *S and *S–Q undergo photoreaction to product P, the quantum yield for the formation of P after an appropriate period of continuous irradiation $t$ is given by Eq. (14):

$$\Phi(\text{P}) = \frac{\int_0^t (k_{rx}[^*\text{S}]_{ss} + k'_{rx}[^*\text{S--Q}]_{ss})dt}{\int_0^t I_a\, dt} \quad (14)$$

If both S and Q are not appreciably consumed during the irradiation period, $[^*\text{S}]_{ss}$, $[^*\text{S--Q}]_{ss}$, and $I_a$ can be considered to be constant. Equation (14) can be integrated to Eq. (15).

$$\Phi(\text{P}) = \frac{k_{rx}\eta^*(k_{-d} + k_{de}) + k'_{rx}\eta^*k_d[\text{Q}]}{k_0(k_{-d} + k_{de}) + k_{de}k_d[\text{Q}]}. \quad (15)$$

The ratio between the quantum yields in the absence and presence of Q is represented by Eq. (16), where $\Phi^0(\text{P})$ is the quantum yield at $[\text{Q}] = 0$, and $\delta = k'_{rx}/k_{rx}$.

$$\frac{\Phi^0(\text{P})}{\Phi(\text{P})} = \frac{1 + \{k_{de}k_d[\text{Q}]/k_0(k_{-d} + k_{de})\}}{1 + \delta\{k_d[\text{Q}]/(k_{-d} + k_{de})\}}. \quad (16)$$

By neglecting the contribution of *S–Q to the reaction, Eq. (16) is reduced to the S–V equation (17) for a quenched photoreaction, which is the same as Eq. (21) of Sec. 2.5:

$$\Phi_0/\Phi = 1 + (k_q/k_0)[\text{Q}] = 1 + K_{SV}[\text{Q}]. \quad (17)$$

*References 80F228 and 82E073.* Through the use of equation (17), $k_q$ was evaluated from the slope of a plot of $\Phi^0(\text{P})/\Phi(\text{P})$ vs [Q].

*Reference 81E458.* Because Q is S, $\Phi^0(\text{P})$ could not be measured; Eq. (18), which again neglects the contribution of *S–Q to the reaction, was used instead of Eq. (17). The slope/intercept ratio of the linear plot of $1/\Phi(\text{P})$ vs [Q] yields $K_{SV}$.

$$1/\Phi(\text{P}) = (k_0/k_{rx}) + (k_q/k_{rx})[\text{Q}]. \quad (18)$$

*Reference 84A141.* A more complex treatment is required when the measured photoreaction is assumed to originate from both the quenched excited state and a higher-energy, unquenchable excited state **S which is directly populated by irradiation. The light absorption step 1 of Sec. 2.2 is substituted by the following steps:

$$S \xrightarrow{I_a} {}^{**}S,$$

$${}^{**}S \xrightarrow{k''_{nr}} S,$$

$${}^{**}S \xrightarrow{k''_{rx}} \text{products},$$

$${}^{**}S \xrightarrow{k''_{ic}} {}^{*}S.$$
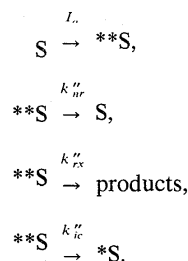
A steady-state treatment leads to Eq. (19). However, a plot of $\Phi^0(P)/\Phi(P)$ vs [Q] is no longer linear.

$$\Phi(P) = \frac{k''_{rx}}{k''_{nr} + k''_{rx} + k''_{ic}} \frac{\eta_{ic} k_{rx}}{k_0 + k_q [Q]}, \qquad (19)$$

where $\eta_{ic} = k''_{ic}/(k''_{nr} + k''_{rx} + k''_{ic})$.

At high [Q], $\Phi(P)$ reaches a lower limit given by Eq. (20), which is the quantum yield for the unquenchable reaction from **S.

$$\Phi(\lim) = k''_{rx}/(k''_{nr} + k''_{rx} + k''_{ic}). \qquad (20)$$

If $\Phi(\lim)$ can be evaluated, Eq. (21) can be applied, so that a plot of $\Phi^0(P)/[\Phi(P) - \Phi(\lim)]$ vs [Q] is linear with a slope/intercept ratio equal to $K_{SV}$.

$$\frac{\Phi^0(P)}{\Phi(P) - \Phi(\lim)}$$

$$= \left[ \frac{k_0 \Phi(\lim) + \eta_{ic} k_{rx}}{\eta_{ic} k_{rx}} \right]$$

$$+ \left[ \frac{(k_0 \Phi(\lim) + \eta_{ic} k_{rx}) k_q}{k_0 \eta_{ic} k_{rx}} \right] [Q]. \qquad (21)$$

*Mech.* [6] *Sensitized emission and reaction*

When a quenching process occurs, at least in part, via energy transfer, an excited state of Q, *Q, is produced which may undergo emission and/or photochemical reaction. The overall quenching constant can then be obtained by measuring the intensity of *Q emission or the quantum yield of its photoreaction under continuous irradiation. The following mechanism is used to determine $k_q$:

$$S \xrightarrow{I_a \eta^*} {}^{*}S,$$

$${}^{*}S \xrightarrow{k_0} S \text{ and/or products P},$$

$${}^{*}S + Q \underset{k_{-d}}{\overset{k_d}{\rightleftarrows}} {}^{*}S\text{-}Q,$$

$${}^{*}S\text{-}Q \xrightarrow{k_1} S + {}^{*}Q,$$

$${}^{*}S\text{-}Q \xrightarrow{k_2} \text{other processes},$$

$${}^{*}Q \xrightarrow{k_3} Q + \text{heat},$$

$${}^{*}Q \xrightarrow{k_4} Q + h\nu' \text{(sensitized emission)},$$

$${}^{*}Q \xrightarrow{k_5} \text{products P}' \text{ (sensitized reaction)}.$$
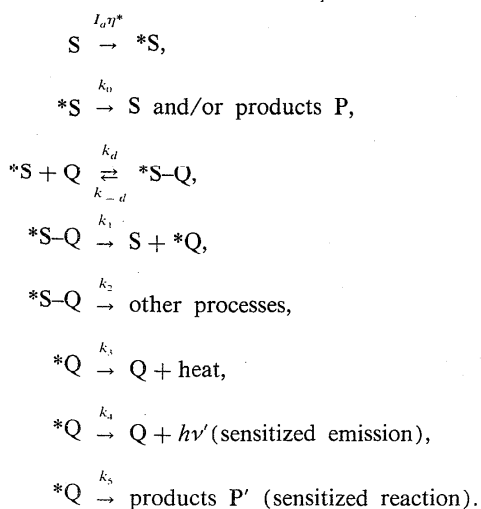
The step represented by $k_1$ has its analog in the ET step of reactions (12)–(16) in Sec. 2.4; $k_2$ represents all the other

processes involving *S–Q in reactions (8)–(10) of Sec. 2.3. Thus, $k_1 + k_2 = k_{de}$. A steady-state treatment applied to [*S], [*S–Q], and [*Q] leads to Eq. (22) for the emission intensity from *Q, where $\alpha$ is an instrumental factor.

$$\frac{1}{I_l} = \left[ \frac{(k_1 + k_2)(k_3 + k_4 + k_5)}{\alpha I_a \eta^* k_1 k_4} \right]$$

$$+ \left[ \frac{k_0(k_{-d} + k_1 + k_2)(k_3 + k_4 + k_5)}{\alpha I_a \eta^* k_1 k_4 k_d} \right]$$

$$\times \left[ \frac{1}{[Q]} \right]. \qquad (22)$$

Provided that Q does not contribute to the absorption of the exciting light, or that an appropriate correction is made, Eq. (22) indicates that a plot of $1/I_l$ vs $1/[Q]$ (S–V plot for the sensitized emission) should be linear; indeed, such a linearity is considered as evidence for the mechanism. Under these conditions, the intercept/slope ratio equals

$$[k_d(k_1 + k_2)]/[k_0(k_{-d} + k_1 + k_2)] = k_q/k_0 = K_{SV}.$$

In an analogous manner, Eq. (23) for the quantum yield of P' production can be written:

$$\frac{1}{\Phi(P')} = \left[ \frac{(k_1 + k_2)(k_3 + k_4 + k_5)}{\eta^* k_1 k_4} \right]$$

$$+ \left[ \frac{k_0(k_{-d} + k_1 + k_2)(k_3 + k_4 + k_5)}{\eta^* k_1 k_4 k_d} \right]$$

$$\times \left[ \frac{1}{[Q]} \right]. \qquad (23)$$

Equation (23) implies that a linear relationship exists between $1/\Phi(P')$ and $1/[Q]$ (S–V plot for the sensitized reaction), provided that Q neither absorbs the exciting light nor is substantially consumed during the irradiation period. From Eq. (23), intercept/slope $= k_q/k_0 = K_{SV}$.

