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Supplementary information

Artificial Synapses Emulated Through a Light Mediated Organic-Inorganic Hybrid Transistor

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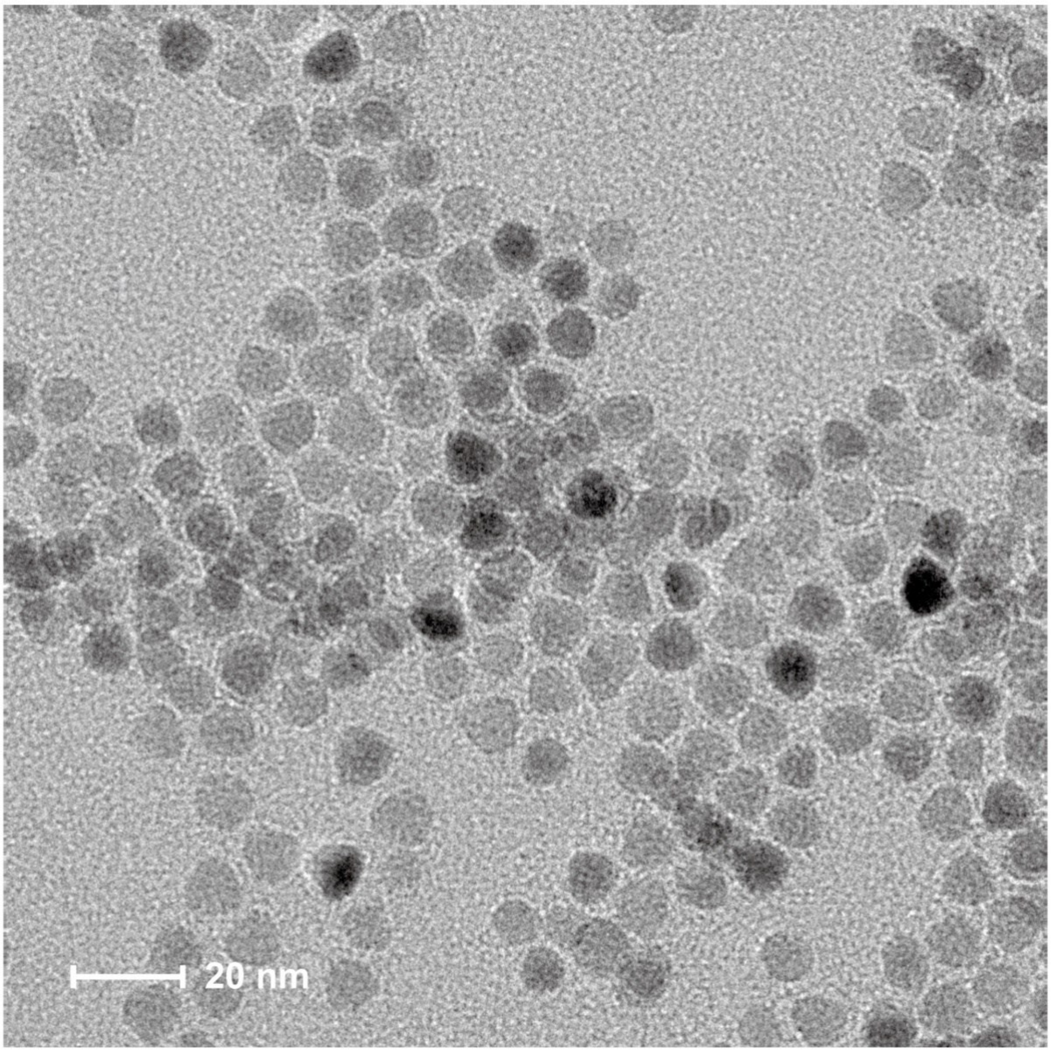

Fig. S1. TEM image of pristine ZnO nanoparticles.

