Lasers could make hard drives faster, simpler and higher density

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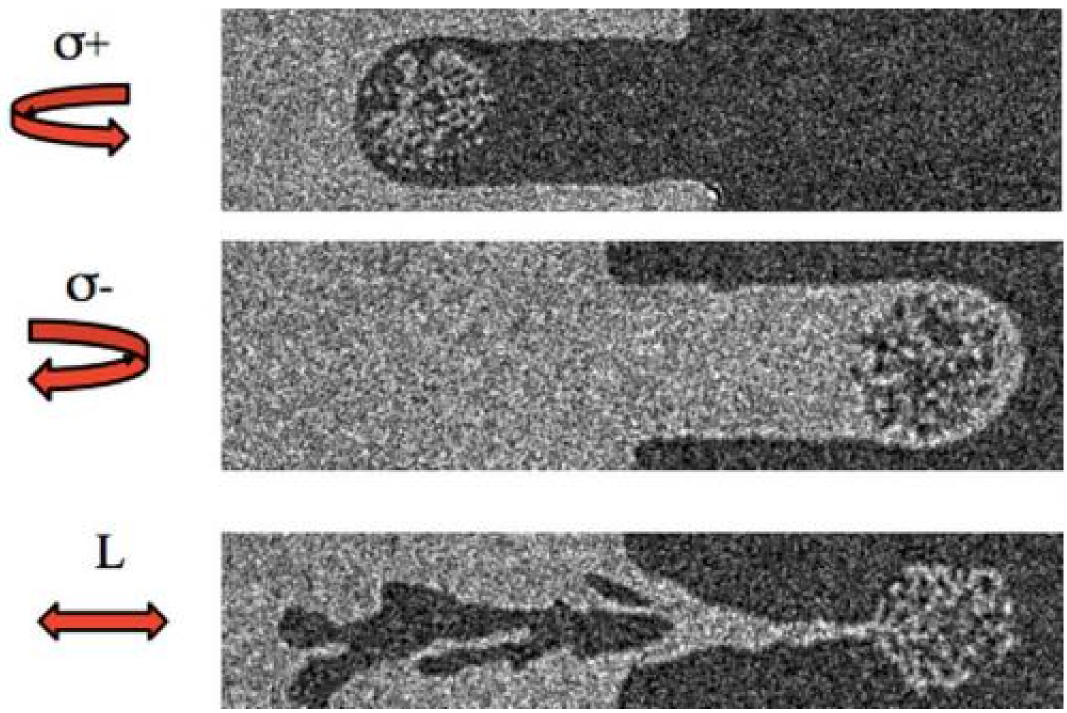

Images of magnetic domains in a cobalt platinum (Co/Pt) alloy multilayer film exposed to laser light where dark gray indicates one magnetization orientation, while the light gray indicates an opposite orientation. The images show that the final direction of magnetization can be controlled using circularly polarized light without the use of magnetic fields.

(Phys.org) —Researchers at the University of California, San Diego have discovered that for a wide range of ferromagnetic materials the direction of magnetization can be completely controlled by polarized light without the need for magnetic fields, a finding that could significantly affect the data memory and storage industries that produce hard disks and magnetic random access memories. Their research, published Aug. 21 in the journal *Science Express*, focused on materials currently being developed for high-density storage applications.

Ferromagnetism's most familiar form is the humble refrigerator magnet, but it is also a core component in many electrical devices, including magnetic storage used in commercial computing applications. In traditional magnetic storage devices magnetic bits are switched using magnetic fields, a slow process that consumes considerable energy and is reaching its density limits.

"Our results showing that it is possible to switch magnetic bits using only the polarization of light could significantly simplify the design and improve the speed of magnetic recording," said electrical engineering professor Eric Fullerton, director of UC San Diego's Center for Magnetic Recording Research."Magnetic storage is emerging in the memory market due to demands for higher-density, fast, and low power non-volatile memory. As industry trends toward silicon nanophotonics, miniaturization, and photonic-electronic integration the ability to couple photonic, electronic, and magnetic materials could enable completely new applications."

Fullerton is also a professor of nanoengineering at UC San Diego Jacobs School of Engineering.

Led by Fullerton, the international and interdisciplinary research team tested a rapid-pulse laser at a variety of ferromagnetic materials including magnetic thin films, multilayers and granular films. Previously, scientists have only been able to use all-optical control on a small set of ferrimagnetic materials that did not lend themselves for data storage applications.

The next step is to scale the technology to be able to write data on the nanoscale (vs. the microscale as the team demonstrated) and time scales required for magnetic recording.

"There is also a lot of work to understand the underlying mechanisms for optical switching of ferromagnets," said Fullerton. "We showed it works. Why it works and how to optimize it for applications still need to be addressed."

The research team includes first author Charles-Henri Lambert a Ph.D. student at the University of Lorraine in France who participated in the research as a visiting student at UC San Diego and second author Stephane Magin, also of the University of Lorraine, who was on sabbatical at UC San Diego at the time.

The paper is "All-optical control of ferromagnetic thin films and nanostructures." In addition to Magin and Lambert, the international researcher partners included scientists from the National Institute for Materials Science in Japan and the University of Kaiserslautern in Germany. The research was funded in part by an Office of Naval Research Multidisciplinary University Research Award.

More information: "All-optical control of ferromagnetic thin films and nanostructures." Charles-Henri Lambert, Stephane Mangin, B. S. D. Ch. S. Varaprasad, Y.K. Takahashi, M. Hehn, M. Cinchetti, G. Malinowski, K. Hono, Y. Fainman, M. Aeschlimann, Eric E. Fullerton arXiv:1403.0784 [cond-mat.mtrl-sci]. arxiv.org/abs/1403.0784

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