*References 80E412 and 86E555.* Emission intensity from the excited quencher was measured under continuous irradiation conditions, and $k_q$ was calculated by the use of Eq. (22).

*References 85F395 and 86A158.* The quantum yield for the sensitized photoreaction of Q was measured under continuous illumination conditions, and $K_{SV}$ was evaluated by means of Eq. (23). In the first paper, however, $k_q$ was evaluated from the competition between the quenching of *S by Q and by $O_2$, where $k_6 = 3 \times 10^9$ L mol$^{-1}$ s$^{-1}$:

$${}^{*}S + O_2 \xrightarrow{k_6} S + {}^{*}O_2.$$
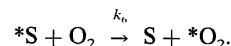
In the presence of $O_2$, the steady-state treatment yields Eq. (24),

$$\frac{1}{\Phi(P')} = \left[ \frac{(k_1 + k_2)(k_3 + k_4 + k_5)}{\eta^* k_1 k_5} \right] \left[ 1 + \frac{1}{K_{SV}[Q]} \right]$$

$$+ \left[ \frac{(k_1 + k_2)(k_3 + k_4 + k_5)k_6}{\eta^* k_1 k_5 k_q} \right] \left[ \frac{[O_2]}{[Q]} \right] \qquad (24)$$

Equation (24) predicts that a plot of $1/\Phi(P')$ vs $[O_2]/[Q]$ will be linear at constant [Q] with a slope/intercept ratio of $(k_6/k_q)/[1 + (K_{SV}[Q])^{-1}]$. From $K_{SV}$ determined in the absence of $O_2$, $k_q$ is obtained.

*Mech.* [7] *Primary products of electron transfer under continuous irradiation*

If *S–Q undergoes oxidative transfer (OT) to $S^+$–$Q^-$ or reductive transfer (RT) to $S^-$–$Q^+$, consideration must be given to the back electron–transfer reactions of the geminate pair ($S^{\pm}$–$Q^{\mp}$) within the solvent cage when evaluation of $k_q$ is made. The detailed mechanism is as follows:

$$S \xrightarrow{I_a\eta^*} {}^*S,$$

$$S \xrightarrow{k_0} S \text{ and/or } P,$$

$$^*S + Q \underset{k_{-d}}{\overset{k_d}{\rightleftarrows}} {}^*S\text{–}Q,$$

$$^*S\text{–}Q \xrightarrow{k_1} S^{\pm}\text{–}Q^{\mp},$$

$$^*S\text{–}Q \xrightarrow{k_2} \text{ other processes,}$$

$$S^{\pm}\text{–}Q^{\top} \xrightarrow{k_3} S^{\pm} + Q^+,$$

$$S^{\pm}\text{–}Q^{\mp} \xrightarrow{k_4} S + Q.$$
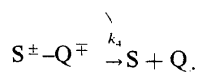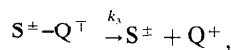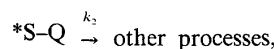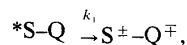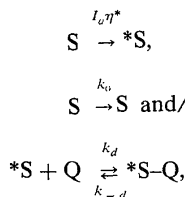
Application of the steady-state treatment to [*S], [*S–Q], and [$S^{\pm}$–$Q^{\mp}$] leads to Eq. (25),

$$[S^{\pm}\text{–}Q^{\mp}]_{ss} = \frac{I_a\eta^*k_1k_d[Q]}{[k_0(k_{-d} + k_1 + k_2) + k_d[Q](k_1 + k_2)](k_3 + k_4)} \tag{25}$$

The rate of primary production of $S^{\pm}$ and $Q^{\mp}$ in the bulk solution is

$$\frac{d[S^{\pm}]}{dt} = \frac{d[Q^{\mp}]}{dt} = k_3[S^{\pm}\text{–}Q^{\mp}].$$

The evaluation of $k_q$ from the quantum yield of $S^{\pm}$ or $Q^{\mp}$ formation, measured after a finite period of irradiation, is complicated by back electron-transfer reaction (26) between $S^+$ and $Q^{\mp}$ in the bulk solution, the rate of which increases with increasing [$S^{\pm}$] and [$Q^{\mp}$]. Different approaches have been used to overcome this difficulty.

$$S^{\pm} + Q^{\mp} \xrightarrow{k_5} S + Q. \tag{26}$$

*References 78A058 and 80F058.* In these cases, $Q^-$ is a Co(II) complex which decomposes via a transformation to P' much more rapidly than the occurrence of reaction (26), which can be neglected. Equation (27) results, which predicts a linear relationship between $1/\Phi(P')$ and $1/[Q]$, with an intercept/slope ratio equal to

$$[k_d(k_1 + k_2)]/[k_0(k_{-d} + k_1 + k_2)] = k_q/k_0$$

$$= K_{SV},$$

$$\frac{1}{\Phi(P')} = \frac{1}{\Phi(Q^-)} = \left[\frac{(k_1 + k_2)(k_3 + k_4)}{\eta^*k_1k_3}\right]$$

$$+ \left[\frac{k_0(k_{-d} + k_1 + k_2)(k_3 + k_4)}{\eta^*k_1k_3k_d}\right]$$

$$\times \left[\frac{1}{[Q]}\right]. \tag{27}$$

*Reference 84F351.* In this case, the solution contained a "sacrificial" electron-transfer reagent X which was able to react with $S^-$ to yield S and products with a rate constant $k_6$. When [X] is sufficiently high such that reaction (26) is of negligible importance and $k_6[X] \gg k_5[Q^+]$, the relationship between $\Phi(Q^+)$ and [Q] is expressed by Eq. (27).

*Reference 81A139.* In this case, a similar system was used, but with a concentration of X insufficiently high for reaction (26) to be rendered negligible. Under these conditions, and by assuming that $k_2 = k_4 = 0$, Eq. (28) was ob-

tained from a steady-state treatment of [*S], [*S–Q], [$S^-$–$Q$ ], and [$S^-$]:

$$\frac{d[Q^-]}{dt} = I_a\eta^*\left[\frac{k_q[Q]}{k_0 + k_q[Q]}\right]\left[\frac{k_6[X]}{k_5[Q^-] + k_6[X]}\right]. \tag{28}$$

Equation (28) shows that [$Q^-$] does not increase linearly with the irradiation time. The value of $d[Q^-]/dt$ at a given [Q ] was obtained at various [Q] and [X] from the tangent of a plot of [$Q^-$] versus irradiation time. The value of $K_{SV}$ was then obtained as the intercept/slope ratio from the linear plot of $dt/d[Q^-]$ vs $1/[Q]$ at constant [X], as expressed by Eq. (29),

$$\frac{dt}{d[Q^-]} = \left[\frac{k_5[Q^-] + k_6[X]}{I_a\eta^*k_6[X]}\right]$$

$$+ \left[\frac{k_0(k_5[Q^-] + k_6[X])}{I_a\eta^*k_6[X]k_q}\right]\left[\frac{1}{[Q]}\right]. \tag{29}$$

*Reference 83A333.* In this case, the same treatment as above was used, but $d[Q^-]/dt$ was evaluated from the initial slope of the plot of [$Q^-$] versus irradiation time.

