

Supporting Information

An adjustable multistage resistance switching behavior of photoelectric artificial synaptic device with ferroelectric diode effect for neuromorphic computing

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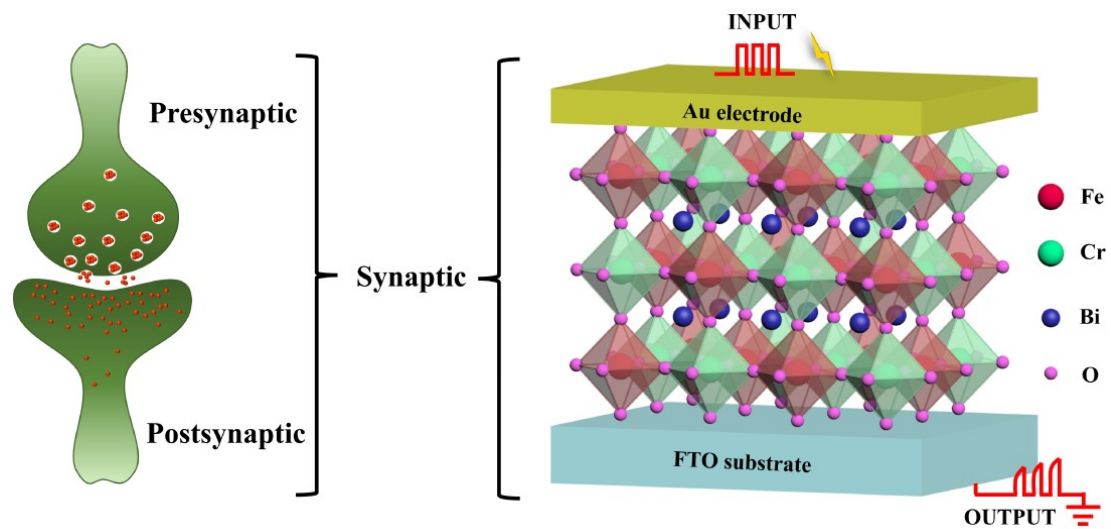


Fig. S1 A graphic depicting the artificial synapse that imitates biological synapses.

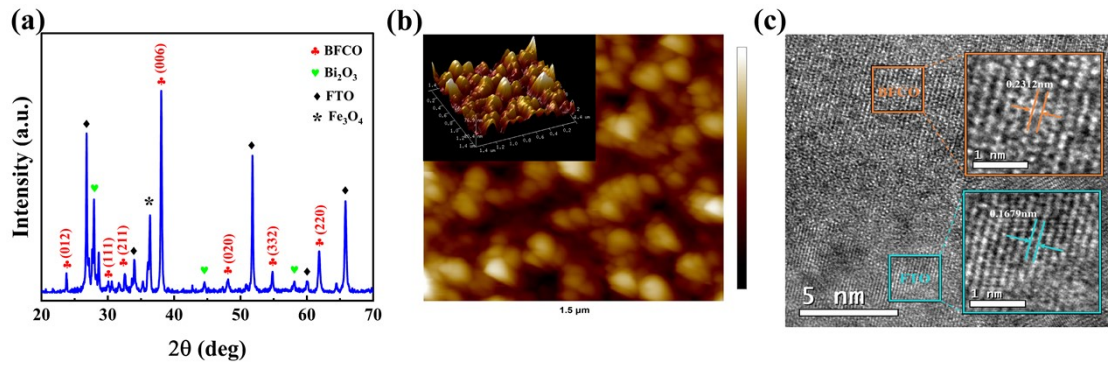


Fig. S2 Morphological characterization of Au/BFCO/FTO. (a) Illustrates the X-ray diffraction (XRD) test conducted on the BFCO thin film. (b) Depicts the atomic force microscopy (AFM) morphology scan of the BFCO thin film ($R_a=13.5\text{nm}$). (c) Showcases the high-resolution transmission electron microscopy (HRTEM) image of the BFCO/FTO interface. The BFCO crystal plane is identified as the (200) lattice planes, while the SnO_2 crystal plane is represented by the (220) lattice planes (highlighted in blue box).

