Unexpected magnetism discovered

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Theoretical work done at the Department of Energy's Oak Ridge National Laboratory has provided a key to understanding an unexpected magnetism between two dissimilar materials.

The results, published in *Nature Communications,* have special significance for the design of future electronic devices for computations and telecommunications, according to co-author Satoshi Okamoto of ORNL's Materials Science and Technology Division. The work was performed at Universidad Complutense de Madrid, synchrotron radiation facilities in France and Japan, University of Bristol and University of Warwick.

"What the team found was an unexpected magnetic order among the titanium atoms at an interface between strontium titanate and lanthanum manganite, which are both insulators in bulk," Okamoto said.

With today's nano-fabrication tools, scientists can develop artificial materials with controlled precision – almost atom by atom – of alternating very thin crystalline layers of different materials. The properties of these materials are determined by the structure of interfaces of the different materials and how atoms interact through the interfaces.

Such an interface has traditionally been considered a source of disorder, but in the case of materials such as complex oxides used for this study, the result was something that does not exist naturally in any other material. In order to clarify the electronic properties of such interfaces, the research team made detailed synchrotron X-ray measurements.

"The result was even more surprising as we observed a new type of magnetism in titanium atoms, which are non-magnetic in bulk strontium titanate," Okamoto said.

Furthermore, the researchers were able to manipulate the structure of spin, or magnetism, at atomic scale. The theoretical work by Okamoto provided the key to understand the origin of this novel form of interfacial magnetism and is of particular importance for the development of new spintronic devices such as tunneling magneto-resistance junction, which can be used as a head of a hard-disc drive.

While today's electronic devices are based on the transfer of electrical charge between two materials, a potential alternative, spintronic devices, would also use the magnetic moment, or spin, of electrons in addition to their charge and would therefore be more efficient for sending or storing information as an electric signal.

More information: The research, published Sept. 21 (www.nature.com/ncomms/journal/ … /abs/ncomms1080.html), was led by Jacobo Santamaria of Universidad Complutense de Madrid. The paper is titled "Spin and orbital Ti magnetism at LaMnO3/SrTiO3 interfaces."

Provided by Oak Ridge National Laboratory

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