Low-power, flexible memristor circuit for mobile and wearable devices

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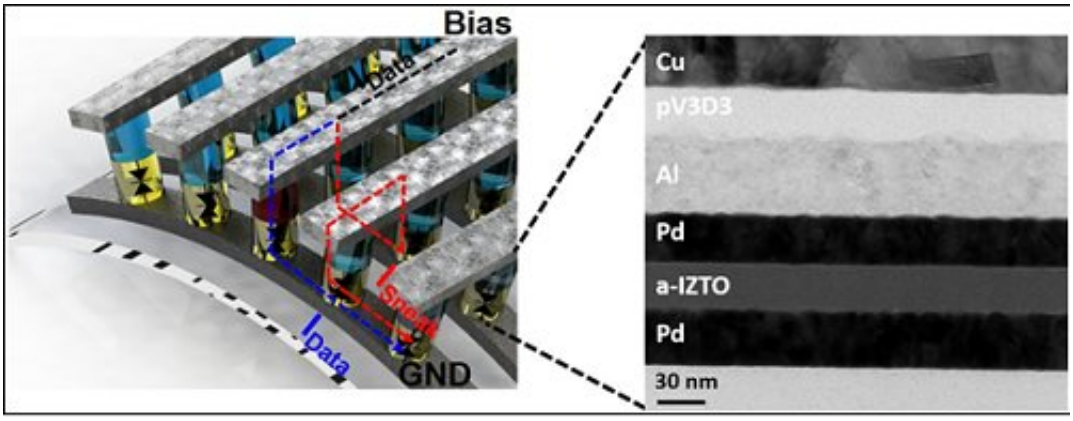

Figure 1. Schematic illustration and cross-sectional TEM image of flexible memristive nonvolatile logic-in-memory circuit. Credit: Korea Advanced Institute of Science and Technology

A KAIST research team succeeded in developing an energy efficient, nonvolatile logic-in-memory circuit by using a memristor. This novel technology can be used as an energy efficient computing architecture for battery-powered flexible electronic systems, such as mobile and wearable devices.

Professor Sung-Yool Choi from the School of Electrical Engineering and Professor Sang-Hee Ko Park from the Department of Materials Science and Engineering developed a memristive nonvolatile logic-in-memory circuit.

Transistor-based conventional electronic systems have issues with battery supply and a long standby period due to their volatile computing architecture. The standby power consumption caused by subthreshold leakage current limits their potential applications for mobile electronic devices. Also, their physical separation of memory and processor causes power consumption and time delay during data transfer.

In order to solve this problem, the team developed a logic-in-memory circuit that enables data storage as well as logic operation simultaneously. It can minimize energy consumption and time delay because it does not require data transfer between memory and processor.

The team employed nonvolatile, polymer-based memristors and flexible back-to-back Schottky diode selector devices on plastic substrates. Unlike the conventional architecture, this memristive nonvolatile logic-in-memory is a novel computing architecture that consumes a minimal amount of standby power. This one-selector-one memristor (1S-1M) solved the issue of undesirable leakage currents, known as 'sneak currents'.

