

Exchange Interaction between the Co^{2+} Ions with Degenerate Orbital States in CoO (Physics)

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Exchange Interaction between the Co^{2+} Ions with Degenerate Orbital States in CoO

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The kinetic exchange mechanism in Anderson's theory of superexchange is formulated for the case of Co^{2+} ion-pairs in CoO. The exchange interaction depends on the orbital angular-momentum operators as well as on the spin operators. The nearest neighbor interaction is shown to be largely anisotropic. The coefficients of the exchange interaction are estimated with the use of the following parameters: Mattheiss' APW result and its modification for the transfer integrals, Anderson's value for the effective Coulomb integral, and the experimental values for the intra-ionic exchange integral and the crystalline field splitting. The estimated values should be correct at least in order of magnitude on account of the fact that the same procedure in the cases of NiO and MnO give result in fairly good agreement with the experimental result. The potential exchange in CoO is also discussed.

Magnetic Anisotropy from Exchange Interaction and Magnetic Structure of CoO

Osamu NAKANISHI and Takemi YAMADA

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The problem of alternative magnetic structure in CoO, the collinear structure or the multi-spin-axis structure, is discussed in connection with the origin of the large tilt angle of spin axes observed by neutron diffraction. Magnetic anisotropy energies from the orbital-momentum dependent exchange interaction in the two model structures are estimated and compared with the other contributions from Kanamori's mechanisms. It is shown that the spin axes can tilt by a large angle only in the collinear structure in virtue of a cancellation of the two contributions, one from the tetragonal deformation of the lattice and the other from the kinetic exchange. The situation is reversed in the multi-spin-axis structure. The multi-spin-axis model is therefore rejected from a theoretical point of view.