Planar Hall effect in CrO_2

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For spin-electronic devices, a high spin polarization as well as a control of the spin orientation are of central importance. Recently, it was demonstrated experimentally that CrO_2 thin films are half-metallic, i.e. have a spin polarization of close to 100%. We show that magnetotransport experiments allow to directly measure the spin orientation in CrO_2 films.
To this end, we have patterned epitaxially grown CrO_2 thin films into Hall bars, with bar widths ranging from 200μm down to 200nm. Anisotropic magnetoresistance (AMR) measurements at 4.3K, with the external magnetic field applied in the film plane, reveal both a longitudinal (sheet) and a transverse (planar Hall) resistance. The observation of the planar Hall effect, as well as the analysis of the AMR as a function of the orientation of the in-plane magnetic field, unambiguously demonstrate the presence of two distinct magnetic easy axes in the plane of the CrO_2 films. CrO_2 thus is a biaxial magnetic system, while it is usually considered as uniaxial, with a small second-order uniaxial contribution, in the literature. We critically discuss our results in view of this discrepancy.

Sorting category: Dd Conducting electrons in condensed matter

Keywords: magnetism, spin transport, planar Hall effect

LT2120