Spin-disorder resistivity of ferromagnetic metals: the disordered local moment approach

J. Kudrnovský*

Institute of Physics, Academy of Sciences of the Czech Republic,

CZ-182 21 Praha 8, Czech Republic

Abstract

The spin-disorder resistivity (SDR) of a broad class of magnetic metals including the transition metal ferromagnets (Fe, Co, Ni), the rare-earth ferromagnets (Gd to Tm), the ordered ferromagnetic alloys (Ni_3Mn and Fe_3Si), and Ni_2MnX (X=In,Sn,Sb) class of Heusler alloys was determined from first principles. We identify the SDR at the Curie temperature with the residual resistivity of the corresponding system evaluated in the framework of the disordered local moment (DLM) model which has the zero spin-spin correlation function. The underlying electronic structure is determined in the framework of the tight-binding linear muffin-tin orbital method which employs the coherent potential approximation (CPA) to describe the DLM state. The DLM fixed-spin moment approach is used in the case when the DLM moment collapses. The electronic structure of rare-earth ferromagnets was determined using both the open core and LDA+U approaches. The Kubo-Greenwood approach is used to estimate the DLM-resistivity. For bcc-Fe and Ni_2MnSn alloy we have also estimated the temperature-dependence of the resistivity below the Curie temperature using a semiempirical approach. Calculations are compared with an alternative supercell Kubo-Landauer approach developed recently in the framework of the current-perpendicular-to-plane (CPP) setup. An overall good agreement with available experimental data was obtained. In the case of Ni_2MnSb Heusler alloy an acceptable agreement with the experiment was obtained only if the native disorder present in the stoichiometric alloy is taken into account.

(*) Work was done in collaboration with V. Drchal, I. Turek, S. Khmelevskii, J.K. Glasbrenner, and K.D. Belaschenko