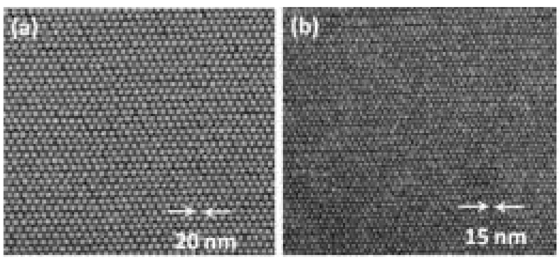
Packing in six times more storage density with the help of table salt

October 14 2011



Scanning electron microscopy images of magnetic bits at densities of (a) 1.9 Terabit/in2 and (b) 3.3 Terabit/in2 formed after depositing Co/Pd multilayers onto resist structures.

(PhysOrg.com) -- Dr Joel Yang from the Institute of Materials Research and Engineering (IMRE), a research institute of Singapore's Agency for Science, Technology and Research, with collaborators from the National University of Singapore (NUS) and the Data Storage Institute (DSI) has developed a process that can increase the data recording density of hard disks to 3.3 Terabit/in^2, six times the recording density of current models. The key ingredient in the much enhanced patterning method that he pioneered is sodium chloride, the chemical grade of regular table salt.

It's like packing your clothes in your suitcase when you travel. The neater you pack them the more you can carry. In the same way, the team of scientists has used nanopatterning to closely pack more of the miniature structures that hold information in the form of bits, per unit area. Dr Joel Yang's IMRE research team has used nanopatterning to create uniform arrays of magnetic bits that can potentially store up to 3.3 Terabit/in^2 of information, six times the recording density of current devices. This means that a hard disk drive that holds 1 Terabyte (TB) of data today could, in the future, hold 6 TB of information in the same size using this new technology.

Conventional hard disks have randomly distributed nanoscopic magnetic grains - with a few tens of grains used to form one bit – that enable the latest hard disk models to hold up to 0.5 Terabit/in^2 of information. The IMRE-led team used the bit-patterned media approach, where magnetic islands are patterned in a regular fashion, with each single island able to store one bit of information.

"What we have shown is that bits can be patterned more densely together by reducing the number of processing steps", said Dr Joel Yang, the IMRE scientist who heads the project. Current technology uses very tiny 'grains' of about 7-8 nm in size deposited on the surface of storage media. However, information or a single bit, is stored in a cluster of these 'grains' and not in any single 'grain'. IMRE's bits are about 10nm in size but store information in a single structure.

The method has been demonstrated to achieve data-storage capability at 1.9 Terabit/in^2, though bits of up to 3.3 Terabit/in^2 densities were fabricated. "In addition to making the bits, we demonstrated that they can be used to store data," explained Dr Yang.

The secret of the research lies in the use of an extremely high-resolution e-beam lithography process that produces super fine nano-sized structures. Dr Yang discovered that by adding sodium chloride to a developer solution used in existing lithography processes, he was able to produce highly defined nanostructures down to 4.5 nm half pitch, without the need for expensive equipment upgrades. This 'salty developer solution' method was invented by Dr Yang when he was a graduate student at the Massachusetts Institute of Technology.

This work is the result of a collaborative effort with Prof Vivian Ng's group at NUS, and Dr Yunjie Chen, Dr Siang Huei Leong, and Mr Tianli Huang from A*STAR DSI's 10 Terabit/in^2 Magnetic Recording programme. The researchers are now looking at increasing the storage density further.

More information: Fabrication and characterization of bit-patterned media beyond 1.5 Tbit/in2, Joel K WYang, Yunjie Chen, Tianli Huang, Huigao Duan,Naganivetha Thiyagarajah, Hui Kim Hui, SiangHuei Leong and Vivian Ng, *Nanotechnology* 22(2011) 385301. DOI:10.1088/0957-4484/22/38/385301

Using high-contrast salty development of hydrogen silsesquioxane for sub-10-nm half-pitch lithography, Joel K W Yang, Karl K Berggren *Journal of Vacuum Science and Technology B: Microelectronics and Nanometer Structures* (2007); Volume: 25, Issue: 6, Pages: 2025. DOI: 10.1116/1.2801881

Provided by Agency for Science, Technology and Research (A*STAR)

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