Using Helical Magnets to Advance Next-Generation Storage

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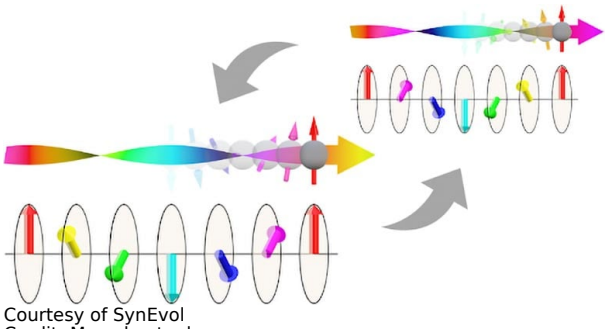
Courtesy of SynEvol

Scientists have developed a novel concept for magnet-based memory devices that, because of their high durability, non-volatility, and potential for large-scale integration, might completely change the information storage industry.

Magnetic random access memory (MRAM) is an example of a spintronic device that uses the magnetization direction of ferromagnetic materials to store and retrieve data. Future information storage components will probably heavily rely on spintronic devices due to their low energy consumption and non-volatility.

There is a possible drawback to ferromagnet-based spintronics systems, though. Nearby ferromagnets are impacted by the magnetic fields that ferromagnets create. This causes crosstalk between magnetic bits in an integrated magnetic device, which lowers the magnetic memory density.

In order to address the magnetic field issue, the research team—which included Jun-ichiro Ohe from Toho University and Hidetoshi Masuda, Takeshi Seki, Yoshinori Onose, and others from Tohoku University's Institute for Materials Research—showed that magnetic materials known as helical magnets can be used for a magnetic memory device.



Courtesy of SynEvol
Credit: Masuda et. al.

The atomic magnetic moment directions are arranged in a spiral in helical magnets. The information could be memorized by taking use of the spiral's chirality, or left- or right-handedness. The helical magnets don't produce a macroscopic magnetic field because the magnetic fields created by each atomic magnetic moment cancel each other out. "The helimagnet-based memory devices, which are devoid of bit-to-bit crosstalk, have the potential to open up new avenues for enhancing memory density," states Masuda.

The researchers were able to write and read out the chirality memory at ambient temperature. They created epitaxial thin layers of a room-temperature MnAu2 helimagnet and showed how the electric current pulses under magnetic fields could change the spiral's chirality, or how left- or right-handed it was. In addition, they created a bilayer device consisting of Pt (platinum) and MnAu2, and they showed that even in the absence of magnetic fields, the chirality memory could be read out as a change in resistance.

"Chiral memory in helical magnets has the potential to be used in next-generation memory devices; it could provide highly stable, non-volatile, and dense memory bits," Masuda continues. "Hopefully, this will result in highly reliable and ultrahigh information density storage devices in the future."