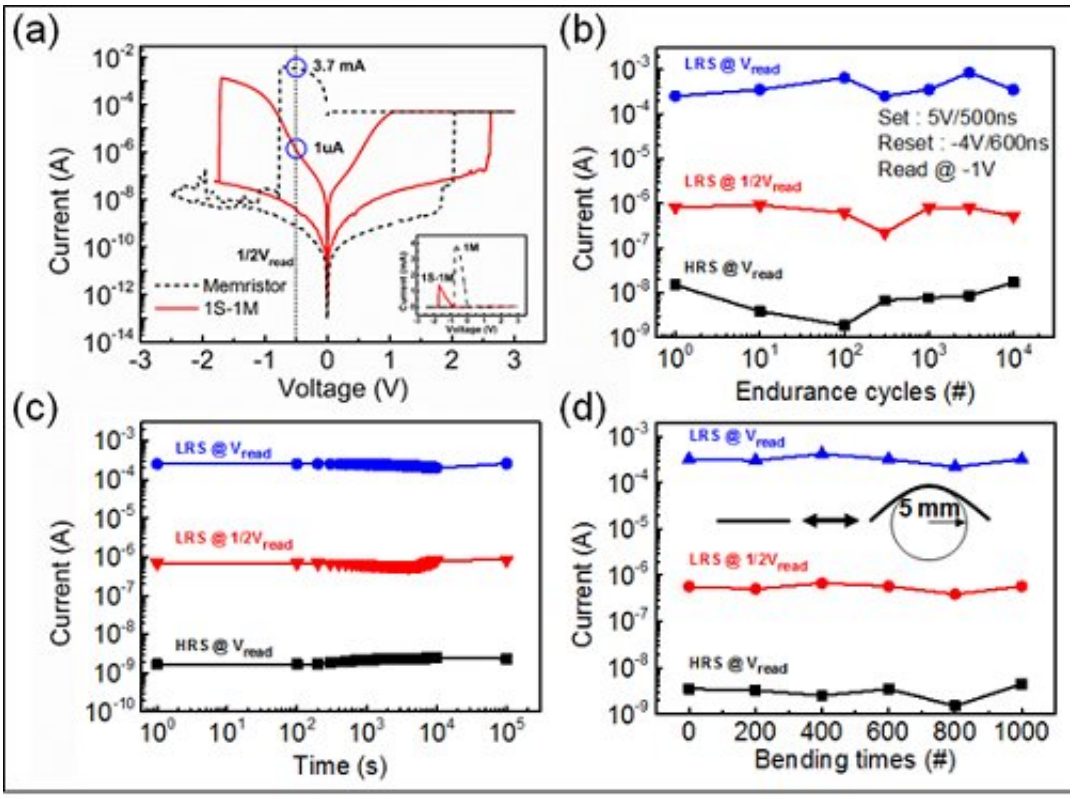

Figure 2. Test performance. Credit: Korea Advanced Institute of Science and Technology

They also implemented single-instruction multiple-data (SIMD) to calculate multiple values at once.

The proposed parallel computing method using a memristive nonvolatile logic-in-memory circuit can provide a low-power circuit platform for battery-powered flexible electronic systems with a variety of potential applications.

Professor Choi said, "Flexible logic-in-memory circuits integrating memristor and selector device can provide flexibility, low power, memory with logic functions. This will be a core technology that will bring innovation to mobile and wearable electronic systems."

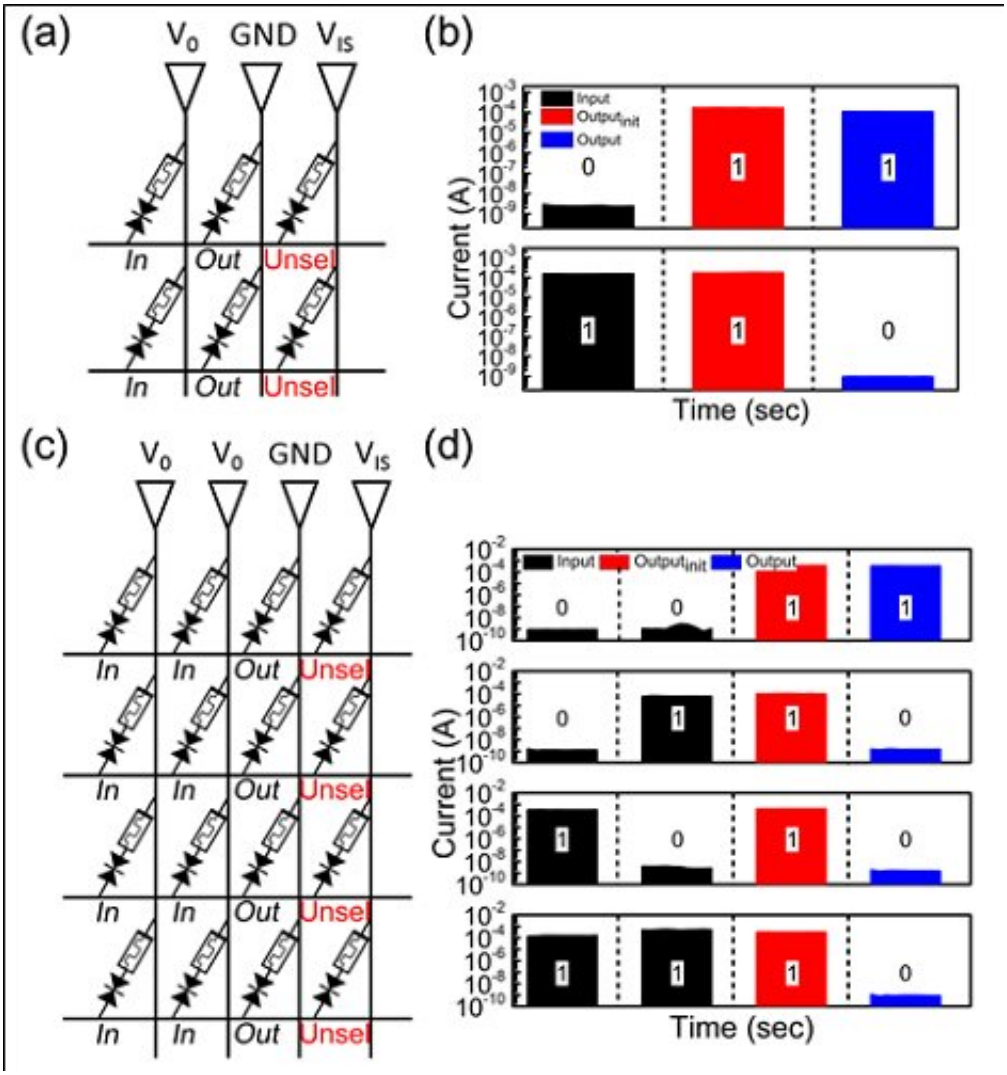

Figure 3. Parallel logic operation within 1S-1M memristor array. Credit: Korea Advanced Institute of Science and Technology

More information: Byung Chul Jang et al. Memristive Logic-in-Memory Integrated Circuits for Energy-Efficient Flexible Electronics, *Advanced Functional Materials* (2017). DOI: 10.1002/adfm.201704725