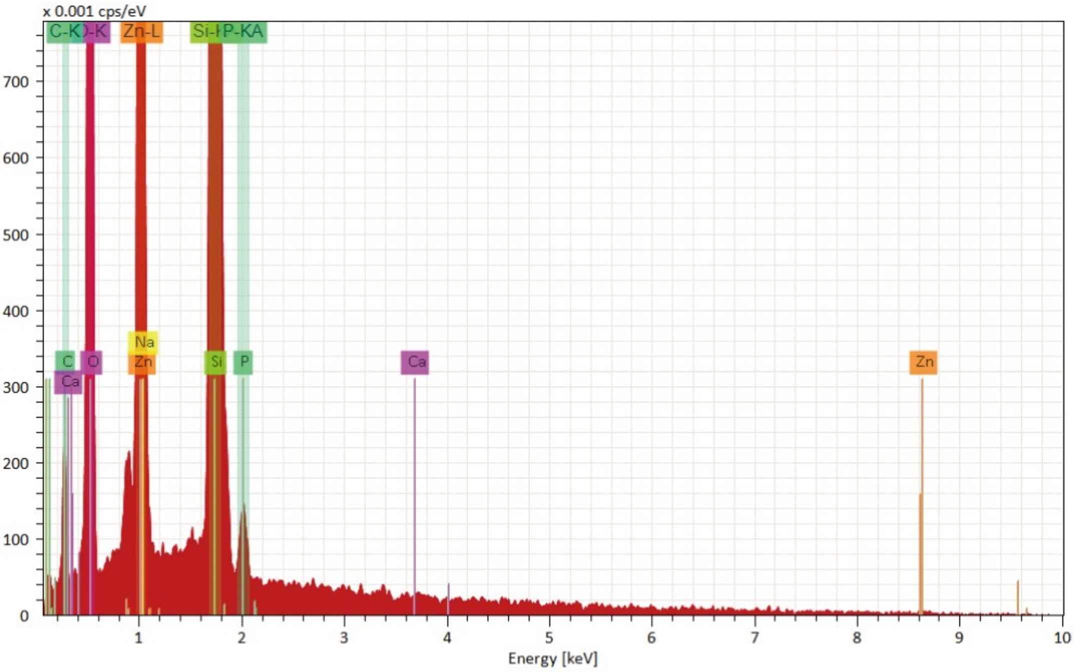

Fig. S2. EDS spectra of an individual BP-ZnO NP sample.

