Fabrication and application of optical synaptic devices based on two-dimensional materials

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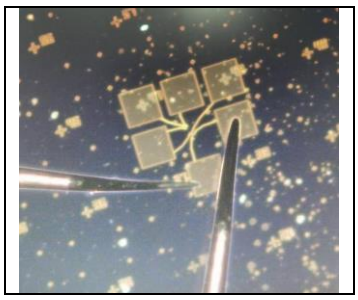
With the rapid advancement of artificial intelligence and neuromorphic computing, traditional silicon-based synaptic devices are increasingly constrained by issues such as high power consumption and limited integration density, making them insufficient to meet the demands of efficient parallel computation. In contrast, optoelectronic synaptic devices based on two-dimensional (2D) materials have demonstrated significant application potential due to their unique photoelectric synergistic regulation capabilities, low energy consumption, and excellent scalability, emerging as promising candidates for next generation brain-inspired computing systems.

In this work, an optoelectronic synaptic device based on 2D transition metal dichalcogenides (TMDs) was designed and fabricated. High-quality, large-area, and thickness-controlled TMD films were synthesized via chemical vapor deposition (CVD). The material was systematically characterized using optical microscopy and Raman spectroscopy to evaluate its structural quality. The synthesized 2D material was then transferred onto the target substrate, and microelectrode structures were defined using electron beam lithography and thermal evaporation coating techniques. The device architecture and electrode interfaces were optimized to enhance synaptic performance. Experimental results demonstrate that the device exhibits robust and tunable synaptic behaviors in response to variations in light intensity, wavelength, and pulse timing, effectively emulating key features of biological synaptic plasticity. This study provides a valuable reference for the further development of 2D-material-based optoelectronic synaptic devices and offers a promising pathway for constructing low-power, highly integrated neuromorphic vision systems.



Pic.1 Optical micrograph of a optoelectronic synaptic device

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