Supporting Information

Bio-inspired Physically Transient/Biodegradable Synapse for Security Neuromorphic Computing Based on Memristors

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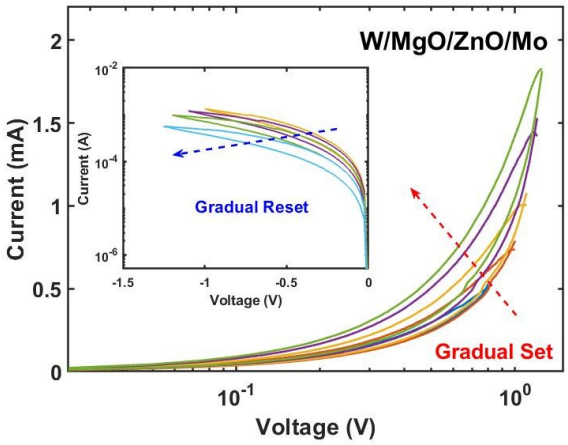

Figure S1. Gradual set under positive sweeps with increasing stop voltage. Inset: Gradual reset under negative sweeps with increasing stop voltage.

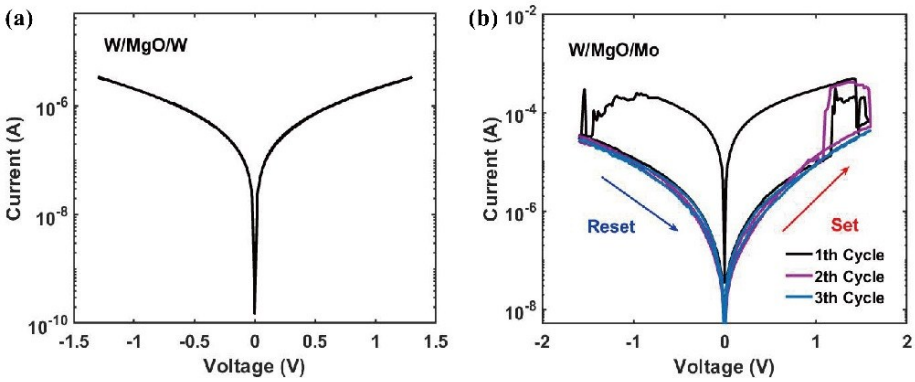

Figure S2. (a) I-V characteristics of W/MgO/W device. (b) 3 circles DC sweeping I-V curves of W/MgO /Mo structure devices.

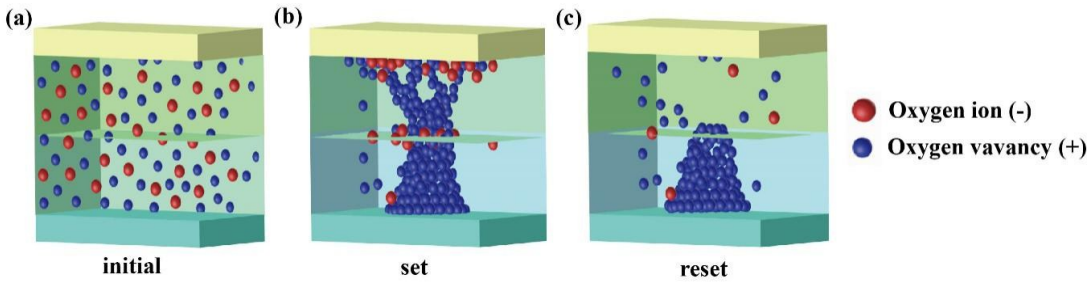

Figure S3. Schematic of W/MgO/ZnO/Mo synapse device (a) initial states before first set. (b) Conductive filaments are formed after set process. (c) Conductive filaments rupture after reset.

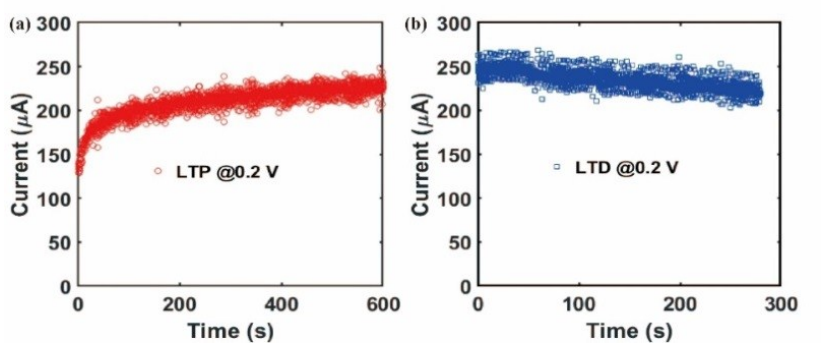

Figure S4. (a) LTP and (b) LTD characteristics of W/MgO/ZnO/Mo synapses using multiple 10 μs, +0.2 V write pulses and 10 μs, -0.2 V erase pulses.

