低功耗高灵敏的光子突触有望实现感存算一体化

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人工突触器件是神经形态系统最重要的组成成分，对突触器件的性能进行评估有助于将其进一步应用于更加复杂的人工神经网络 (ANN)。

电子科技大学巫江教授带领的光电探测与传感团队设计了基于大面积、均匀的多层 MoS_2 薄膜的三端光子突触阵列，实现了对 5 μs 超短光脉冲的探测和 40 aJ 超低的功耗，其性能远远优于目前已报道的光子突触的性能，而且较生物突触的相应参数低了好几个数量级，表明该光子突触可进一步用于更复杂的 ANN。通过光刺激信号调节 CVD 生长的 MoS_2 沟道的光电导，使得该器件可以模拟短期突触可塑性 (STP)、长期突触可塑性 (LTP)、双脉冲易化 (PPF) 等突触性能。因此，该光子突触可以模拟人眼视觉感知，而且探测波长可拓展至近红外光波段。

此外，在栅压电刺激的辅助调控下，该光子突触可以模拟经典的巴浦洛夫实验和不同情绪对记忆能力的调节，如正面情绪增强记忆能力，负面情绪减弱记忆能力。文章展示的光子突触有望实现感存算一体化，可用于实时的图像检测和原位存储，这也为突破冯·诺伊曼瓶颈提供了可能。

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Photonic synapses with low power consumption and high sensitivity are expected to integrate sensing-memory-preprocessing capabilities

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Artificial synaptic devices are the most important components of neuromorphic systems. The performance evaluation of synaptic devices will help to further apply them to more complex artificial neural networks (ANN).

The research Group of Optical Detection and Sensing (GODS) from University of Electronic Science and Technology of China have reported a three-terminal photonic synapse based on the large-area, uniform multilayer MoS_2 films. The reported device realized ultrashort optical pulse detection within 5 μs and ultralow power consumption about 40 aJ, which means its performance is much better than the current reported properties of photonic synapses.

Moreover, it is several orders of magnitude lower than the corresponding parameters of biological synapses, indicating that the reported photonic synapse can be further used for more complex ANN. The photoconductivity of MoS_2 channel grown by CVD is regulated by photostimulation signal, which enables the device to simulate short-term synaptic plasticity (STP), long-term synaptic plasticity (LTP), paired-pulse facilitation (PPF) and other synaptic properties. Therefore, the reported photonic synapse can simulate human visual perception, and the detection wavelength can be extended to near infrared light.

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