New Understanding of Manganites: Another Nanoscale Engineering Approach

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LOS ALAMOS, N.M., June 3, 2004 -- University of California researchers working at Los Alamos National Laboratory recently unveiled a new theory explaining the strange coexistence of metallic and insulating phases in the crystals of a mineral called perovskite manganite. The theoretical framework they present could provide a basis for the engineering of nanoscale metallic and insulating phase patterns in manganites. Such phase patterns could be useful in the computer industry's quest to miniaturize computer disk drive heads beyond their current size limitations.

In a paper published in the March 25 issue of the scientific journal Nature, Los Alamos scientists Ken Ahn, Turab Lookman and Alan Bishop theorize that the presence of metallic and insulating phases in perovskite manganite are strain-induced, caused by pressures applied to the mineral's structure lattice during formation. Perovskite manganite, or manganite, is a steel-gray or black mineral that occurs as crystals of manganese ore. Perovskite refers to the cubic crystal form the manganite may take.

According to Lookman, a physicist in the Theoretical Division, a better understanding of the nanoscale structure of manganites is more than simply an academic adventure. "If the computer industry is going to continue to miniaturize electronics beyond silicon's current limitations, it will probably be necessary to look at materials like manganites, where, for example, nanoscale structures such as coexistent metallic and insulating phases can be built within media that are otherwise

homogenous," Lookman said.

The evolution of computer drives has been made possible to a significant extent by a better understanding of magnetoresistance in materials. In 1988, a property called "gigantic magnetoresistance" (GMR) was discovered in certain materials that made them useful for creating better magnetic read heads for computer disk drives. In 1994, a more powerful magnetoresistance phenomenon known as "colossal magnetoresistance" (CMR) was discovered in manganite and other materials with perovskite crystalline structure that made them appealing to industry as potential materials for use in a new generation of miniature magnetic read heads for computer disk drives. While GMR-based technologies are now used in most hard drives, CMR has been less widely understood and therefore not been applied.

The Los Alamos discovery could lead to advanced electronic applications of CMR in the future, if the strain-induced metallic and insulating phases can be replicated at nanoscales using electromagnetic radiation, explained Lookman.

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Find the original press release here.