*Reference 85F328.* In this case, back electron-transfer reaction (26) was prevented by means of competitive irreversible reaction (30); this latter reaction substitutes for all the reactions of $S^+$–$Q^-$ in the previous mechanism.

$$S^+\text{–}Q^- + X \xrightarrow{k_7} S + Q^- + \text{products.} \tag{30}$$
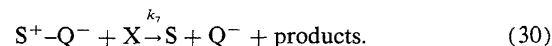
The quantum yield of formation of $Q^-$ as a function of [Q] is given by Eq. (31),

$$\frac{1}{\Phi(Q^-)} = \left[\frac{(k_1 + k_2)(k_4 + k_7[X])}{\eta^*k_1k_7[X]}\right]$$

$$+ \left[\frac{k_0(k_{-d} + k_1 + k_2)(k_4 + k_7[X])}{\eta^*k_1k_7[X]k_d}\right]$$

$$\times \left[\frac{1}{[Q]}\right]. \tag{31}$$

The plot of $1/\Phi(Q^-)$ vs $1/[Q]$ is linear, and the inter-

cept/slope ratio is again equal to $K_{SV}$. Note that [X] affects $\Phi(Q^-)$, but not $K_{SV}$.

*Mech.* [8] *Primary products of electron transfer upon pulsed irradiation*

*Reference 82F065.* $k_q$ was determined from the measurement of the concentration of a primary product $S^+$ resulting from the flash. The following mechanism was assumed, in which back electron transfer in the bulk solution is neglected:

$$S \xrightarrow{I_o \eta^*} {}^*S,$$

$$^*S \xrightarrow{k_0} S,$$

$$^*S + Q \xrightarrow{k_1} S^+ + Q^-,$$

$$^*S + Q \xrightarrow{k_2} \text{other quenching processes.}$$
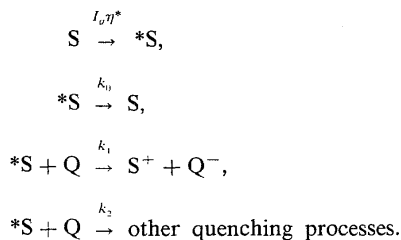
The quantum yield for the production of $S^+$ during the flash, assuming that the quenching is irreversible, is $\Phi(S^+) = k_1[Q]/(k_0 + k_q[Q])$, where $k_q = k_1 + k_2$;

$$1/\Phi(S^+) = (k_q/k_1) + (k_0/k_1[Q]).$$

Experimentally, $\Phi(S^+) = [S^+]_0/\int I_a \eta^*$, where $[S^+]_0$ is the concentration of $S^+$ just at the end of the flash, evaluated from absorbance measurements at various times after the flash and extrapolated to $t = 0$ in order to account for back electron transfer. The quantity $\int I_a \eta^*$ was obtained from actinometric measurements, using very complex numerical calculations in order to account for the changes in [S] (and [Q], inasmuch as this species absorbs a fraction of the exciting light) during the flash. From the intercept and slope of the linear plot of $1/\Phi(S^+)$ vs $1/[Q]$, $k_q$ and the efficiency of formation of the primary products in the bulk solution $(k_1/k_q)$ were obtained.

*Reference 80A023.* The time-dependent variation of the electrical conductivity of the solution after pulsed excitation was used to evaluate $k_q$ for the following ground-state electron-transfer quenching process:

$$^*S + S \xrightarrow{k_q} S^+ + S^-.$$
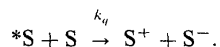
With the assumption that *S–Q does not contribute to the reaction, the rate of variation of the conductivity equals the rate of consumption of *S after the flash as given in Eq. (32). $k_q$ was obtained from the slope of the linear plot of $1/t_{1/2}$ (conductivity) vs [S].

$$[^*S]_t = [^*S]_0 \exp\{-(k_0 + k_q[S])t\}. \qquad (32)$$

*Reference 80E224.* $k_q$ was evaluated by means of photocurrent measurements taken after flash excitation. The proposed mechanism is:

$$S \xrightarrow{I_o \eta^*} {}^*S,$$

$$^*S \xrightarrow{k_0} S,$$

$$^*S + Q \quad k_q \begin{cases} \xrightarrow{k_1} S^+ + Q^- \\ \xrightarrow{k_2} S + {}^*Q \end{cases},$$

$$S + {}^*Q \xrightarrow{k_3} S^+ + Q^-,$$

$$^*Q \xrightarrow{k_4} Q,$$

$$S^+ + Q^- \xrightarrow{k_5} S + Q,$$

$$S^+ + e^- \rightarrow S \quad \text{(at the electrode)}.$$
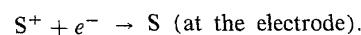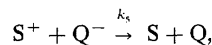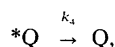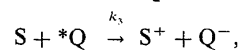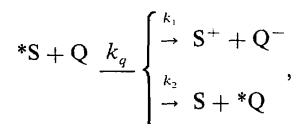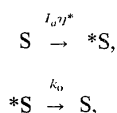
Inasmuch as the resolution time of the apparatus was of the order of $\mu$s, the reactions represented by $k_q$ and $k_3$ were considered to be complete at $t = 0$ after the flash. If the reaction represented by $k_5$ is considered to be of negligible importance during the flash, the concentration of $S^+$ at $t = 0$ is given by Eq. (33), where $I_f$ is the number of photons effectively absorbed by 1 dm³ of solution during the flash.

$$[S^+]_0 = \frac{I_f[Q]\{k_1 + (k_2 k_3[S]/(k_4 + k_3[S]))\}}{(k_0 + k_q[Q])}. \qquad (33)$$

By assuming that the reaction at the electrode is diffusion controlled, and by solving the equation describing the diffusion, Eq. (34) is obtained for the intensity of the photocurrent $i$ as a function of time after the flash, from which the product $\lambda[S^+]_0$, where $\lambda$ is a constant, can be evaluated. Inasmuch as $Q^-$ was initially present in excess before the flash, $[Q^-]$ is a constant value.

$$i = \lambda\,[S^+]_0 t^{-1/2} \exp(-k_5[Q^-]t). \qquad (34)$$

A linear plot of $1/\lambda[S^+]_0$ vs $1/[Q]$ was obtained experimentally. The rearrangement of Eq. (33) to Eq. (35) shows that the intercept/slope ratio of this plot is equal to $K_{SV}$.

$$\frac{1}{\lambda[S^+]_0} = \left[\frac{(k_q/\lambda I_f)}{k_1 + \{k_2 k_3[S]/(k_4 + k_3[S])\}}\right]$$
$$+ \left[\frac{(k_0/\lambda I_f)}{k_1 + \{k_2 k_3[S]/(k_4 + k_3[S])\}}\right]$$
$$\times \left[\frac{1}{[Q]}\right]. \qquad (35)$$

*Mech.* [9] *Quenching of higher-energy excited states*

If *S is indirectly populated from a higher-energy excited state **S and both *S and **S are quenched by Q, the light absorption step 1 of Sec. 2.2 must be substituted by the following reactions:

$$S \xrightarrow{I_a} {}^{**}S,$$

$$^{**}S \xrightarrow{k_1} S \text{ and/or } P,$$

$$^{**}S \xrightarrow{k_2} {}^*S,$$

$$^{**}S + Q \xrightarrow{k'_q} \text{quenching products.}$$
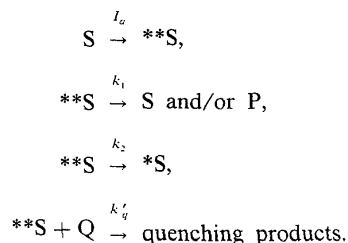
By making the steady-state approximation for [**S], [*S], and [*S–Q], and neglecting as usual any emission from *S–Q, one obtains Eq. (36) for the emission intensity of *S, where $K_{SV}$ is the S–V constant for the quenching of *S, and $K_h = k'_q/(k_1 + k_2)$. According to Eq. (36), the S–V plot of $I_l^0/I_l$ vs [Q] shows a positive deviation from linearity.

$$I_l^0/I_l = 1 + (K_{SV} + K_h)[Q] + (K_{SV}K_h)[Q]^2. \quad (36)$$

On the other hand, in flash experiments the quenching of **S results in a decrease of [*S]$_0$, but generally has no effect on its decay, provided that the lifetime of **S is much shorter than that of *S.

*Reference 74E519.* Although the S–V plot for $I_l$ from *S has negative deviation from linearity, its initial slope was taken as equal to $(K_{SV} + K_h)$ because the quadratic term in Eq. (36) is negligible for [Q] $\ll$ 1 mol/L. In addition, $K_h$ was considered to be small compared to $K_{SV}$; it is presumed that $k'_q \sim k_d$, and $(k_1 + k_2) \gg k_0$.