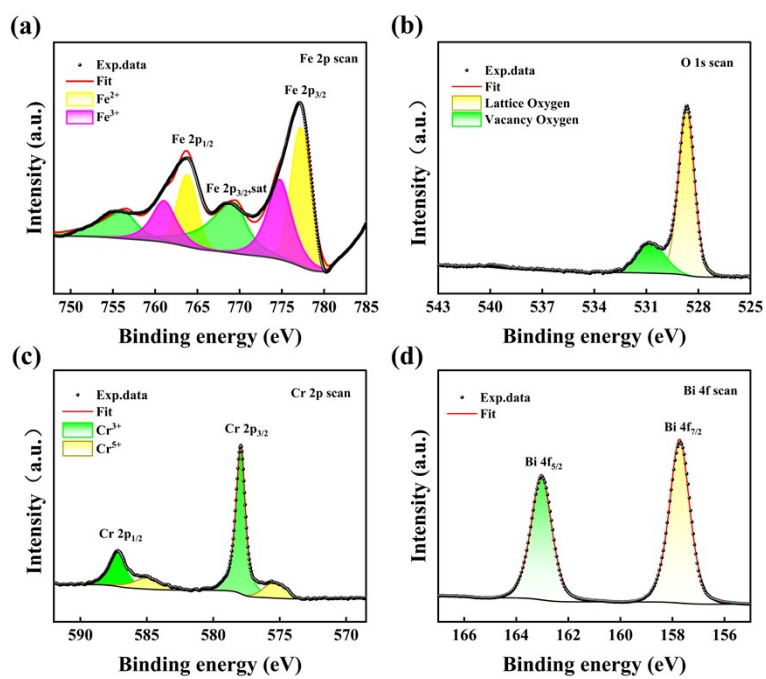


Fig. S3 XPS testing of BFCO films. (a) Fe 2p, (b) O 1s, (c) Cr 2p, (d) Bi 4f.

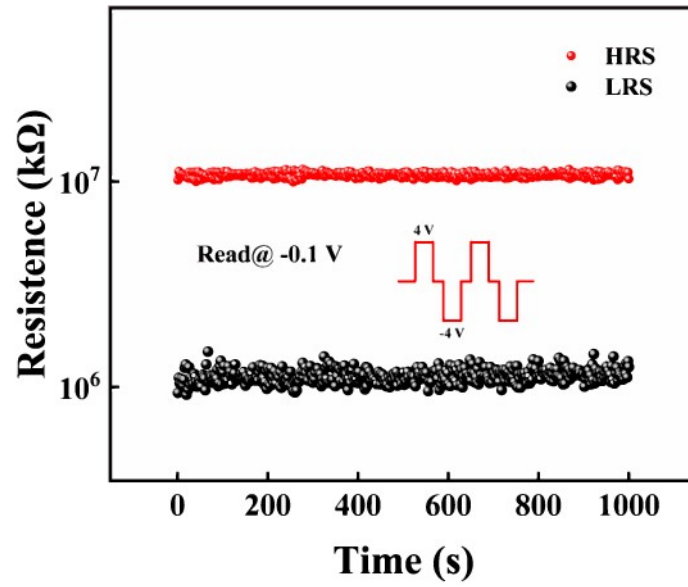


Fig. S4 Resistance switch stability measured at a pulse voltage of plus or minus 4 V, reading voltage of 0.1 V.

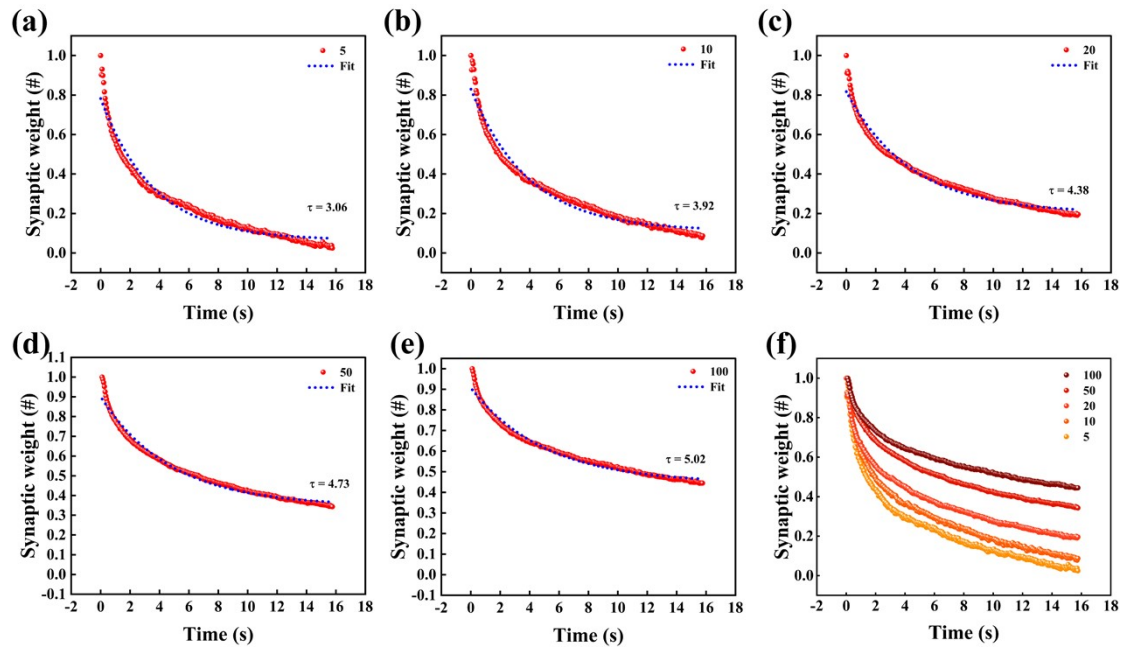


Fig. S5 Measurement of synaptic weight with retention time under different numbers of spikes. (a) - (e) The retention times for 5, 10, 20, 50, and 100 pulse quantities are 3.06s, 3.92s, 4.38s, 4.73s, and 5.02s, respectively. (f) The variation of retention times for different pulse quantities.

