Perovskite memory devices with ultra-fast switching speed

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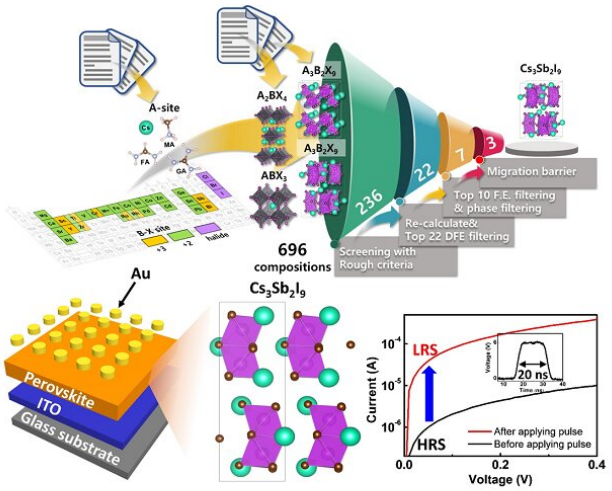

The strategy to design the halide perovskite for the ultra-fast switching memory by combining first-principles calculations and experimental verification.

Credit: Pohang University of Science & Technology (POSTECH)

A research team led by Professor Jang-Sik Lee of Pohang University of Science and Technology (POSTECH) has successfully developed the halide perovskite-based memory with ultra-fast switching speed. The findings from this study were published in *Nature Communications* on June 10, 2021.

Resistive switching memory is a promising contender for next-generation memory device due to its advantages of simple structure and low power consumption. Various materials have been previously studied for resistive switching memory. Among them, halide perovskites are receiving much attention for use in the memory because of low operation voltage and high on/off ratio. However, halide perovskite-based memory devices have limitations of slow switching speed which hinder their practical application in memory devices.

To this end, the researchers at POSTECH (Prof. Jang-Sik Lee, Prof. Donghwa Lee, Youngjun Park, and Seong Hun Kim) have successfully developed ultra-fast switching memory devices using halide perovskites by using a combined method of first-principles calculations and experimental verification. From a total of 696 compounds of halide perovskites candidates, $Cs_3Sb_2I_9$ with a dimer structure was selected as the best candidate for memory application. To verify the calculation results, memory devices using the dimer-structured $Cs_3Sb_2I_9$ were fabricated. They were then operated with an ultra-fast switching speed of 20 ns, which was more than 100 times faster than the memory devices that used the layer-structured $Cs_3Sb_2I_9$. In addition, many of the perovskites contain lead (Pb) in the materials which has been raised as an issue. In this work, however, the use of lead-free perovskite eliminates such environmental problems.

"This study provides an important step toward the development of resistive switching memory that can be operated at an ultra-fast switching speed," remarked Professor Lee on the significance of the research. He added that "this work offers an opportunity to design new materials for memory devices based on calculations and experimental verification."

More information: Youngjun Park et al, Designing zero-dimensional dimer-type all-inorganic perovskites for ultra-fast switching memory, *Nature Communications* (2021). DOI: 10.1038/s41467-021-23871-w

Provided by Pohang University of Science & Technology (POSTECH)