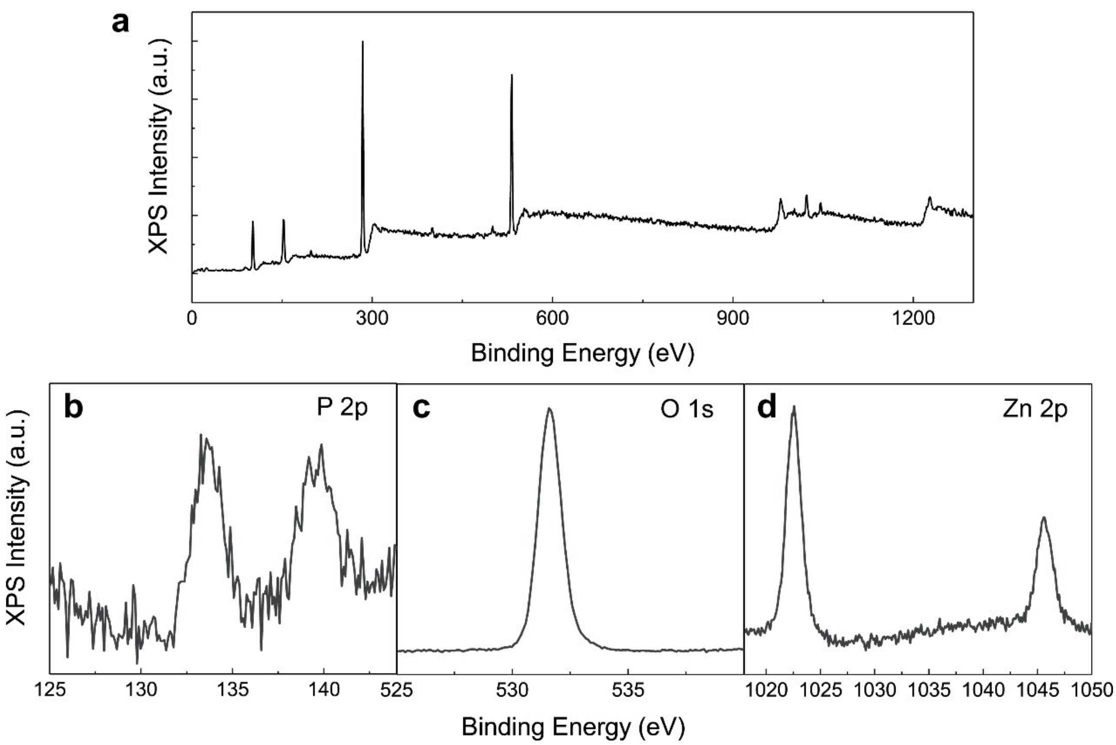

Fig. S3. (a) XPS survey scan. XPS spectra of (b) P 2p, (c) O 1s and (d) Zn 2p.

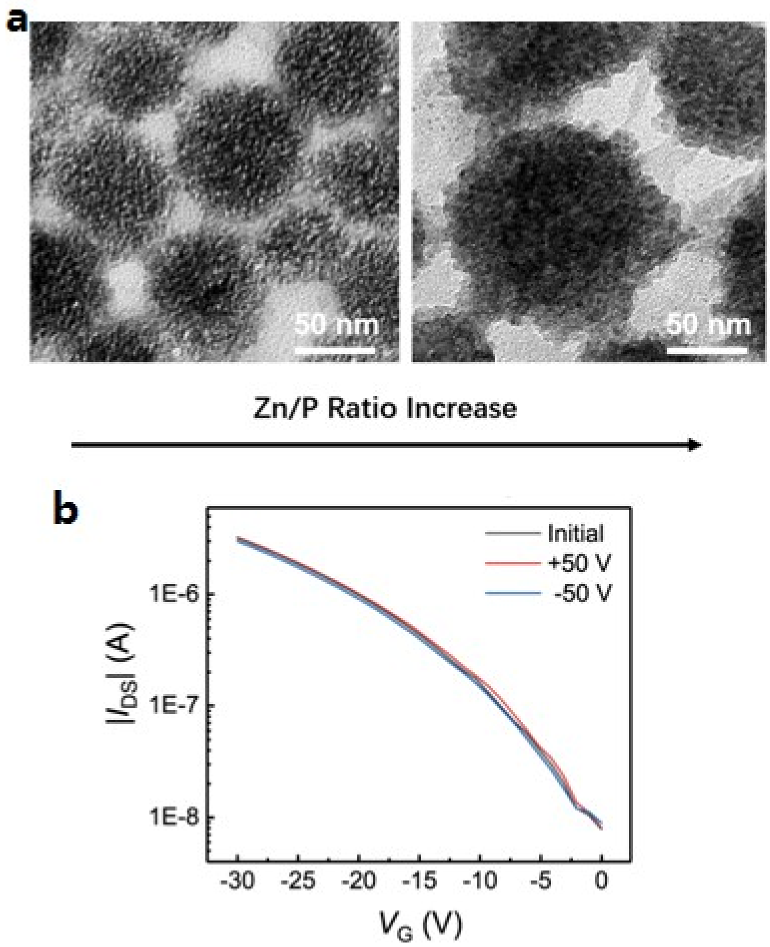

Fig. S4. (a) TEM images of BP-ZnO NPs differed in size controlled by the ratio Zn/P. (b) Transfer characteristics of transistor devices based on 142.3 nm BP-ZnO NPs.