*Reference 79A220.* $k_q$ for the quenching of *S was obtained from lifetime measurements in the usual way; $k_q$ for the quenching of **S was determined from the measurement of [*S] and [S$^+$] at 50 $\mu$s after the flash. The following quenching modes for **S were assumed:

$$**S + Q \xrightarrow{k_3} *S + Q,$$

$$**S + Q \xrightarrow{k_4} S^+ + Q^-.$$
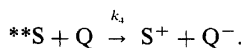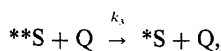
By assuming that at 50 $\mu$s after the flash all the reactions involving **S were completed while those involving *S had proceeded to a negligible extent, Eqs. (37) and (38) were obtained for the concentrations of *S and S$^+$ at that time ([*S]$_{50}$ and [S$^+$]$_{50}$, respectively).

$$[*S]_{50} = \frac{(k_2 + k_3[Q])I_a}{k_1 + k_2 + (k_3 + k_4)[Q]}, \quad (37)$$

$$[S^+]_{50} = \frac{k_4[Q]I_a}{k_1 + k_2 + (k_3 + k_4)[Q]}. \quad (38)$$

The ratio of Eq. (37) and (38) yields Eq. (39). From the intercept and slope of the linear plot of [*S]$_{50}$/[S$^+$]$_{50}$ vs 1/[Q], $k_2/k_4$ and $k_3/k_4$ can be evaluated. Values of $k_3$, $k_4$, and $k_q$ ($= k_3 + k_4$) were obtained by assuming that $k_2$, the rate constant for intersystem crossing between **S and *S, is in the range $10^7$–$10^8$ s$^{-1}$.

$$\frac{[*S]_{50}}{[S^+]_{50}} = \left[\frac{k_3}{k_4}\right] + \left[\frac{k_2}{k_4}\right]\left[\frac{1}{[Q]}\right]. \quad (39)$$

*Mech.* [10] *Quenching in the presence of triplet–triplet reactions*

Consider a triplet excited state that undergoes ground-state quenching and triplet–triplet reaction simultaneously:

$$*S \xrightarrow{k_0} S,$$

$$*S + S \xrightarrow{k_q} \text{quenching},$$

$$*S + *S \xrightarrow{k_1} S \text{ and/or products.}$$
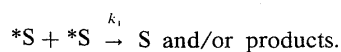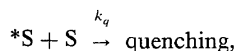
The decay of *S after pulsed excitation does not follow first-order kinetics: $-d[*S]/dt = K[*S] + k_1[*S]^2$, where $K = (k_0 + k_q[S])$.

*Reference 83A102.* $K$ and $k_1$ were evaluated by a best-fit procedure from the decay curves of the optical absorption of *S using Eq. (40), obtained from the solution of the differential equation above. Conversion of absorbances to concentrations was effected by using the following relationships: [*S]$_0$ = $(A_0 - A_b)/\epsilon$(*S) and [*S]$_t$ = $(A_t - A_b)/\epsilon$(*S), where $\epsilon$(*S) is the molar absorptivity of *S at the monitoring wavelength, and $A_b$, $A_0$, and $A_t$ are the optical absorbances before the flash, just after the flash, and at time $t$ after flash, respectively. $k_q$ was then obtained as the slope of the linear plot of $K$ vs [S].

$$[*S]_t = \frac{(K/k_1)}{\left[\dfrac{K}{k_1[*S]_0} + 1\right]\exp(Kt) - 1}. \quad (40)$$

*Reference 60E006.* For similar systems, $K$ was evaluated by means of Eq. (41), where $\epsilon$(S) is the molar absorptivity at the monitoring wavelength, $l$ is the optical pathlength, and $\epsilon$(*S), $A_b$, $A_0$, and $A_t$ have the same meaning as above.

$$\frac{d\{\ln[(A_0 - A_b)/(A_t - A_b)]\}}{dt}$$
$$= K + \left[\frac{(k_1 - k_q)(A_t - A_b)}{[\epsilon(*S) - \epsilon(S)]l}\right]. \quad (41)$$

The value of the derivative [left-hand side of Eq. (41)] was determined as the tangent to the plot of $(A_0 - A_b)/(A_t - A_b)$ vs $t$, and $K$ as the intercept of the plot of the derivative vs $(A_t - A_b)$.

*Reference 60A002.* The same treatment as above was applied to the quenching of *S by Q. Now, $K = k_0 + k_q[S] + k'_q[Q]$ in Eq. (41); $k'_q$ was evaluated from the plot of $K$ vs [Q] at constant [S]:

$$*S + Q \xrightarrow{k'_q} \text{products.}$$
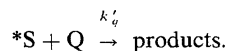
*Mech.* [11] *Static quenching*

Static quenching is a nondynamical process that results from the excitation of ground-state adducts between S and Q; static quenching may occur simultaneously with the dynamic quenching reaction, particularly when S and Q are ions of opposite sign:

$$S + Q \underset{}{\overset{K_{eq}}{\rightleftarrows}} S–Q.$$
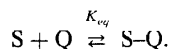
When the emission from *S (and *S–Q) is measured under steady-state conditions, the light absorption step of Sec. 2.2 must be replaced with the following reactions, where $I_a$ is the intensity of light absorbed by all the various S species, and $\chi$ is the fraction of the light absorbed by uncomplexed S; $\chi = (1 + K_{eq}[Q])^{-1}$ if S and S–Q have the same molar absorptivity at the exciting wavelength.

$$S \xrightarrow{I_a\chi} *S,$$

$$S–Q \xrightarrow{I_a(1-\chi)} *S–Q.$$
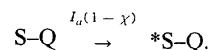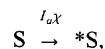
If it is assumed that $K_{eq} = k_d/k_{-d}$, the general steady-

state treatment leads to expressions for the dependence of the emission intensity on [Q]: Eq. (42) for irreversible

quenching [reaction (5) in Sec. 2.3], and Eq. (43) for reversible quenching [reaction (6) in Sec. 2.3]:

$$I_l^0/I_l = 1 + (K_{SV} + K_{eq})[Q] + K_{SV}K_{eq}[Q]^2, \tag{42}$$

$$\frac{I_l^0}{I_l} = \frac{1 + (K_{SV} + K_{eq})[Q] + K_{SV}K_{eq}[Q]^2}{1 + (1+\gamma)\{k_d[Q]/(k_{-d} + k_{de})\} + \gamma\{(k_0 + k_d[Q])K_{eq}[Q]/(k_{-d} + k_{de})\}}. \tag{43}$$

Equation (42) is a quadratic equation which shows positive deviation from linearity when $I_l^0/I_l$ is plotted against [Q]. Equation (43), on the other hand, tends toward a limiting value at high [Q]: $I_l^0/I_l(\text{lim}) = k_{de}/k_0\gamma$. Equation (43) reduces to Eq. (42) whenever the denominator of Eq. (43) is close to unity, in particular when $(k_{-d} + k_{de}) \gg k_d[Q]$ and $k_{de} \gg k_0$. If one assumes that $k'_{rd} = k_{rd}$, the condition that $k_{de} \gg k_0$ implies that the quantum yield of emission from *S–Q is much smaller than that from *S.

In pulsed excitation experiments, ground-state complexation between S and Q affects [*S] and [*S–Q] at $t = 0$ after the flash, but not their decay kinetics. Then, only the "dynamic" part of the quenching, which generally is monoexponential and exhibits a linear S–V plot, is monitored.

*References 80E669 and 81A250.* $k_q$ was obtained from steady-state emission intensity measurements by assuming that $I_l^0/I_l$ follows Eq. (42). In the first paper, however, the S–V plot has a negative deviation from linearity. In the latter paper, a value of $K_{eq}$ obtained from the Debye–Smoluchowski and Eigen equations, was used in the best-fit procedure to evaluate $K_{SV}$.

*Reference 85E375.* A biexponential decay of the emission after pulsed excitation was observed in the presence of static quenching. The values of $k_d$, $k_{-d}$, and $k_{de}$ were obtained through a best-fit procedure from $m_1$ and $m_2$ values at two different [Q], by assuming that $k'_{rd} = k_{rd}$, $k'_{nr} = k_{nr}$, and $k'_{rx} = k_{rx}$. The value of $k_q$ reported in this compilation was calculated by us using the values of $k_d$, $k_{-d}$, and $k_{de}$ quoted in this paper.

