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Magnetism at the Edge; New Phenomena at Oxide Interfaces.

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Abstract

Magnetism in oxides is normally associated with transition-metal ions with a partly-filled *d* (or *f*) shell. The common ferrite magnets, $BaFe_{12}O_{19}$ and $SrFe_{12}O_{19}$, which are produced in quantities in excess of 1 million tons per annum, are the best example. In recent years techniques have been perfected to produce oxide thin films and heterostructures, following the high-T_C superconductor boom. Beginnng with colossal magnetoresistance in mixed-valence manganites, these thin films often exhibit magnetic properties that are quite different to those of the bulk material. These differences can often be traced to the influence of the surface or interface with the substrate (often another oxide such as $SrTiO_3$ or MgO). Oxide-oxide interfaces are full of surprises, especially when one of them is polar and charge transfer occurs at the interface to avoid a polar catastrophe. The $LaAlO_3/SrTiO_3$ interface is the best example. The formation, location and magnetism of the resulting two-dimensional electron gas will be discussed. The onset of such charge transfer can abruptly change the magnetic properties of oxide layers a few unit cells thick. More puzzling are the observation of magnetic coupling across thick layers of nonmagnetic polar insulators, and the elusive temperature-independent d^0 magnetism of some thin films and nanoparticles, which may it may not be possible to accommodate in the current paradigm of magnetism in solids.