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New interaction between thin film magnets for faster memory devices

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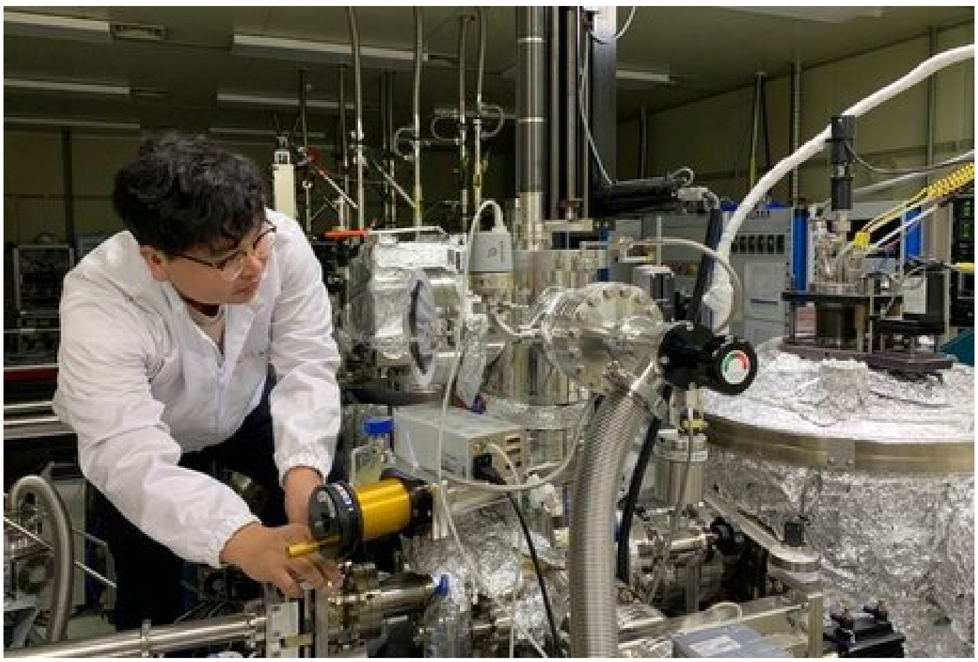


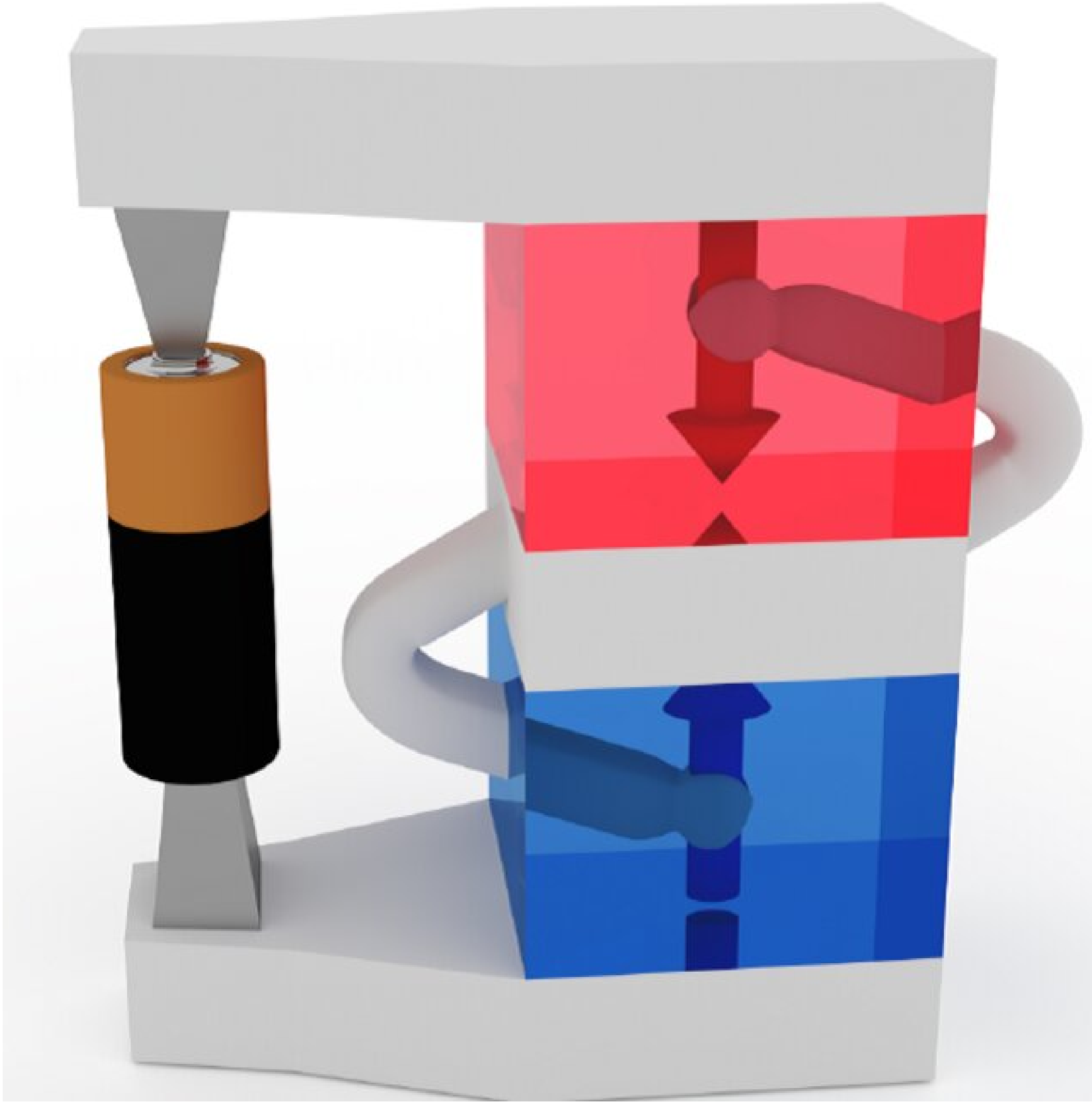
Dr. Dong-Soo Han. Credit: Eindhoven University of Technology

