

RESEARCH ARTICLE

A device harnessing capacitive-coupled memristive effects for leaky integrate-and-fire neuron and electrocardiogram signal recognition implementation

Jingjuan Wang¹, Biao Yang², Hui He², Changliang Li², Xiaobing Yan^{2,*}

¹Intelligent Sensor Network Engineering Research Center of Hebei Province, Hebei Key Laboratory of Optoelectronic Information and Geo-detection Technology, School of Information Engineering, Hebei GEO University, Shijiazhuang 050031, China

²Key Laboratory of Brain-Like Neuromorphic Devices and Systems of Hebei Province, College of Electron and Information Engineering, Hebei University, Baoding 071002, China

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Corresponding author. E-mail: *xiaobing_yan@126.com

Supporting Information

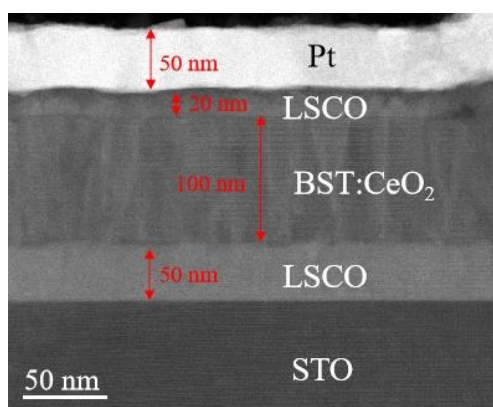


Fig. S1 TEM image of the device structure.

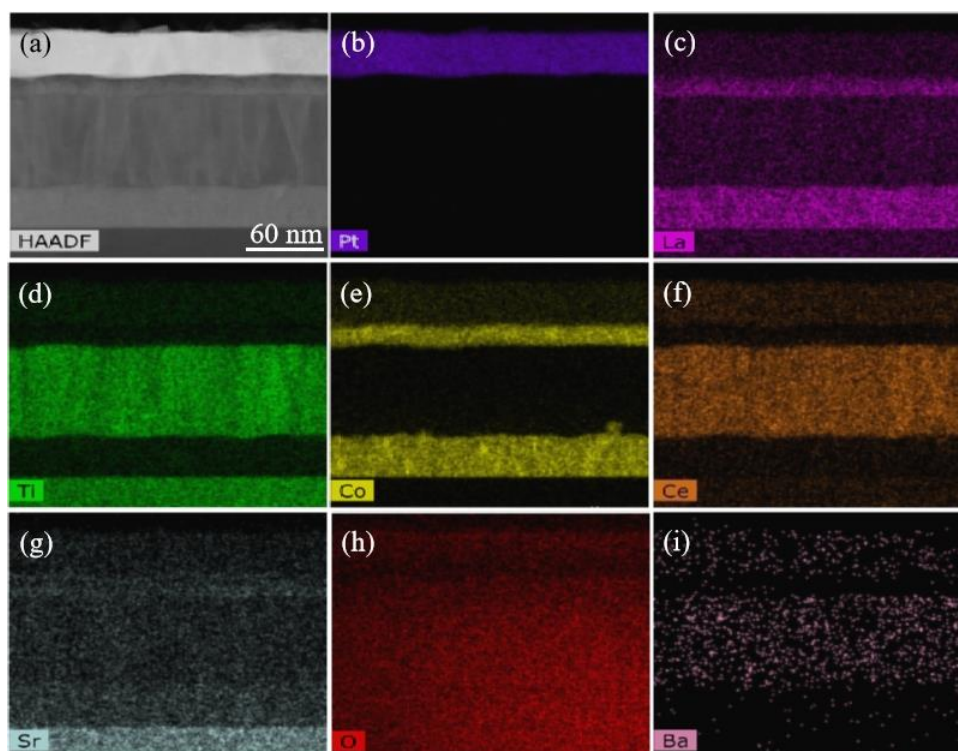


Fig. S2 The EDS elemental mapping.

It was found that after the I - V curve of the device underwent the forming process, it could undergo 100 cycles without significant attenuation, as shown in Fig. S3(a). Figure S3(b) shows the statistical distribution diagrams of high resistance state (HRS) and low resistance state (LRS) under 100 consecutive cyclic scans corresponding to Fig. S3(a). It can be concluded that the distribution of high resistance state (HRS) and low resistance state (LRS) of the device is concentrated, and the device has good uniformity and repeatability. The retention characteristic of a device is an important indicator for judging the stability of the memristor. Figure S3(c) demonstrates the ability of the memory device to store and retain the data after the written information is stored. The results indicate that the device can maintain the set state for more than 2×10^4 s, possessing excellent retention characteristics.

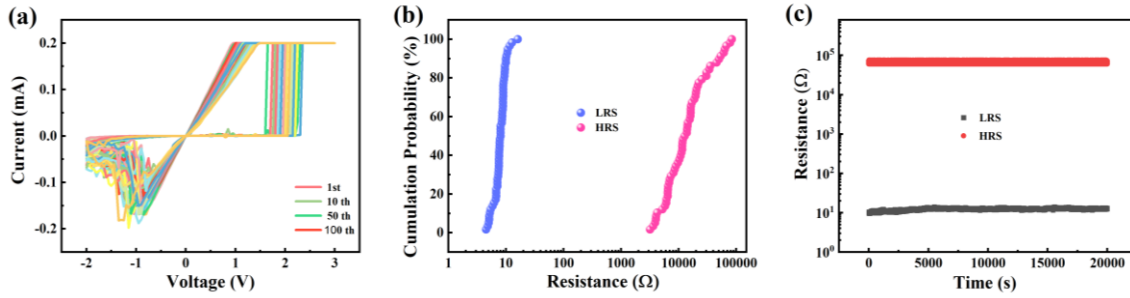


Fig. S3 (a) Typical I - V curve characteristics of the pure memristive device. (b) Distribution diagram of HRS and LRS. (c) Retention characteristics.

