

Magnetoelectric Effects in Multiferroics

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Magneto electric phenomena were investigated for two different classes of multiferroics: The coupling of dielectric and magnetic properties and the simultaneous occurrence of long-range magnetic and polar order are discussed for manganites and for spinels. In addition to the pure rare earth manganites, $\text{Eu}_{1-x}\text{Gd}_x\text{MnO}_3$ is investigated as function of temperature and magnetic field. As a function of lattice parameters, these solid solutions resemble the main features of the well-known phase diagram of the rare earth manganites, however with no interference of the rare-earth magnetism with the multiferroic behaviour which are driven by the manganese spins coupled to polar displacements. Special attention is paid to the occurrence of fundamentally new excitations, i. e. electromagnons which can be characterized as spin waves excited by an ac electric field. As a function of magnetic field, the optical weight can be transferred from these new excitations to a low-lying phonon branch. At the same time this transfer of optical weight results in considerable changes of the index of refraction. In the second part we discuss the simultaneous occurrence of colossal magnetoresistance and colossal magneto capacitance in ferromagnetic CdCr_2S_4 and in antiferromagnetic HgCr_2S_4 which reveals a complex spiral spin structure at low temperatures. We speculate that the occurrence of ferroelectricity in these compounds results from slight doping of the pure compounds and rather is of electronic than of ionic origin.

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