World record data density for ferroelectric recording

August 17 2010

Scientists at Tohoku University in Japan have recorded data at a density of 4 trillion bits per square inch, which is a world record for the experimental "ferroelectric" data storage method. As described the journal *Applied Physics Letters*, which is published by the American Institute of Physics, this density is about eight times the density of today's most advanced magnetic hard-disk drives.

The data-recording device scans a tiny cantilever tip that rides in contact with the surface of a ferroelectric material. To write data, an electric pulse is sent through the tip, changing the electric polarization and nonlinear dielectric constant of a tiny circular spot in the substrate beneath. To read data, the same tip detects the variations in nonlinear dielectric constant in the altered regions.

"We expect this ferroelectric data storage system to be a candidate to succeed magnetic hard disk drives or flash memory, at least in applications for which extremely high data density and small physical volume is required," said Dr. Yasuo Cho.

In earlier experiments, the researchers had noticed one problem: When the data being written required that several consecutive marks be written next to each other, the written polarized regions expanded the normal diameter and coalesced to the point the bits were not distinct. Cho and Kenkou Tanaka then developed a method for anticipating strings of consecutive marks in the data and reducing the writing-pulse voltage by up to about 10 percent, which resulted in clear and distinct data marks.

While ferroelectric storage has the advantage of using only electric methods -- nothing magnetic or thermal -- to achieve its record-high density, Cho and Tanaka are well aware that many practical improvements would be needed for commercial viability. Such advances would include increasing the speed and accuracy of reading the data and developing a low-cost ferroelectric substrate.

Another risk is that existing data storage technologies continue to improve beyond the ferroelectric's capabilities. Disk drive maker Seagate, for example, has said it can envision achieving a density of 50 trillion bits per square inch.

Provided by American Institute of Physics