The size of BP-ZnO NPs is closely correlated with the designed atomic ratio of Zn/P. The TEM images show an evolution of size controlled by the ratio with an average diameter of 87.4 and 142.3 nm, respectively. More involvement of Zn atoms will boost the nucleation rate of ZnO component in composite NPs. As seen in Fig. S4, the size of BP-ZnO NPs has an effect on the device performance. Larger particle size will induce the high off current in the transistor and less threshold voltage shift is observed in larger NPs based device.

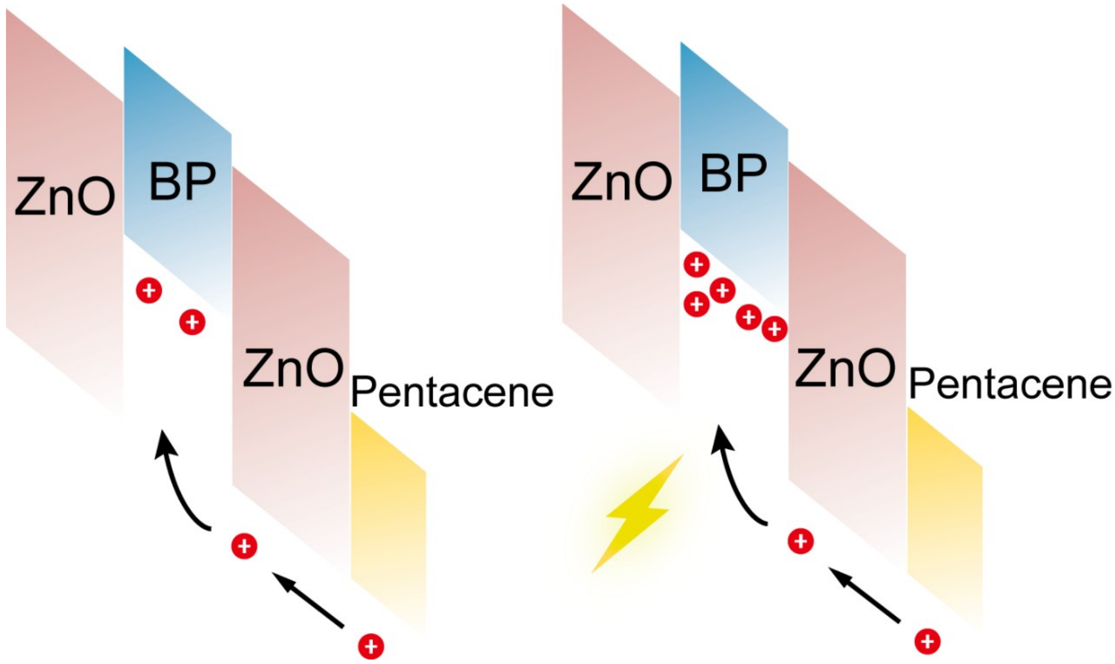

Fig. S5. Energy band diagram of the programming process without and with light illumination.