Breakthrough discovery in the field of electromagnetism opens up to the design of three-dimensional spin structures, which could be the basic units of the magnetic storage units of the future.

Researchers from Eindhoven University of Technology, Germany and South Korea discovered a new interaction between thin film magnets, which lays the foundations for faster and robust memory devices with larger data capacity. Results are published today in *Nature Materials*.

Nowadays, we ubiquitously stream videos, download audiobooks to mobile devices, and store huge numbers of photos on our devices. Thus, the storage capacity we need is growing rapidly, and researchers are working hard to develop new data storage options. One possibility is represented by the so-called 'racetrack memory device," in which data is stored in nanowires in the form of oppositely magnetized layers ('domains').

A research team from TU/e, Johannes Gutenberg University (JGU) (Germany), Peter Grunberg Institute (PGI), Daegu Gyeongbuk Institute of Science and Technology (South Korea) and Sogang University (South Korea), has now made a discovery that could significantly improve these racetrack memory devices. Instead of using individual domains, in the future one could store the information in three-dimensional spin structures, making memories faster, more robust and providing a larger data capacity.



Interlayer coupling interaction. Two ferromagnetic layers (red, blue) antiparallel aligned (arrows indicate the direction from the south to the north pole) are forced by this electronic effect to ‘twist’ their magnetization (as indicated by the arms) adding a chirality (preferential rotation sense). Credit: Eindhoven University of Technology

New interaction

The research team was able to demonstrate a hitherto undiscovered interaction, which occurs between two thin magnetic layers separated by a non-magnetic layer. Usually, spins align either parallel or antiparallel to each other. This would also be expected for such two separate magnetic layers. However, in this work, the researchers have been able to show that the spins in the two layers are twisted against each other. More precisely, they couple to align perpendicular, at an angle of 90 degrees with one another.

Reinoud Lavrijsen, assistant professor at Applied Physics: "This breakthrough discovery opens up the possibility of designing various new three-dimensional spin structures, which in the long term could lead to new magnetic storage units. The identified interaction, however, is at this moment not strong enough for applications, but we are committed to engineer and optimize this further so that it can be used in future 3-dimensional data storage and logic devices."

More information: Dong-Soo Han et al. Long-range chiral exchange interaction in synthetic antiferromagnets, *Nature Materials* (2019). DOI: 10.1038/s41563-019-0370-z

Provided by Eindhoven University of Technology