Kondo-Lattice Model: Application to Thin Ferromagnetic Local-Moment Films

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9.7 cm

We study correlation effects and temperature dependencies in the electronic structure of thin ferromagnetic local-moment films. In a first step the Kondo-lattice model is investigated as a candidate for a proper representation of local-moment ferromagnets. Magnetic and electronic key-quantities as the Curie-temperature and the quasiparticle density of states are derived with previously tested many-body procedures. It is shown that the magnetic properties can be interpreted exclusively in terms of the temperature-dependent electronic quasiparticle structure. An extended RKKY theory leads to effective Heisenberg exchange integrals, which turn out to be functionals of the conduction electron selfenergy, getting therewith a remarkable temperature and band occupation dependence.

In a second step the model studies are combined with tight binding-LMTO bandstructure calculations in order to get for real ferromagnetic films quasiparticle densities of states and quasiparticle bandstructures. The proposed method avoids the double-counting of relevant interactions and takes into account the correct symmetry of the atomic orbitals. Special results are given for thin ferromagnetic EuO (100) films. The Curie temperature T_C of the EuO film turns out to be strongly thickness-dependent, starting from a very low value ($\simeq$ 15 K) for the monolayer and reaching the bulk value at about 30 layers. For a 20-layer film we predict the existence of a surface state, the temperature-behaviour of which can lead to a surface halfmetal-insulator transition.

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