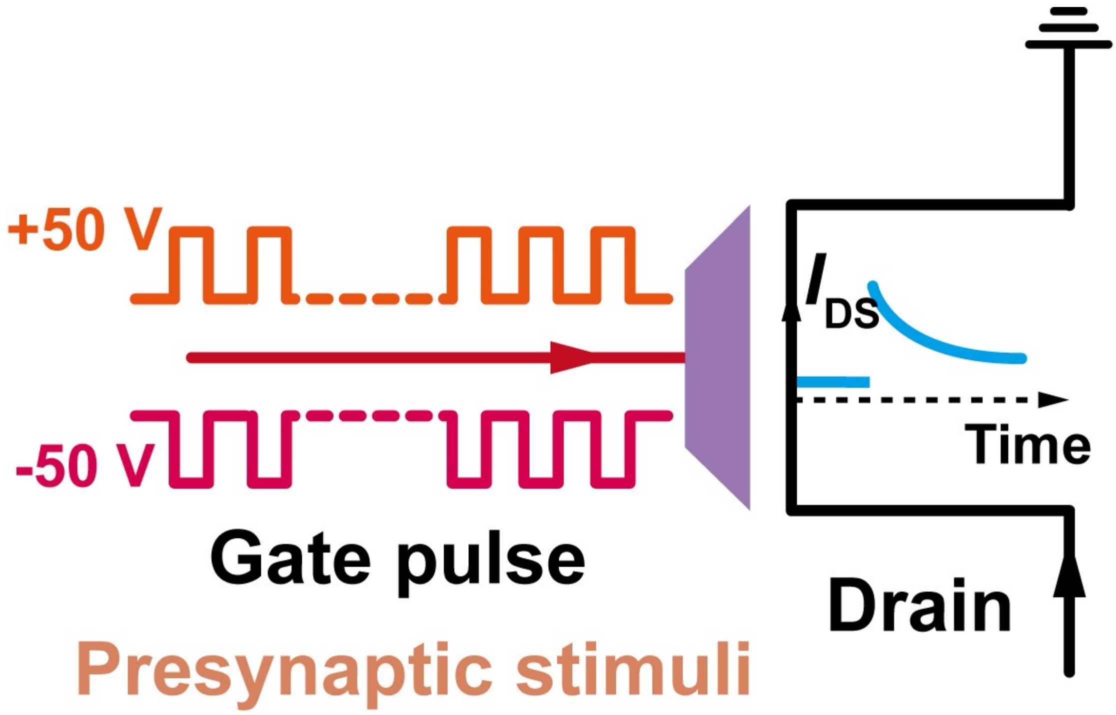

Fig. S6. Long term memory model implemented by applying repeated electrical pulses as rehearsal events.

