Study uncovers new materials interactions that could improve data storage

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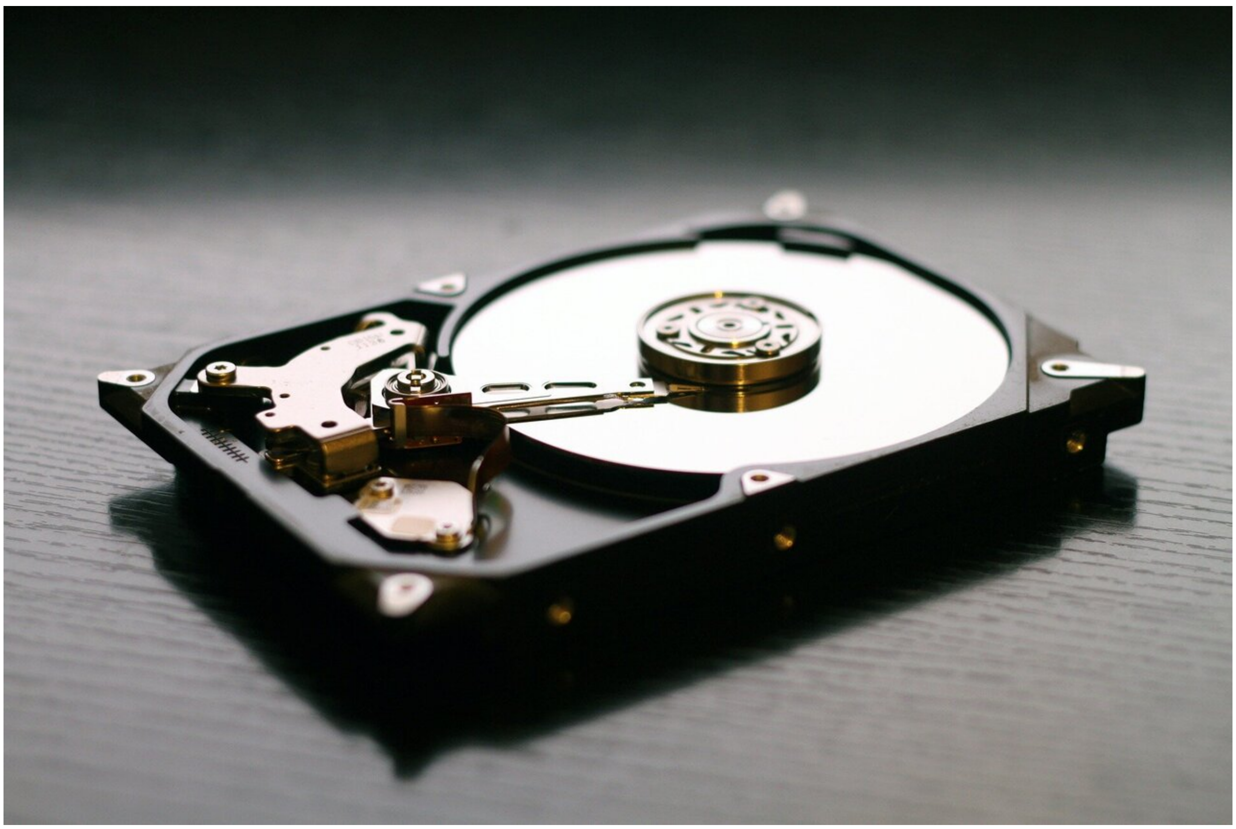

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A new study provides insight into multiferroic materials, which could have substantive implications in fields such as data storage.

The study looked at lanthanum cobaltite ($LaCoO_3$ or LCO), a thin crystalline film that, once grown on a substrate, can be analyzed through electron microscopy and polarized neutron reflectometry to measure electron density and differences in magnetization, respectively.

LCO is special because it is a ferroelastic material, meaning that its properties will change in response to a stressor and retain the changes after the stressor has been removed.

An ultrathin film of LCO—one whose thickness is about 12 nanometers, or 12 thousand-millionths of a meter—is especially unique because it is also a ferromagnet. The combination of being ferroelastic and a ferromagnet means ultrathin LCO is a multiferroic—a material with elastic and magnetic properties that can change under stress or by magnetic fields. This means the material could, in principle, record the stress of its environment as magnetic information.

"An important finding was that by growing the LCO films on chemically different substrates, or bases, we could change the magnetic properties of the film," said Michael Fitzsimmons, a joint physics professor at the University of Tennessee, Knoxville, and Oak Ridge National Laboratory and leader of the Thin Films and Nanostructures Group in ORNL's Neutron Scattering Division. Being able to easily manipulate a substance's ferromagnetic properties is an important step in creating devices that require less energy to operate. In the case of LCO, the connection between its ferroelastic and ferromagnetic properties would drastically cut down on the amount of energy currently required by current magnetic technology.

"An example is a magnetic read head, a piece used in digital storage units," Fitzsimmons said. "A magnetic field changes the alignment of a small region of magnetic material—its direction represents some information." This type of magnetic field is produced by a current pulse, which takes a significant amount of energy.

"If instead we could change the direction of magnetization by applying electric charge without passing current, then we wouldn't need so much energy," Fitzsimmons said.

"One aim is to create devices that can do new things like sense light, chemical composition, magnetic fields, or heat, or manipulate and store data in compact objects that do not require much energy to operate."

Provided by University of Tennessee at Knoxville

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