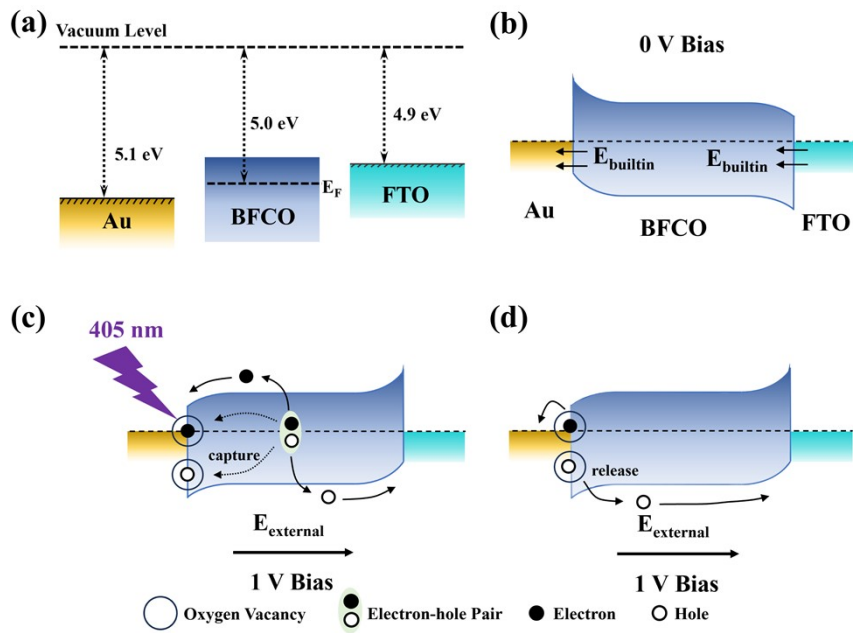


Fig. S6 The schematic diagram of the optical memory effect. (a) The energy band diagram of Au/BFCO/FTO in equilibrium state. (b) Align the energy bands at the interface under thermal equilibrium. (c) The process of capturing photo generated carriers under 405nm light irradiation and 1V bias voltage conditions. (d) After removing the illumination, the process of gradually releasing photo generated charge carriers under a 1V bias voltage.

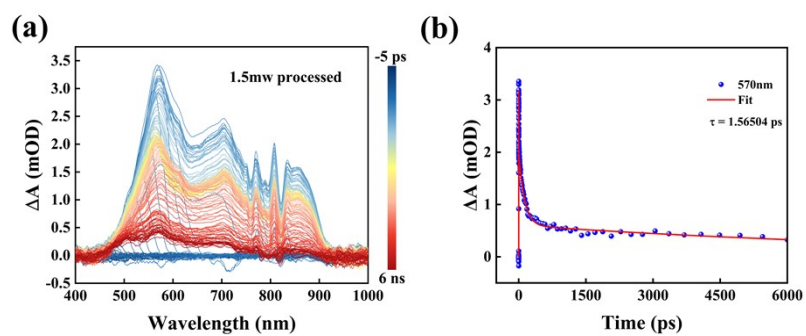


Fig. S7 Transient absorption spectroscopy absorption test. (a) Transient absorption spectra at different time nodes. (b) Detect molecular dynamics at a wavelength of 570nm.

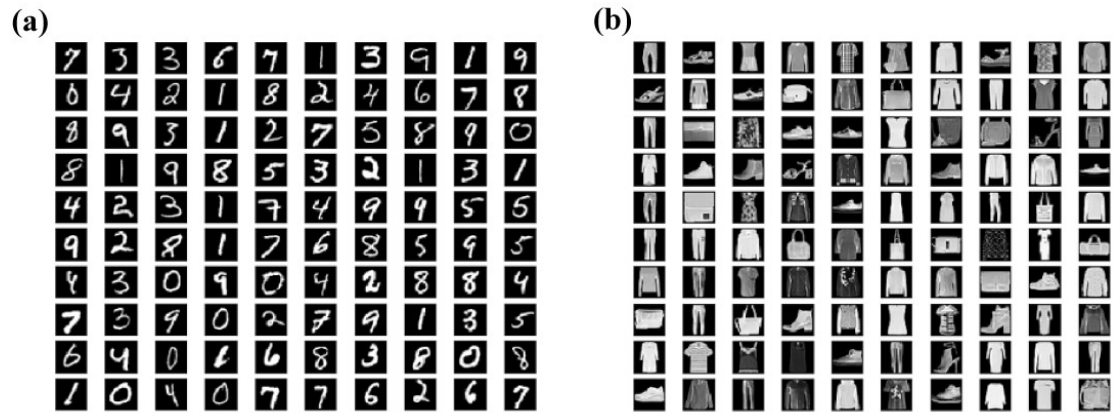


Fig. S8 Image of a dataset for neuromorphic computation. (a) Images of numbers written with hands from the MNIST dataset. (b) Photographs of clothing from the Fashion-MNIST collection.