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Magnetic Order and Spin Dynamics in Multiferroic $HoMnO_3$ and Related Systems

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Hexagonal $HoMnO_3$ is a c-axis ferroelectric (T_C=875 K) that couples to the antiferromagnetism at 72 K (1). The S=2 Mn^{3+} ions occupy a frustrated triangular lattice, with the spins forming a non-collinear 120° magnetic structure from 72 to 40 K, and then undergoing a spin-flop transition to another 120° Mn spin structure below. The spin wave dispersion relations are well described by a two-dimensional nearest-neighbor Heisenberg model with exchange J=2.44 meV, and an anisotropy D that is 0.093 meV above the spin reorientation transition at 40 K, increasing to 0.126 meV below. For H$\|$c the phase diagram has been determined, and reveals a re-entrant phase boundary for the structure below 40 K, and additional hysteretic transitions below the magnetic ordering temperature of 8 K for the holmium spins. The effects of an applied electric field in the magnetically ordered phases will be discussed. We also briefly describe the effects of A-site chemical disorder on the ferromagnetic phase transition and spin dynamics of the $La_{1-x}Ba_xMnO_3$ perovskite (2). The dramatically reduced Curie temperature of the disordered system primarily originates from the enhanced polaron formation that truncates the ferromagnetic state, rather than a reduction in the exchange. The overall behavior observed in the CMR regime of the manganites is quite similar to that observed in the relaxor ferroelectrics as well as the spin and charge stripes found cuprate oxides, demonstrating a commonality of many of the underlying physical concepts of these perovskite oxides.

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(2) Work in collaboration with T. Sato and B. Dabrowski

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