*Mech.* [12] *Ion-pairing of the substrate*

*Reference 86F346.* For the system where the substrate is Ru(bpy)$_3^{2+}$ and the quencher is MV$^{2+}$, it has been found that the quenching reaction is affected by both the nature and the concentration of added halide ions (X$^-$ = Cl$^-$, I$^-$). This behavior was attributed to the presence of ion pairs between S and X$^-$, their excitation, and subsequent quenching. The following mechanism was assumed:
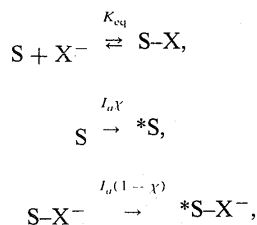
$$S + X^- \overset{K_{eq}}{\rightleftarrows} S–X,$$

$$S \overset{I_a\gamma}{\to} *S,$$

$$S–X^- \overset{I_a(1-\gamma)}{\to} *S–X^-,$$

$$*S \overset{k_{nr}}{\to} S + \text{heat},$$

$$*S \overset{k_{rd}}{\to} S + h\nu',$$

$$*S–X^- \overset{k''_{nr}}{\to} S–X^- + \text{heat},$$

$$*S–X^- \overset{k''_{rd}}{\to} S–X^- + h\nu'',$$

$$*S–X^- + Q \overset{k_q}{\to} \text{quenching}.$$
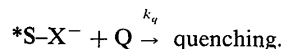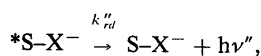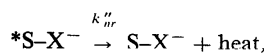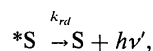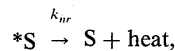
The quenching of "free" *S by Q, and ion pairing between Q and X$^-$ were ignored. A steady-state treatment, in which it was assumed that $\epsilon(S) = \epsilon(S–X^-)$ at the excitation wavelength, $k_{rd} = k''_{rd}$, and $k_{nr} = k''_{nr}$, leads to Eq. (44),

$$\frac{I_l^0}{I_l} = 1 + \frac{K_{eq}[X^-]K_{SV}[Q]}{1 + K_{eq}[X^-] + K_{SV}[Q]}. \tag{44}$$

In this treatment, [X$^-$] was taken to be equal to [X$^-$]$_0$, the concentration of X$^-$ in the initially prepared solution, inasmuch as [S] < [X$^-$]$_0$. Equation (44) is converted easily to Eq. (45),

$$Y = \frac{[Q]}{(I_l^0/I_l) - 1}$$

$$= \left[\frac{1}{K_{SV}}\right] + \left[\frac{1 + K_{SV}[Q]}{K_{eq}K_{SV}}\right] \times \left[\frac{1}{[X^-]}\right]. \tag{45}$$

A linear plot of $Y$ vs $1/[X^-]$ was obtained at constant [Q]; $K_{SV}$ was calculated directly from the intercept of this plot. It is worth noting that changes in [X$^-$] also caused changes in the ionic strength of the solution; this fact was not considered in the paper.

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Marshall, J.L.   82S130: *14.6;*   85E347: *14.3, 14.6,*
      *14.7, 14.8, 14.9, 14.10, 14.11, 14.15, 14.16, 14.17,*
      *14.18, 14.19;*   85E779: *9.6, 16.2;*   86S121: *14.6.*
Martins, M.J.T.   86N292: *29.18, 29.23.*
Matheson, M.S.   776406: *20.1;*   78A070: *20.1;*
      78A219: *20.1, 21.1;*   82N117: *21.1.*
Matsubara, T.   81N003: *19.11, 19.14, 19.17, 19.58,*
      *20.1, 21.1.*
Matsuda, M.   81F266: *21.1;*   83N153: *19.21, 19.58;*
      85F408: *21.1.*
Matsuo, T.   78A269: *19.58, 21.1;*   80N125: *19.37;*
      80N169: *19.37;*   81S011: *21.1, 22.1;*   85F007:
      *21.1;*   86N075: *29.16, 29.17.*
Mau, A.W.-H.   80S001: *19.35, 21.1, 22.1;*   82S257:
      *21.1, 22.1;*   83A008: *21.1;*   83N214: *19.53,*
      *19.54, 19.72;*   85F222: *19.14, 20.1, 21.1, 22.1;*
      85N094: *21.1;*   86F456: *21.1.*
Mauzerall, D.C.   75A245: *29.30;*   80A023: *29.9;*
      82E152: *29.9.*
Maverick, A.W.   83F069: *12.1.*
Mayer, E.   85A431: *19.24, 19.25, 19.57, 22.1.*
Mayo, S.L.   85A362: *4.18, 20.1.*
McBride, R.P.   777221: *9.2, 9.5, 14.4, 14.10, 14.13,*
      *14.14, 19.20, 19.21, 19.30, 19.59, 19.60, 19.61,*
      *19.62, 19.63.*
McCarthy, M.G.   85F222: *19.14, 20.1, 21.1, 22.1.*
McLendon, G.   82N022: *21.1.*
McMillin, D.R.   80F403: *5.2;*   85E063: *5.3;*   85E277:
      *5.2.*
Meares, C.F.   81E787: *24.7, 24.18.*
Meisel, D.   776406: *20.1;*   78A070: *20.1;*   78A219:
      *20.1, 21.1;*   82N117: *21.1.*
Mercer-Smith, J.A.   78A101: *15.4, 15.8, 16.4;*
      79E349: *15.8.*
Meyer, T.J.   747159: *20.1, 21.1;*   757168: *21.1;*
      767009: *7.5, 15.4, 19.30, 19.58, 19.68, 20.1,*
      *22.1;*   767528: *21.1;*   776441: *19.3, 19.4, 19.5,*
      *19.6, 19.8, 19.9, 19.33, 19.34, 22.1;*   777106:
      *21.1;*   77F920: *19.3, 19.4, 19.5, 19.6, 19.8, 19.9,*
      *19.33, 19.34, 21.1, 22.1;*   79C010: *21.1, 22.1;*
      80A259: *21.1;*   81C001: *19.71;*   81E203: *21.1;*
      82S130: *14.6;*   82S163: *20.1;*   85E347: *14.3,*
      *14.6, 14.7, 14.8, 14.9, 14.10, 14.11, 14.15, 14.16,*
      *14.17, 14.18, 14.19;*   85F051: *19.27, 19.28, 19.55;*
      86A052: *19.43;*   86S121: *14.6.*
Meyerstein, D.   78A219: *20.1, 21.1;*   85F140: *9.2.*
Mialocq, J.C.   84A264: *29.15;*   85A430: *29.15;*

Ramaswamy, B.S.    82F217:  *18.16.*

Raney, K.W.    84N050:  *14.5, 14.10, 14.12, 14.15,*
    *14.16, 14.18.*

Ratz, R.    83A402:  *21.2, 21.3.*

Rau, H.    82N184:  *20.1;*    83A402:  *21.2, 21.3;*
    83E621:  *20.1;*    86A140:  *22.1.*

Reed, J.L.    84E097:  *4.9, 4.10.*

Renge, I.V.    82A389:  *29.4, 29.24.*

Riccieri, P.    84E097:  *4.9, 4.10.*

Richardson, F.S.    776186:  *24.20;*    80E072:  *24.10.*

Richoux, M.-C.    80E669:  *29.27, 29.28;*    81A188:
    *11.8, 11.9;*    81F164:  *29.17;*    82A161:  *29.7,*
    *29.17, 29.29.*

Rieger, P.T.    85N199:  *19.17, 19.18, 19.19, 19.58,*
    *19.63.*

Rillema, D.P.    81C001:  *19.71.*

Rodgers, M.A.J.    80N138:  *21.1, 22.1.*

Rodman, G.S.    84E074:  *16.2.*

Romanovskaya, G.I.    81F325:  *28.1.*

Rosenfeld-Gruenwald, T.    80A291:  *20.1, 28.1;*
    82A353:  *28.1.*

Rossi, R.    78E300:  *28.1.*

Rougee, M.    82A306:  *29.19.*

Roy, J.K.    72E284:  *29.4;*    747293:  *11.3, 29.4, 29.9.*

Rumfeldt, R.C.    82E073:  *18.2, 18.4.*

Rybak, W.    81A250:  *14.1, 20.1.*

Rygalov, L.N.    727386:  *28.1.*

Sabbatini, N.    84F176:  *7.3;*    86E195:  *19.13, 19.15,*
    *19.19, 19.36, 19.38, 19.39, 19.42, 19.44, 19.47,*
    *19.48, 19.50, 20.1;*    86E832:  *7.1, 7.3, 24.4, 24.17.*

