

Electronic Supplementary Material (ESI) for Nanoscale.

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Memristor based on 2D MoSe₂ nanosheets as artificial synapse and nociceptor for neuromorphic computing

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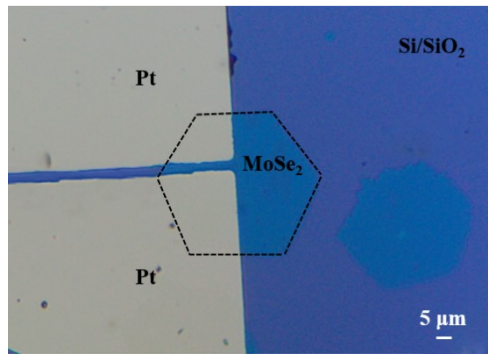


Fig. S1. The optical microscope image of the memristor with Pt/MoSe₂/Pt structure on SiO₂/Si substrate.

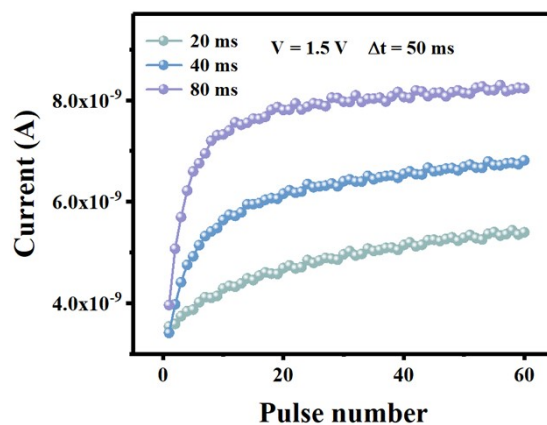


Fig. S2. The pulse width dependent potentiation behaviors with pulse amplitude of 1.5 V, pulse interval of 50 ms and the pulse width ranging from 20 to 80 ms. As the pulse width increases from 20 to 80 ms, the potentiation effects are enhanced in the long-term potentiation (LTP) behaviors.

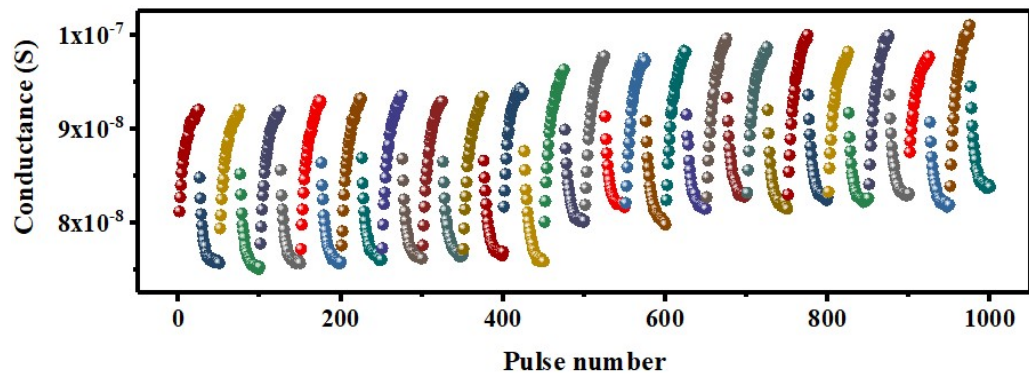


Fig. S3. The consecutive 20 sets of LTP/LTD cycles with good repeatability.

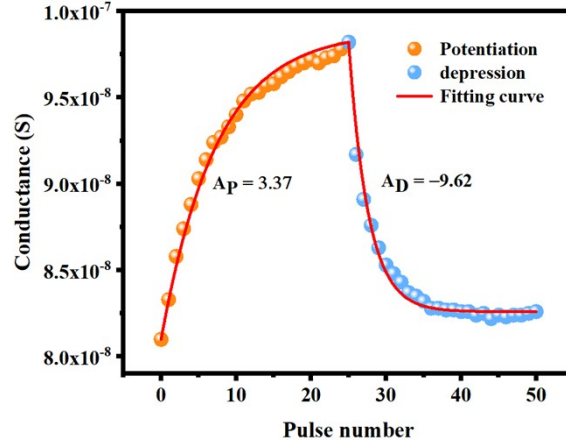


Fig. S4. Fitting curve of the typical LTP and LTD curves.

To describe the linearity of LTP and long-term depression (LTD) quantitatively, the relationship between the conductance value (G) and the number of pulses (x) was fitted by the following two equations:¹

$$G_{LTP}(x) = \frac{G_{max} - G_{min}}{1 - \exp\left(\frac{-A_P}{P_{max}} \cdot x\right)} \left[1 - \exp\left(\frac{-A_P}{P_{max}} \cdot x\right) \right] + G_{min} \quad (1)$$

$$G_{LTP}(x) = \frac{G_{max} - G_{min}}{1 - \exp\left(\frac{-A_D}{P_{max}} \cdot (2P_{max} - x)\right)} \left[1 - \exp\left(\frac{-A_D}{P_{max}} \cdot (2P_{max} - x)\right) \right] + G_{min} \quad (2)$$

where G_{max} refers to the maximum conductance value, G_{min} refers to the minimum conductance value, P_{max} is the maximum number of pulses, and A_P and A_D are the number of nonlinear factors of LTP and LTD, respectively. The fitted curves are shown in Fig. S4, where A_P is about 3.37 and A_D is about -9.62 . Although the nonlinear factors for LTP and LTD are relatively large, the simulation of image recognition based on the artificial neural network (ANN) can be achieved with the recognition accuracy of small image up to 92% and large image up to 85%.

References

- 1 S. Cheng, L. Zhong, J. Yin, H. Duan, Q. Xie, W. Luo and W. Jie, *Nanoscale*, 2023, **15**, 4801–4808.