New innovation enhances information storage in electronics

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A team of researchers from the Department of Electrical & Computer Engineering at the National University of Singapore (NUS) Faculty of Engineering has developed a new Magnetoresistive Random Access Memory (MRAM) technology that will boost information storage in electronic systems. The innovative technology will drastically increase storage space and enhance memory which will ensure that fresh data stays intact, even in the case of a power failure. The team has already filed a US provisional patent for their technology.

Led by Dr Yang Hyunsoo, the team developed a new device structure useful for the next generation MRAM chip which can potentially be applied to enhance the user experience in consumer electronics, including personal computers and mobile devices such as laptops and mobile phones. The new technology can also be applied in transportation, military and avionics systems, industrial motor control and robotics, industrial power and energy management as well as health care electronics.

Commenting on the benefits of their chip, Dr Yang said, "From the consumer's standpoint, we will no longer need to wait for our computers or laptops to boot up. Storage space will increase, and memory will be so enhanced that there is no need to regularly hit the 'save' button as fresh data will stay intact even in the case of a power failure. Devices and equipment can now have bigger memory with no loss for at least 20 years or probably more. Currently pursued schemes with a very thin magnetic layer can only retain information for about a year."

Dr Yang added, "With the heavy reliance on our mobile phones these days, we usually need to charge them daily. Using our new technology, we may only need to charge them on a weekly basis."

The innovation is expected to change the architecture of computers, making them much easier to manufacture as it does away with many facilities such as flash memory, effectively bringing down the cost. Major semiconductor players such as Samsung, Intel, Toshiba and IBM are intensifying research efforts in MRAM and the team's innovative technology has received strong interest from the industry.

How the chip works

MRAM is emerging as the next big thing in data storage as it is non-volatile, which means that data can be retrieved even when the electronic equipment or device is not powered up. There is strong research interest in MRAM as it has the potential to provide high bit density and low power consumption.

The current methods of applying MRAM revolve round the technology which uses an 'in-plane', or horizontal, current-induced magnetisation. This method uses ultra-thin ferromagnetic structures which are challenging to implement due to their thickness of less than 1 nanometre. Their manufacturing reliability is low and tends to retain information for only less than a year.

The NUS team, in collaboration with the King Abdullah University of Science and Technology in Saudi Arabia, was able to resolve this problem by incorporating magnetic multilayer structures as thick as 20 nanometre, providing an alternative film structure for transmission of electronic data and storage. This innovation allows for storage which can last for a minimum of 20 years. The findings were published online in *Physical Review Letters* on 9 December.

In the next phase of their research, the team plans to apply the invented structure in memory cells. They are looking for industry partners for collaborations on developing a spin-orbit torque-based MRAM.

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