Saito, K.    82A068:  *20.1.*

Saji, T.    80E224:  *14.1, 14.4, 14.10, 19.14, 20.1.*

Sakamoto, T.    85F007:  *21.1.*

Sakurai, H.    81F381:  *21.1;*    84F069:  *21.1.*

Salama, S.    80E072:  *24.10.*

Salmon, D.J.    777106:  *21.1.*

Salokhiddinov, K.I.    81E738:  *2.1, 5.5, 15.2, 29.6.*

Sandrini, D.    776252:  *4.16;*    80F128:  *19.58, 20.1;*
    81E237:  *19.60;*    83E586:  *4.14;*    84A255:  *14.10,*
    *19.14, 19.17, 19.58, 20.1;*    84E372:  *19.30;*
    84E462:  *19.41, 19.42, 19.50, 19.51;*    84F249:
    *4.14;*    85A248:  *19.2, 19.42, 19.51, 21.1.*

Santus, R.    86A063:  *29.24.*

Sapunov, V.V.    74E520:  *5.4, 11.6, 15.1, 15.5;*
    76E693:  *11.6, 15.1, 15.3, 29.13, 29.24;*    85F493:
    *15.1.*

Sargeson, A.M.    85F222:  *19.14, 20.1, 21.1, 22.1.*

Sasaki, Y.    82A068:  *20.1.*

Sasse, W.H.F.    80S001:  *19.35, 21.1, 22.1;*    82S257:
    *21.1, 22.1;*    83A008:  *21.1;*    83N214:  *19.53,*
    *19.54, 19.72;*    85F222:  *19.14, 20.1, 21.1, 22.1;*
    85N094:  *21.1;*    86F456:  *21.1.*

Sassoon, R.E.    80A133:  *19.30;*    82N118:  *21.1;*
    85A387:  *19.29;*    85B030:  *19.30, 21.1, 22.1.*

Sauvage, J.P.    79F206:  *20.1;*    84S117:  *5.3.*

Scandola, F.    767517:  *4.14;*    78E518:  *4.14, 9.1, 21.1;*
    83S001:  *20.1;*    84B055:  *18.13;*    86A133:  *20.1;*
    86E555:  *9.4, 16.3.*

Scandola, M.A.R.    83S001:  *20.1.*

Schettler, P.D.,Jr.    86F346:  *22.1.*

Schindler, J.W.    82E553:  *16.1.*

Schmehl, R.H.    79E349:  *15.8;*    81N147:  *15.7;*
    85E552:  *15.7.*

Schuetz, R.    85A136:  *29.23, 29.24;*    86A508:  *29.25,*
    *29.26.*

Schwarz, H.A.    78A090:  *14.2, 14.4, 19.1, 19.11,*
    *19.14, 19.15, 19.17, 19.18, 19.19, 19.22, 19.58,*
    *20.1;*    82A278:  *19.1, 19.11, 19.14, 19.15, 19.16,*
    *19.18, 19.19, 19.58, 19.62, 21.1;*    83C017:  *19.11,*
    *19.14, 19.15, 19.17, 19.18, 19.19, 19.58, 21.1.*

Searle, N.    79F712:  *29.23, 29.24.*

Seddon, K.R.    85E617:  *19.23, 19.32, 19.45, 22.1.*

Seki, H.    85A013:  *8.2, 8.5;*    86A325:  *18.15, 18.17.*

Sergeeva, G.I.    767278:  *28.1.*

Serpone, N.    78F263:  *4.14, 14.4;*    79E270:  *4.3, 4.4,*
    *4.5, 4.6, 4.11, 4.12, 4.14, 4.18;*    81E458:  *4.1, 4.3,*
    *4.4, 4.5, 4.6, 4.7, 4.8, 4.11, 4.12, 4.13, 4.14, 4.18;*
    83A192:  *4.18;*    83E110:  *4.14;*    83E317:  *4.14,*
    *4.18.*

Sexton, D.    84A141:  *18.5, 18.6.*

Seymour, P.    85E218:  *19.24, 20.1.*

Shablya, A.V.    75E542:  *13.1.*

Shaffer, D.I.    86F346:  *22.1.*

Shagisultanova, G.A.    83A403:  *4.14, 14.4, 20.1;*
    83E719:  *4.14, 14.4, 20.1;*    85A469:  *4.14, 9.2,*
    *14.4, 20.1, 28.1.*

Shah, J.    80E664:  *24.4.*

Shakhverdov, P.A.    65A001:  *11.5, 11.6;*    67A003:
    *29.23, 29.24.*

Shakhverdov, T.A.    72E317:  *24.4, 24.19;*    73E367:
    *24.4;*    73E368:  *7.1, 24.4.*

Shand, M.A.    86A101:  *28.1;*    86F357:  *28.1.*

Shepherd, T.M.    756252:  *24.15;*    766073:  *24.15.*

Shimidzu, T.    85E075:  *19.31, 19.32.*

Shizuka, H.    85A013:  *8.2, 8.5;*    86A325:  *18.15,*
    *18.17.*

Shuto, Y.    78A269:  *19.58, 21.1.*

Skuridin, E.Yu.    84E308:  *11.7.*

Slama-Schwok, A.    85F140:  *9.2;*    86A057:  *9.2.*

Smalley, J.F.    83A102:  *11.4.*

Snyder, S.W.    85N199:  *19.17, 19.18, 19.19, 19.58,*
    *19.63.*

Solovev, K.N.    74E520:  *5.4, 11.6, 15.1, 15.5;*
    76E693:  *11.6, 15.1, 15.3, 29.13, 29.24.*

Sostero, S.    79F334:  *28.1.*

Sparks, R.H.    80F228:  *20.2.*

Spaulding, L.    83E604:  *24.2.*

Spikes, J.D.    86F214:  *29.28.*

Spreer, L.O.    86F171:  *20.1.*

Sprintschnik, H.W.    776441:  *19.3, 19.4, 19.5, 19.6,*
    *19.8, 19.9, 19.33, 19.34, 22.1;*    77F920:  *19.3,*
    *19.4, 19.5, 19.6, 19.8, 19.9, 19.33, 19.34, 21.1,*
    *22.1.*

Sriram, R.    81E458:  *4.1, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,*
    *4.11, 4.12, 4.13, 4.14, 4.18.*

Staryi, V.P.    80F472:  *29.14;*    81F368:  *8.4;*    82E636:
    *1.3, 11.7, 11.11.*

Stepanov, A.V.    84E828:  *28.1.*

Stiegman, A.E.    85E779:  *9.6, 16.2.*

**Strekas, T.C. 82F048:** *19.12, 20.1, 21.1;* **84E347:** *19.65.*

## 11.2. Index of Excited States

A locator *t.m* following a substrate name refers to table number *t* and excited state number *m*.