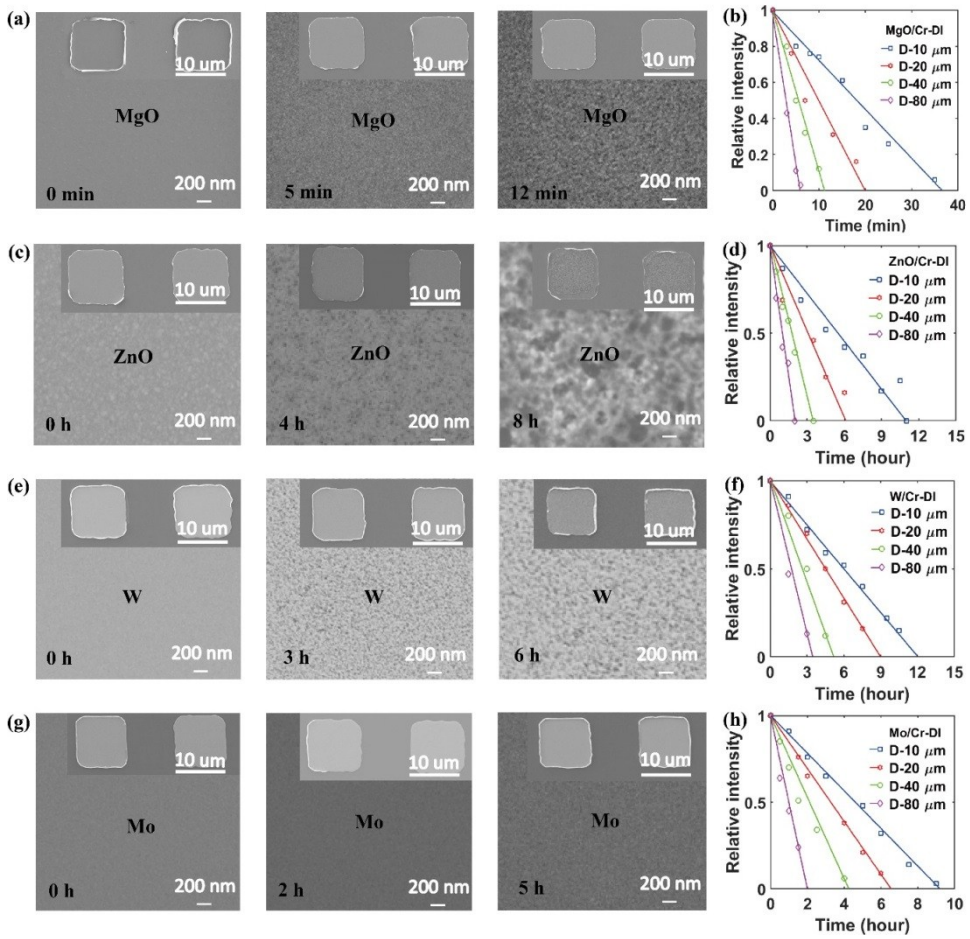

Figure S5. Dissolution properties of materials (MgO, ZnO, W, and Mo) for transient synapse devices in DI water. (a) SEM images of MgO (60 nm thick), (c) ZnO (100 nm thick), (e) W (100 nm thick), and (g) Mo (100 nm thick) thin film microtopography dissolution process over time in DI water at 37°C. Normalized EDS intensity of four different distance of patterned films of (b) MgO/Cr, (d) ZnO/Cr, (f) W/Cr and (h) Mo/Cr film in DI water at 37°C as the function of time.

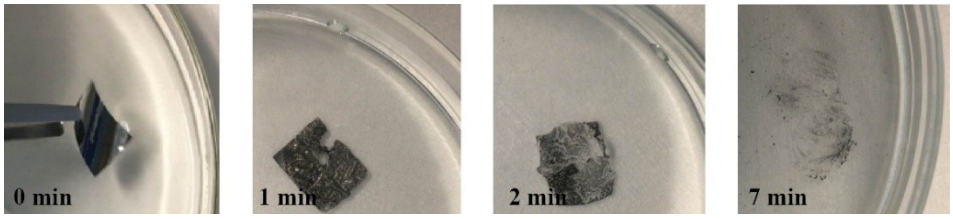

Figure S6. Evolution images of W/MgO/ZnO/Mo memristors on silk substrate in DI water as the function of time at room temperature.

Table S1. The degradation rates of MgO/Cr, ZnO/Cr, W/Cr and Mo/Cr patterned films

Degradation Rates	10 μm	20 μm	40 μm	80 μm
MgO (PBS)	4 nm/min	6.7 nm/min	12 nm/min	20 nm/min
ZnO (PBS)	8.7 nm/h	12.5 nm/h	23 nm/h	40 nm/h
W (PBS)	11.1 nm/h	17.2 nm/h	32.3 nm/h	50 nm/h
Mo (PBS)	17.4 nm/h	28.8 nm/h	50 nm/h	83.3 nm/h
MgO (DI water)	1.7 nm/min	3 nm/min	5.5 nm/min	10 nm/min
ZnO (DI water)	9.1 nm/h	16.7 nm/h	28.6 nm/h	50 nm/h
W (DI water)	8.3 nm/h	11.1 nm/h	20 nm/h	31.2 nm/h
Mo (DI water)	16.7 nm/h	22.7 nm/h	37.5 nm/h	75 nm/h