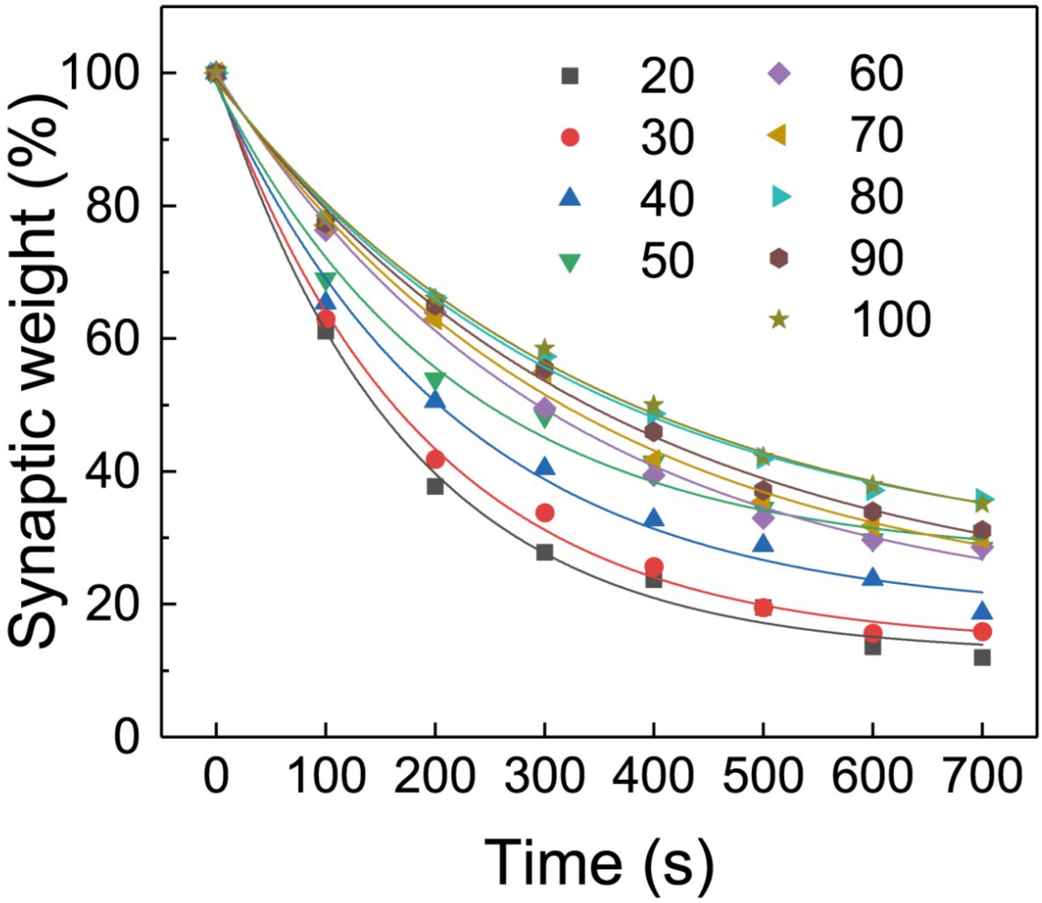

Fig. S7. Normalized synaptic weight decay with number of pulses ranging from 20 to 100 cycles. The solid lines represent the exponentially fitted curves.

