2-dimensional perovskite nanosheet-based synaptic devices for mimicking heterosynaptic plasticity

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Abstract

Electrical synaptic devices are the basic components for neuromorphic computational systems, which are expected to break the bottleneck of current von Neumann architecture. Especially, the development of artificial synapses having tunable multiple synaptic response can be an essential step forward for the advancement of novel neuromorphic computing [1]. Three-terminal based transistors, which modulate the channel conductance through a floating gate and/or charge trapping layer use gate pulses, have been reported to realize multiple synaptic response. However, the vertical 2-terminal device, which provides more energy-efficient system, with heterosynaptic behavior have not been reported so far. Herein, high-performance and low-power consumption Pt/bi-layer A-site modified $Sr_2Nb_3O_{10}$ (3 nm)/Nb:$SrTiO_3$ memristors are demonstrate. We successfully controlled oxygen vacancies as trap site in 2-dimensional $Sr_2Nb_3O_{10}$ nanosheet through the A-site modification, and the tunneling current of Pt/Nb:$SrTiO_3$ interface is modulated by controlled electron trap/detrap amounts in $Sr_2Nb_3O_{10}$ nanosheet layer. The A-site modified perovskite nanosheets were synthesized by 2-step cation exchange method and deposited Langmuir-Blodgett method via solution-based process. The synaptic devices exhibit good biological synaptic functions of excellent stability, high endurance, long-term potentiation/depression, and paired-pulse facilitation.

References

[1] Shilei Dai,Yiwei Zhao,Yan Wang,Junyao Zhang,Lu Fang,Shu Jin,Yinlin Shao,Jia Huang, Advanced Functional Materials, Volume29, Issue42 (2019) 1903700.

Figures

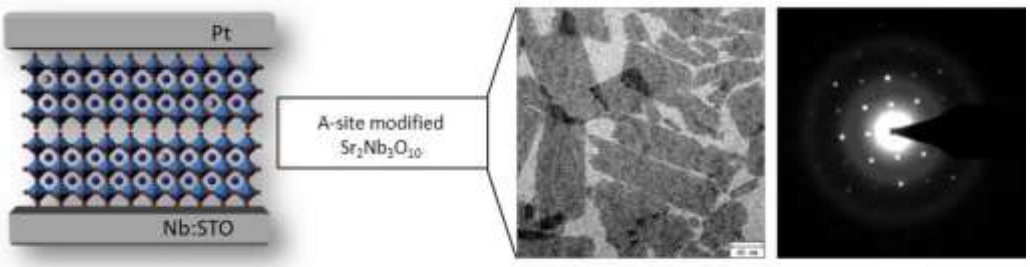

Figure 1: Schematic diagram of Pt/bi-layer $Sr_2Nb_3O_{10}$ (3 nm)/Nb:$SrTiO_3$ memristors and TEM image of nanosheets.