Ab initio investigation of domain walls in ferromagnetic films and wires

HEIKE C. HERPER, PETER ENTEL, Theoretical Physics, University of Duisburg-Essen, Lotharstrasse 1, D-47048 Duisburg — Domain walls can be viewed as special type of interfaces. In case of relatively thin domain walls a magnetoresistance effect can be observed due to the domain wall, which has been addressed in a considerable number of experimental and theoretical studies. However, only few ab initio investigations have been done in this field. We have determined the influence of domain walls on the resistance in ferromagnetic Co and Ni layers employing the fully-relativistic, spin-polarized Screened Korringa-Kohn-Rostoker method (SKKR) and the Kubo-Greenwood formula. In order to investigate the magnetoresistance in thin wires we made use of a real-space SKKR and Kubo-Greenwood method. The magnetoresistance and the formation energy of the domain walls have been calculated depending on the thickness and the type of the domain wall. As expected the formation energy decreases with increasing number of FM layers. Throughout this paper all domain walls are assumed to be oriented in the plane of layers. In order to avoid contributions from the anisotropic magnetoresistance the current flows perpendicular to the domain walls, i.e. parallel to the surface normal. The results support the predictions from Zhang and Levy concerning the width dependence of the domain wall resistance.

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