Pd(octaethylchlorin)  *15.3.*

Pd(2,3,7,8,12,13,17,18-octaethylporphyrin)  *15.4.*

Pd(tetrabenzoporphyrin)  *15.5.*

Pd[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$  *15.6.*

Pd[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$  *15.7.*

Pd(5,10,15,20-tetraphenylporphyrin)  *15.8.*

Pt(CN)$_4{}^{2-}$  *16.1.*

Pt$_2$[$\mu$-diphosphito(2-)-$P,P'$]$_4{}^{4-}$  *16.2.*

Pt(8-hydroxyquinolinato)$_2$  *16.3.*

Pt(5,10,15,20-tetraphenylporphyrin)  *16.4.*

*fac*-Re(CO)$_3$(5-Clphen)Cl  *17.1.*

*fac*-Re(CO)$_3$(4,7-Ph$_2$phen)Cl  *17.2.*

*fac*-Re(CO)$_3$(4-acetylpyridine)$_2$I  *17.3.*

*fac*-Re(CO)$_3$(4-benzoylpyridine)$_2$Cl  *17.4.*

*fac*-Re(CO)$_3$(bpy)Br  *17.5.*

*fac*-Re(CO)$_3$(phen)Cl  *17.6.*

*fac*-Re(CO)$_3$(4-phenylpyridine)$_2$Cl  *17.7.*

Re$_2$Cl$_8{}^{2-}$  *17.8.*

Rh(ND$_3$)$_6{}^{3+}$  *18.1.*

Rh(ND$_3$)$_5$Cl$^{2+}$  *18.2.*

Rh(NH$_3$)$_6{}^{3+}$  *18.3.*

Rh(NH$_3$)$_5$Br$^{2+}$  *18.4.*

Rh(NH$_3$)$_5$Cl$^{2+}$  *18.5.*

Rh(NH$_3$)$_5$I$^{2+}$  *18.6.*

Rh(4,7-Ph$_2$phen)$_3{}^{3+}$  *18.7.*

*cis*-Rh(4,7-Ph$_2$phen)$_2$Cl$_2{}^+$  *18.8.*

*cis*-Rh(bpy)$_2$Cl$_2{}^+$  *18.9.*

*trans*-Rh(cyclam)(CN)$_2{}^+$  *18.10.*

Rh$_2$(1,3-diisocyanopropane)$_4{}^{2+}$ [singlet]  *18.11.*

Rh$_2$(1,3-diisocyanopropane)$_4{}^{2+}$ [triplet]  *18.12.*

Rh(phen)$_3{}^{3+}$  *18.13.*

*cis*-Rh(phen)$_2$Cl$_2{}^+$  *18.14.*

Rh(5,10,15,20-tetraphenylporphyrin)Cl  *18.15.*

Rh(5,10,15,20-tetraphenylporphyrin)[OC(O)CH$_3$]  *18.16.*

Rh(5,10,15,20-tetraphenylporphyrin)(pyridine)Cl  *18.17.*

Ru(5-Brphen)$_3{}^{2+}$  *19.1.*

Ru(4,4'-Bu$_2$bpy)$_3{}^{2+}$  *19.2.*

Ru[4,4'-(COObz)$_2$bpy]$_3{}^{2+}$  *19.3.*

Ru[4,4'-(COOchl)$_2$bpy]$_3{}^{2+}$  *19.4.*

Ru[4,4'-(COOcyc)$_2$bpy]$_3{}^{2+}$  *19.5.*

Ru[4,4'-(COOdec)$_2$bpy]$_3{}^{2+}$  *19.6.*

Ru[4,4'-(COOet)$_2$bpy]$_3{}^{2+}$  *19.7.*

Ru[4,4'-(COOnap)$_2$bpy]$_3{}^{2+}$  *19.8.*

Ru[4,4'-(COOpr)$_2$bpy]$_3{}^{2+}$  *19.9.*

Ru(4,4'-Cl$_2$bpy)$_3{}^{2+}$  *19.10.*

Ru(5-Clphen)$_3{}^{2+}$  *19.11.*

Ru[4-(Et$_3$P)bpy]$_3{}^{5+}$  *19.12.*

Ru(3,3'-Me$_2$bpy)$_3{}^{2+}$  *19.13.*

Ru(4,4'-Me$_2$bpy)$_3{}^{2+}$  *19.14.*

Ru(3,4,7,8-Me$_4$phen)$_3{}^{2+}$  *19.15.*

Ru(3,5,6,8-Me$_4$phen)$_3{}^{2+}$  *19.16.*

Ru(4,7-Me$_2$phen)$_3{}^{2+}$  *19.17.*

Ru(5-Mephen)$_3{}^{2+}$  *19.18.*

Ru(5,6-Me$_2$phen)$_3{}^{2+}$  *19.19.*

Ru[4,7-(PhSO$_3$)$_2$phen]$_3{}^{4-}$  *19.20.*

Ru(4,7-Ph$_2$phen)$_3{}^{2+}$  *19.21.*

Ru(5-Phphen)$_3{}^{2+}$  *19.22.*

Ru[4,4'-(SO$_3$)$_2$bpy]$_3{}^{4-}$  *19.23.*

Ru(2,2'-bipyrazine)$_3{}^{2+}$  *19.24.*

Ru(3,3'-bipyridazine)$_3{}^{2+}$  *19.25.*

Ru(2,2'-bipyrimidine)$_3{}^{2+}$  *19.26.*

Ru$^{II}$[1,2-bis(phenylthio)ethane]$_2$Cl($\mu$-vio)Ru$^{II}$(bpy)$_2$Cl$^{2+}$  *19.27.*

Ru$^{II}$[1,2-bis(phenylthio)ethane]$_2$Cl($\mu$-vio)Ru$^{III}$(bpy)$_2$Cl$^{3+}$  *19.28.*

