

Synaptic Plasticity Selectively Activated by Polarization-Dependent Energy-Efficient Ion Migration in an Ultrathin Ferroelectric Tunnel Junction

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Abstract (Calibri 11)

Selectively activated inorganic synaptic devices, showing a high on/off ratio, ultrasmall dimensions, low power consumption, and short programming time, are required to emulate the functions of high-capacity and energy-efficient reconfigurable human neural systems combining information storage and processing.

Here, we demonstrate that such a synaptic device is realized using a Ag/PbZr_{0.52}Ti_{0.48}O₃ (PZT)/La_{0.8}Sr_{0.2}MnO₃ (LSMO) ferroelectric tunnel junction (FTJ) with ultrathin PZT (thickness of ~4 nm). Ag ion migration through the very thin FTJ enables a large on/off ratio (10⁷) and low energy consumption (potentiation energy consumption = ~22 aJ and depression energy consumption = ~2.5 pJ). In addition, the simple alignment of the downward polarization in PZT selectively activates the synaptic plasticity of the FTJ and the transition from short-term plasticity to long-term potentiation.

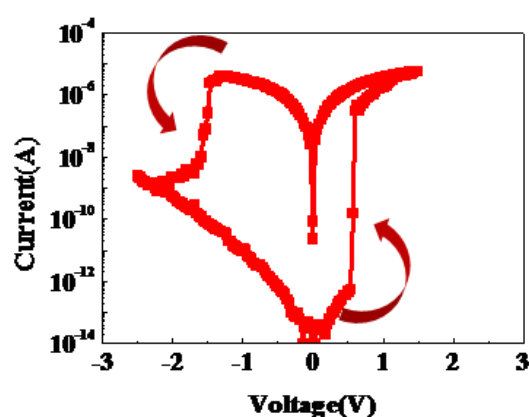


Figure 1. Resistive switching behavior.

