Application of light-switched magnets within reach

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A minuscule antenna which focuses a bundle of light is a technological development that has suddenly brought light-enabled magnetic storage of data within reach. In an article which appeared this week in *Nano Letters*, Radboud University physicist Theo Rasing demonstrates that magnetic switching with light is now possible on a surface area of just 40 nanometres. He did the research in an international team composed of members from Japan, Germany and the United States.

The Nijmegen discovery that magnets could also be switched using light pulses had been interesting, but largely theoretical up till now. For practical data storage the principle was too coarse as the switching surface could not be reduced to much less than half the wavelength of the light being used, in other words, about 300 nm. The current magnetic switching techniques can function on a much smaller scale, and commercial hard disks are making use of this.

Golden antennas

Light can be concentrated by means of an antenna. Just like the old radio antenna on the roof could pick up and concentrate waves 300-1000 metres long, these golden antennas which Rasing uses, can focus light with a wavelength of 800nm onto a 40-nm surface. As a result, Theo Rasing, professor of Spectroscopy of Solids and Interfaces, was the centre of interest at the most important conference on magnetic data recording industry in the US.

Even handier

"We have the technology. The read/write heads of the next generation of hard disks which will be using heat-assisted magnetic recording (HAMR) already contain a laser. We've shown you can make this work even better. Instead of using laser heat to help the magnet write data, you can use light to write data to the disk both quickly and efficiently, without needing an external magnet."

One advantage of the technique is that it uses less energy than the present method of storing data. The heat produced by present-day data centres leads to all sorts of problems, and cooling is expensive.

"Suddenly a whole lot of other universities are working with light and magnetism too. And they're using the new technological developments, such as the group in Berkeley and the large San Diego Center for Memory and Recording. That's good news."

Solving world energy problem

Theo Rasing received the Spinoza Prize in 2008 for his discovery that light can influence magnetisation. "Of course that was very interesting for physicists, and an exciting discovery. But now that an application is becoming realistic, I feel extremely enthusiastic about this technique being able to help solve a serious worldwide energy problem.

To do that really well we'll have to stop using hard disks. Quite apart from how much data fits onto a disk, 90% of the energy it uses for data storage is actually required for turning the disk. However, we already have some ideas for how we'll be able to apply concentrated light switching in low-energy MRAM memories. So watch this space …."

More information: Tian-Min Liu et al. Nanoscale Confinement of All-Optical Magnetic Switching in TbFeCo - Competition with Nanoscale Heterogeneity, *Nano Letters* (2015). DOI: 10.1021/acs.nanolett.5b02743

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