

## MEDIA RELEASE

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

*Dr Joel Yang from the Institute of Materials Research and Engineering (IMRE), a research institute of Singapore's Agency for Science, Technology and Research (A\*STAR), 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<sup>2</sup>, 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.*

1. **Singapore, 14 October 2011** – 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, working with peers from A\*STAR's DSI and NUS, has used nanopatterning to create uniform arrays of magnetic bits that can potentially store up to 3.3 Terabit/in<sup>2</sup> 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.
2. 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<sup>2</sup> 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.
3. "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.
4. The method has been demonstrated to achieve data-storage capability at 1.9 Terabit/in<sup>2</sup>, though bits of up to 3.3 Terabit/in<sup>2</sup> densities were fabricated. "In addition to making the bits, we demonstrated that they can be used to store data," explained Dr Yang.
5. 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.
6. 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<sup>2</sup> Magnetic Recording programme. The researchers are now looking at increasing the storage density further.

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**Encl. Annex A:** A\*STAR Corporate Profiles  
**Annex B:** Image of magnetic bits at the IMRE achieved densities and reference to the published papers

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**Annex A - A\*STAR Corporate Profiles**

**About the Institute of Materials Research and Engineering (IMRE)**

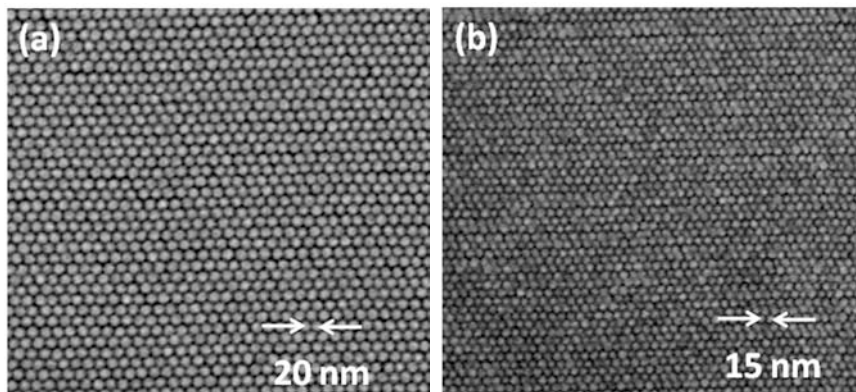
The Institute of Materials Research and Engineering (IMRE) is a research institute of the Agency for Science, Technology and Research (A\*STAR). The Institute has capabilities in materials analysis & characterisation, design & growth, patterning & fabrication, and synthesis & integration. We house a range of state-of-the-art equipment for materials research including development, processing and characterisation. IMRE conducts a wide range of research, which includes novel materials for organic solar cells, photovoltaics, printed electronics, catalysis, bio-mimetics, microfluidics, quantum dots, heterostructures, sustainable materials, atom technology, etc. We collaborate actively with other research institutes, universities, public bodies, and a wide spectrum of industrial companies, both globally and locally. For more information about IMRE, please visit [www.imre.a-star.edu.sg](http://www.imre.a-star.edu.sg).

**About the Agency for Science, Technology and Research (A\*STAR)**

The Agency for Science, Technology and Research (A\*STAR) is the lead agency for fostering world-class scientific research and talent for a vibrant knowledge-based and innovation-driven Singapore. A\*STAR oversees 14 biomedical sciences and physical sciences and engineering research institutes, and six consortia & centres, located in Biopolis and Fusionopolis as well as their immediate vicinity. A\*STAR supports Singapore's key economic clusters by providing intellectual, human and industrial capital to its partners in industry. It also supports extramural research in the universities, and with other local and international partners. For more information about A\*STAR, please visit [www.a-star.edu.sg](http://www.a-star.edu.sg).

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**Annex B - Image of magnetic bits at the IMRE achieved densities and reference to the published papers**



Scanning electron microscopy images of magnetic bits at densities of (a) 1.9 Terabit/in<sup>2</sup> and (b) 3.3 Terabit/in<sup>2</sup> formed after depositing Co/Pd multilayers onto resist structures.

**Fabrication and characterization of bit-patterned media beyond 1.5 Tbit/in<sup>2</sup>**

*Joel K W Yang, 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