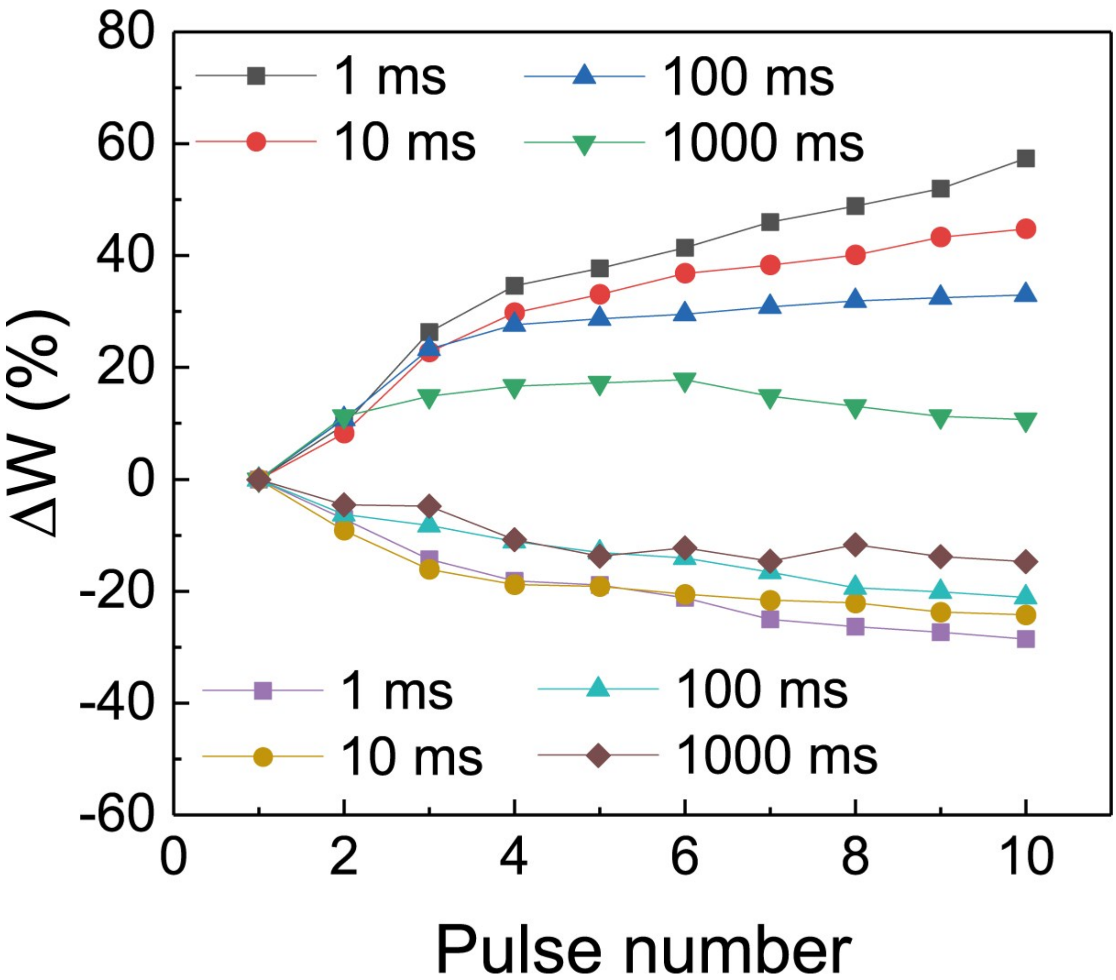

Fig. S8. Readout currents for 10 consecutive pulses with different pulse intervals for both potentiation and depression process.

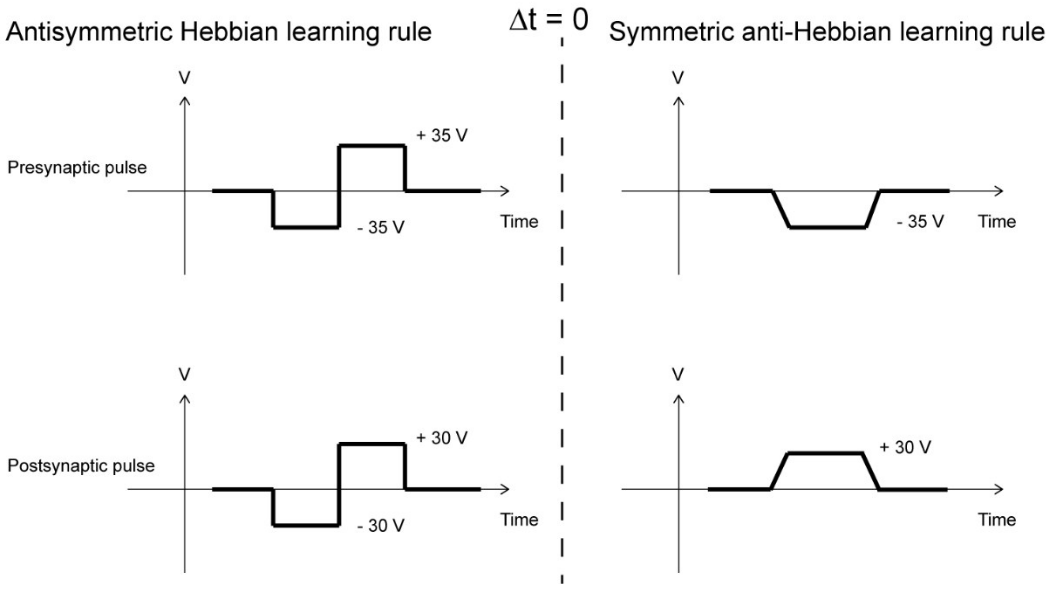

Fig. S9. Demonstrations of the pulses applied during STDP measurements for antisymmetric Hebbian learning rule and symmetric anti-Hebbian learning rule.

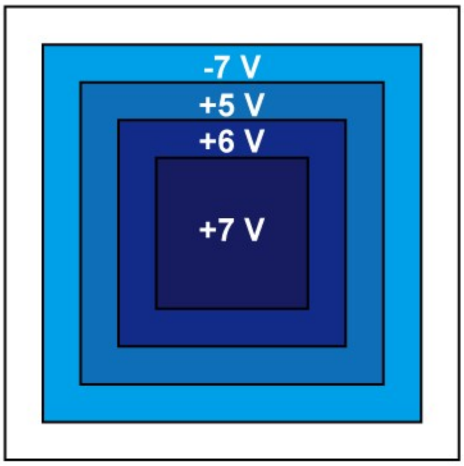

Fig. S10. Demonstration of the application of tip bias in the realization of different levels of surface potentials.