Ru(bpy)$_3{}^{2+}$  *20.1, 21.1, 22.1.*

(+)$_D$-Ru(bpy)$_3{}^{2+}$  *21.2.*

(−)$_D$-Ru(bpy)$_3{}^{2+}$  *20.2, 21.3.*

Ru(bpy)$_2$[(BUG)$_2$bpy]$^{n+}$  *19.29.*

*cis*-Ru(bpy)$_2$(CN)$_2$  *19.30.*

Ru(bpy)$_2$[4,4'-(COOH)$_2$bpy]$^{2+}$  *19.31.*

Ru(bpy)$_2$[4,4'-(COO)$_2$bpy]  *19.32.*

Ru(bpy)[4,4'-(COOchl)$_2$bpy]$_2{}^{2+}$  *19.33.*

Ru(bpy)$_2$[4,4'-(COOchl)$_2$bpy]$^{2+}$  *19.34.*

Ru(bpy)$_2$[4,4'-(COOet)$_2$bpy]$^{2+}$  *19.35.*

Ru(bpy)$_2$(4,4'-Cl$_2$bpy)$^{2+}$  *19.36.*

Ru(bpy)$_2$(Do$_2$Ca$_2$bpy)$^{2+}$  *19.37.*

Ru(bpy)(3,3'-Me$_2$bpy)$_2{}^{2+}$  *19.38.*

Ru(bpy)$_2$(3,3'-Me$_2$bpy)$^{2+}$  *19.39.*

Ru(bpy)$_2$(4,4'-Me$_2$bpy)$^{2+}$  *19.40.*

Ru(bpy)(Me$_2$dibenzoH$_2$phen)$_2{}^{2+}$  *19.41.*

Ru(bpy)$_2$(Me$_2$dibenzoH$_2$phen)$^{2+}$  *19.42.*

Ru(bpy)$_2$[5-(NH$_2$)phen]$^{2+}$  *19.43.*

Ru(bpy)$_2$[4-(NO$_2$)bpy]$^{2+}$  *19.44.*

Ru(bpy)[4,4'-(SO$_3$)$_2$bpy]$_2{}^{2-}$  *19.45.*

Ru(bpy)$_2$(acetylacetonato)$^+$  *19.46.*

Ru(bpy)$_2$(3,3'-biisoquinoline)$^{2+}$  *19.47.*

Ru(bpy)(3,3'-biisoquinoline)$_2{}^{2+}$  *19.48.*

Ru(bpy)$_2$(2,2'-bipyrimidine)$^{2+}$  *19.49.*

Ru(bpy)(2,2'-biquinoline)$_2{}^{2+}$  *19.50.*

Ru(bpy)$_2$(2,2'-biquinoline)$^{2+}$  *19.51.*

Ru(bpy)$_2$(en)$^{2+}$  *19.52.*

Ru(bpy)[2-(thiazol-2-yl)pyridine]$_2{}^{2+}$  *19.53.*

Ru(bpy)$_2$[2-(thiazol-2-yl)pyridine]$^{2+}$  *19.54.*

*cis*-Ru(bpy)$_2$(vio)Cl$^+$  *19.55.*

Ru(2,7-dimethyl-1,4,5,8-tetraazaphenanthrene)$_3{}^{2+}$  *19.56.*

Ru[4-methyl-2-(2-pyridyl)pyrimidine]$_3{}^{2+}$  *19.57.*

Ru(phen)$_3{}^{2+}$  *19.58.*

Ru(phen)$_2$(5-Brphen)$^{2+}$  *19.59.*

*cis*-Ru(phen)$_2$(CN)$_2$  *19.60.*

Ru(phen)$_2$(5-Clphen)$^{2+}$  *19.61.*

Ru(phen)$_2$[4,7-(PhSO$_3$)$_2$phen]  *19.62.*

Ru(phen)$_2$(4,7-Ph$_2$phen)$^{2+}$  *19.63.*

Ru(phen)$_2$(5-Phphen)$^{2+}$  *19.64.*

Ru[2-(phenylazo)pyridine]$_3{}^{2+}$  *19.65.*

Ru(phthalocyanine)(DMF)$_2$  *19.66.*

Ru(phthalocyanine)(pyridine)$_2$  *19.67.*

Ru(terpy)(bpy)(NH$_3$)$^{2+}$  *19.68.*

Ru(1,4,5,8-tetraazaphenanthrene)$_3{}^{2+}$  *19.69.*

Ru(5,10,15,20-tetraphenylporphyrin)  *19.70.*

Ru(5,10,15,20-tetraphenylporphyrin)(CO)  *19.71.*

Ru[2-(thiazol-2-yl)pyridine]$_3{}^{2+}$  *19.72.*

Sm$^{3+}$  *23.1.*

## 11.3. Index of Inorganic Quenchers

A locator *t.m.n* following a quencher name refers to table number *t*, excited state number *m*, and quencher number *n*.

$Tl^{3+}$   *3.1.5, 9.2.18, 20.1.229, 28.1.79.*
$Tl(OH)^{2+}$   *9.3.5.*
$UO_2^+$   *28.1.80.*
$UO_2^{2+}$   *20.1.230, 28.1.81.*
$V^V$   *28.1.82.*
$V(CO)_6$   *28.1.83.*
$W^{VI}$   *28.1.84.*
$W(CO)_6$   *28.1.85.*
$Yb^{3+}$   *28.1.86.*
Yb(etioporphyrin I)$^+$   *15.1.4, 15.3.1, 29.13.1.*
Zn(OEP)   *29.9.1.*
Zn(protoporphyrin)   *29.12.2.*
Zn(TPP)   *29.24.8.*
Zn(uroporphyrin I)   *29.30.6.*

## 11.4. Index of Organic Quenchers

A locator *t.m.n* following a quencher name refers to table number *t*, excited state number *m*, and quencher number *n*.

The following abbreviations are used to designate *parts* of organic quenchers:

**bpy$^{2+}$** 2,2'-Bipyridinium dication (in *N,N'*-disubstituted derivatives)
**H-3-pyl** Pyridinium-3-yl cation radical
**H-4-pyl** Pyridinium-4-yl cation radical
**Me-2-pyl** *N*-Methylpyridinium-2-yl cation radical
**Me-3-pyl** *N*-Methylpyridinium-3-yl cation radical
**Me-4-pyl** *N*-Methylpyridinium-4-yl cation radical
**phen$^{2+}$** 1,10-Phenanthrolinium dication (in *N,N'*-disubstituted derivatives)
**poly-2,4-ionene** Poly[(dimethylimino)-1,4-butanediyl(dimethylimino)-1,2-ethanediyl dication], Fig. 9
**py$^+$** Pyridinium cation (in *N*-substituted derivatives)
**sydnone** 1,2,3-Oxadiazol-5-one, Fig. 18 (in mono- and disubstituted derivatives)
**vio$^+$** 4-(4-Pyridyl)pyridinium cation (in *N*-monosubstituted derivatives)
**vio$^{2+}$** 4,4'-Bipyridinium dication (in *N,N'*-disubstituted derivatives)
**vioH$^{2+}$** 4-(4-Pyridyl)pyridinium cation, protonated (in *N*-monosubstituted derivatives)

Acetate ion   *21.1.1.*
2-Acetonaphthone   *see* 2-Acetylnaphthalene
cis-α-Acetoxystilbene   *21.1.2.*
1-Acetylanthracene   *7.1.7, 7.7.1.*
2-Acetylanthracene   *24.4.23.*
2-Acetylnaphthalene   *6.1.3, 24.4.24, 24.15.8.*
4-Acetylphenol   *21.1.3.*
cis-α-Acetylstilbene   *21.1.4.*
2-Acetylthiophene   *28.1.87.*
3-Acetylthiophene   *28.1.88.*
Acid Fuchsin   *24.4.25, 24.19.1.*
Acridine   *7.1.8, 24.4.26.*
Acridine Orange   *24.19.2.*

Acridine Yellow   *24.19.3.*
Acrylamide   *29.8.1.*
Allylacetic acid   *see* Pent-4-enoic acid
2-Amino-2-methylpropane   *see* *tert*-Butylamine
1-Aminonaphthalene   *4.14.65, 7.1.9, 7.2.1, 7.4.1, 21.1.5, 24.4.27, 29.8.2.*
2-Aminonaphthalene   *4.14.66, 21.1.6, 28.1.89.*
2-Aminophenol   *29.8.3.*
4-Aminophenol   *21.1.7.*
*N*-(4-Aminophenyl)aniline   *4.14.67, 19.2.1, 19.42.3, 19.51.2, 21.1.8.*
Aniline   *4.14.68, 7.1.10, 9.1.1, 17.2.1, 17.6.1, 19.24.10, 28.1.90.*
Aniline Bright Red B   *24.4.28.*
*p*-Anisidine   *see* 4-Methoxyaniline
Anthracene   *7.1.11, 7.2.2, 7.4.2, 7.5.1, 7.6.1, 7.7.2, 7.8.1, 7.9.1, 16.2.6, 17.1.1, 18.12.1, 21.1.9, 24.4.29, 27.1.1.*
Anthracene-9-carboxylate ion   *5.3.11, 21.1.10.*
9,10-Anthraquinone   *29.8.4.*
9,10-Anthraquinone-2,6-disulfonate ion   *19.30.43, 21.1.11, 29.20.1.*
9,10-Anthraquinone-2-sulfonate ion   *21.1.12.*
9,10-Anthraquinone-2-sulfonate ion, β-CD complex   *29.20.2.*
Ascorbate ion   *19.1.13, 19.11.37, 19.14.34, 19.15.16, 19.16.6, 19.18.16, 19.19.17, 19.58.60, 19.62.2, 21.1.13.*
Ascorbic acid   *28.1.91.*
D-Asparagine   *28.1.92.*
Auramine   *24.19.4.*
Aurin   *24.19.5.*
Azulene   *16.2.7, 18.12.2, 29.4.1.*
Benzaldehyde   *29.8.5.*
Benzene   *28.1.93.*
Benzenediazonium cation   *21.1.14, 29.23.2, 29.24.9.*
1,4-Benzenedicarboxylic acid, dinitrile   *see* 1,4-Dicyanobenzene
Benzenethiolate ion   *21.1.15.*
Benzidine   *see* 4,4'-Diaminobiphenyl
Benzoate ion   *21.1.16.*
Benzoic acid   *29.8.6.*
Benzophenone   *4.2.3, 18.11.1.*
Benzophenone-2-diazonium cation   *19.9.1.*
1,4-Benzoquinone   *1.1.13, 1.2.1, 1.3.1, 2.2.1, 4.19.1, 5.6.1, 8.4.1, 11.5.1, 11.6.10, 11.11.2, 15.8.1, 16.3.4, 18.11.2, 19.46.1, 19.52.1, 19.70.1, 21.1.17, 29.3.1, 29.8.7, 29.9.2, 29.11.9, 29.12.3, 29.23.3, 29.24.10.*
2,1,3-Benzothiadiazole-4,7-dicarbonitrile (Fig. 4)   *see* OrgQue6
*N*-Benzyl-3-carbamyl-py$^+$   *9.6.1, 14.3.1, 14.10.21, 14.11.1, 29.30.7.*
1-Benzyl-1,4-dihydronicotinamide   *21.1.18.*
Benzyldimethylamine   *see* *N,N*-Dimethylbenzylamine
Biacetyl   *9.2.19, 9.3.6.*
Biphenyl   *16.2.8.*
2,2'-Bipyridine, diprotonated   *see* bpyH$_2^{2+}$