Spin-orbit coupling effects in Fe/GaAs junctions

M. Gmitra[a], A. Matos-Abiague[a], C. Ambrosch-Draxl[b] and J. Fabian[a]

[a]Institute for Theoretical Physics, University of Regensburg, Universitaetsstrasse 31, D-93040 Regensburg, Germany

[b]Atomistic Modeling and Design of Materials, University of Leoben, Erzherzog-Johann-Strasse 3, A-8700 Leoben, Austria

The spin-orbit interaction, as a fundamental property of a particle motion and its spin, plays an important role in nowadays spintronics investigations. In particular, the spin-orbit coupling gives rise to the tunneling-magnetoresistance effect (TAMR). TAMR essentially means that the tunneling current depends on the direction of the magnetization of the ferromagnet; if strong enough, this anisotropy can give a nice spin-valve-like signal. Important, TAMR has recently been observed in a metallic system, namely, in Fe/GaAs/Au junctions. Surprisingly, while all the bulk components of the system are cubic, the observed anisotropy is twofold. This suggests that rather than coming from the bulk anisotropy of the density of states, the effect arises from the interface that indeed has a reduced symmetry. A phenomenological model reflecting this symmetry in the form of the Bychkov-Rashba and the Dresselhaus spin-orbit coupling was proposed, giving a quantitative fit to the experiment. In the talk we report on comprehensive ab initio calculations of the spin-orbit effects stemming from the interface anisotropy, providing strong support to the phenomenological theory. In particular, we have performed FPLAPW density functional calculations of an Fe/GaAs slab to extract quantitative information about the proposed model as well as to provide guidance to future experiments.

9.7 cm

13.4 cm

Subject category :

4. Spin Electronics and Magneto-Transport

Presentation mode :

oral

Corresponding author :

M. Gmitra

Address for correspondence :

Institute for Theoretical Physics, University of Regensburg, Universitaetsstrasse 31, D-93040 Regensburg, Germany

Email address :

martin.gmitra@physik.uni-regensburg.de