Figure S4 illustrates the investigation of the biological synaptic characteristics of the device in the memristive state. The device successfully realizes several key biological synaptic functions, including paired-pulse facilitation (PPF), spike-timing-dependent plasticity (STDP), and excitatory postsynaptic current (EPSC). These results suggest that the device can effectively mimic the functions of biological synapses in the pure memristive state.

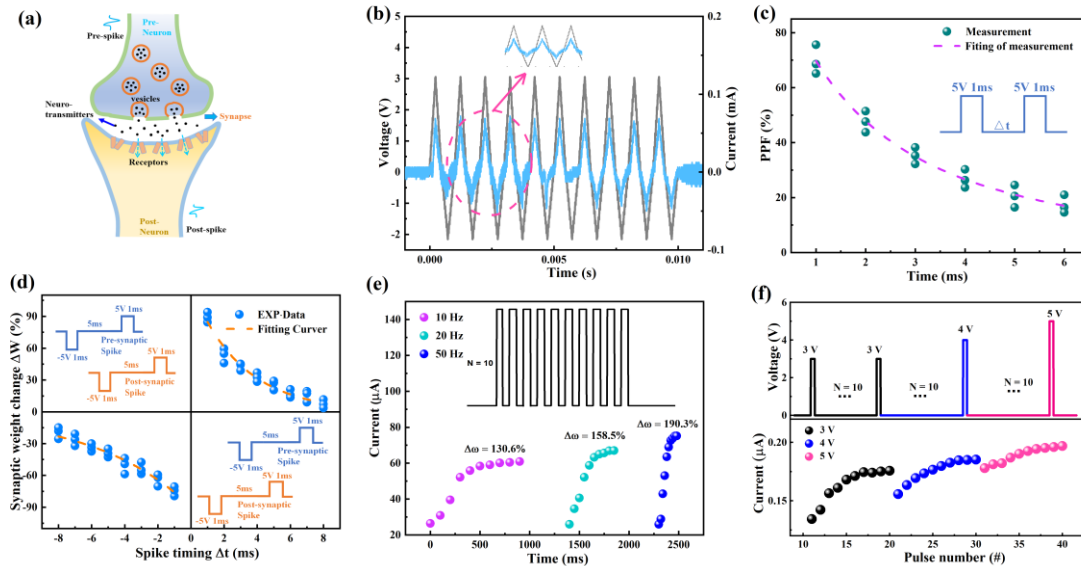


Fig. S4 (a) Schematic diagram of biological synapse. (b) Curves of current and voltage vs. time. (c) PPF test result diagram. (d) The result diagram of the STDP simulation. (e) EPSC result. (f) Conductance modulation of the device by pulse stimulus.

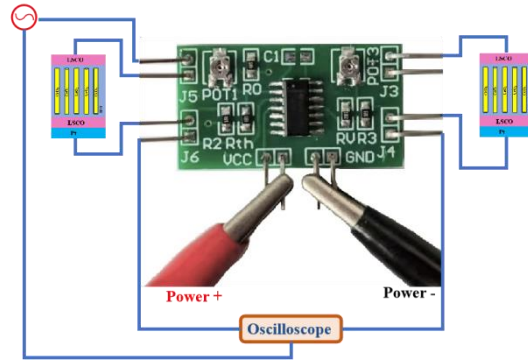


Fig. S5 Physical diagram of neuron circuit with leakage integral and excitation function.

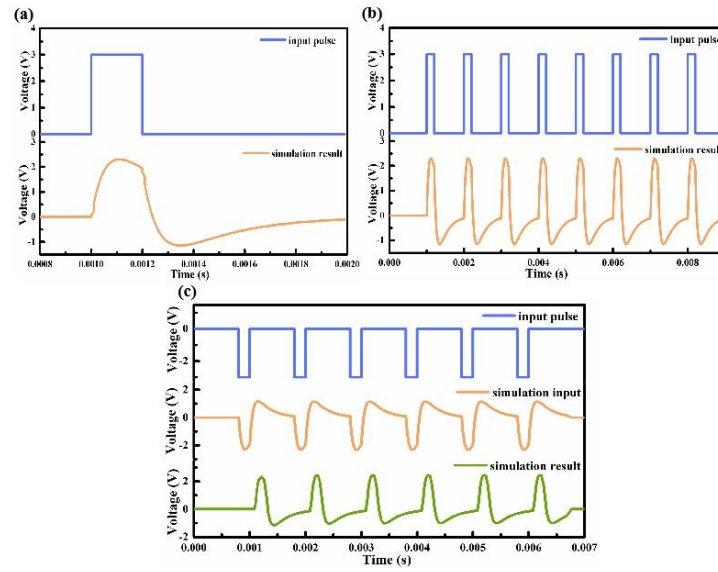


Fig. S6 Schematic of the simulated ignition trigger.