Supporting Information

Emulation of Synaptic Metaplasticity in Memristors

Xiaojian Zhu[†], Chao Du[†], Yeonjoo Jeong and Wei D. Lu^{*}

Department of Electrical Engineering and Computer Science, the University of

Michigan, Ann Arbor, Michigan 48109, USA

E-mail: wluee@eecs.umich.edu



Figure S1. Hysteretic *I-V* curves showing the Forming and the subsequent RESET process of a fresh $Pt/Ta_2O_{5-x}/TaO_y/Pt$ memristive device. During the Forming process, a series resistor (10 K Ω) was used to prevent the device from permanent breakdown.



Figure S2. The dependence of the device conductance on the number of applied programming pulse (1.4 V, 0.5 μ s) when the device is switched from S3 to S1 (black squares) by applying positive pulses, and from S1 to S3 (red circles) by applying negative pulses, respectively.



Figure S3. The effect of pulse width during pre-programming process on the polarity of plasticity. (a) Time dependent voltage and current evolution in pre-programming process A and B. The width of the pulse applied to the device in process A and B is 100 μ s and 1 μ s respectively, while the amplitude of the pulses are both 1.2 V. (b) The dependence of device conductance on the number of stimulation pulses (0.9 V, 5 μ s) in the device after different pre-programming process (A and B) shown in Figure S3a. The conductance is measured with a read pulse (0.3 V, 5 μ s).



Figure S4. Comparison of the device conductance before and after the application of 100 programming pulses (1.2 V, 100 ns) with different frequencies (6.7 MHz, 6.3 MHz, 5.9 MHz, 5.6 MHz, 5.3 MHz and 5.0 MHz).