Ultralow power consumption for data recording

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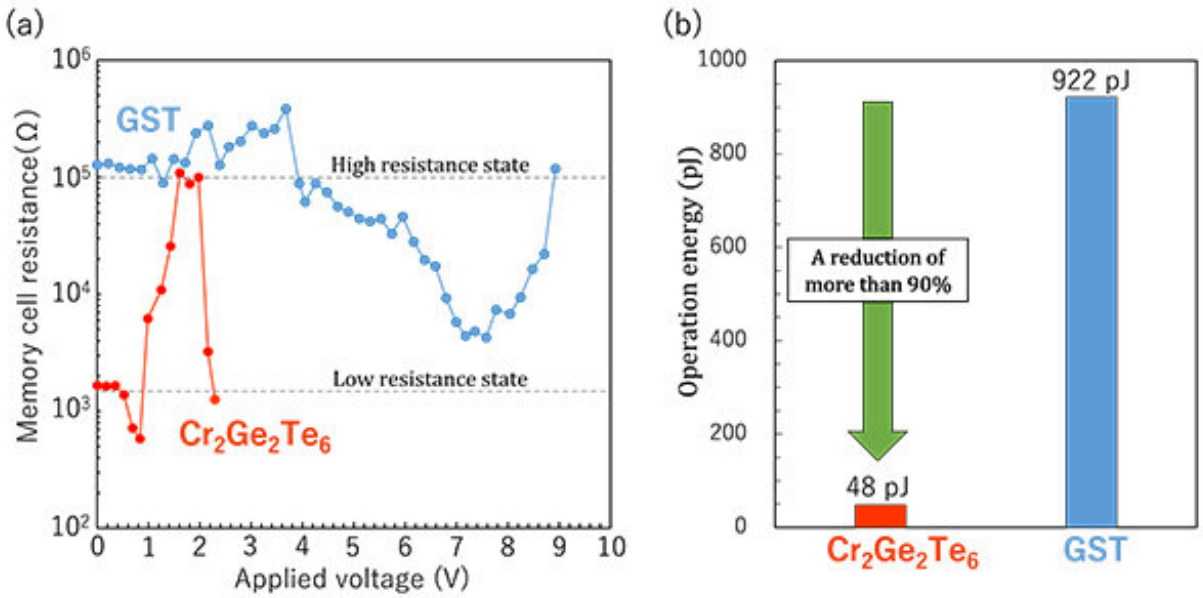

(a) Memory cell resistance vs. applied voltage curves in Cr2Ge2Te6 and GST memory cell. (b) Comparison of operation energy between Cr2Ge2Te6 and GST. Credit: Shogo Hatayama

A team of researchers at Tohoku University, in collaboration with the National Institute of Advanced Industrial Science and Technology (AIST) and Hanyang University, has developed new phase change material with electrical characteristics different from those of conventional materials. This new material allows a drastic reduction in

power consumption for data recording in non-volatile random access memory.

Phase change random access memory (PCRAM) is a next-generation practical non-volatile memory. PCRAM is expected not only to replace flash memory, but also to be used for storage-class memory, which can mitigate the difference in latencies between DRAM and flash memory.

The principle of PCRAM operation relies on the change in electrical resistance between high-resistance amorphous states and low-resistance crystalline states in phase change material.

Ge-Sb-Te (GST) is a phase change material for PCRAM application. GST can operate at high speeds, but has poor data retention at high temperatures (~ 85 degrees C) and needs high power for data-recording.

This newly developed phase change material, $Cr_2Ge_2Te_6$, exhibits an inverse resistance change from low-resistance amorphous states to high-resistance crystalline states. The researchers demonstrated that the $Cr_2Ge_2Te_6$ can achieve a reduction of more than 90 percent in power consumption for data-recording compared to using conventional GST memory cell.

Simultaneously, $Cr_2Ge_2Te_6$ was found to combine a faster operation speed (~30 ns) and a higher data retention property (over 170 degrees C) than conventional materials. Comparison with other reported materials indicates that $Cr_2Ge_2Te_6$ can break the trade-off relationship between data retention and operation speed.

The researchers believe that the inverse resistance change $Cr_2Ge_2Te_6$ is a breakthrough material for PCRAM with combined low operation energy, high data retention and fast operation speed.

More information: Shogo Hatayama et al, Inverse Resistance Change $Cr_2Ge_2Te_6$-Based PCRAM Enabling Ultralow-Energy Amorphization, *ACS Applied Materials & Interfaces* (2017). DOI: 10.1021/acsami.7b16755

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