

Engineering VI-group bismuthides for functional optoelectronic devices

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Abstract

Two-dimensional materials with tunable structures and electronic properties offer unique opportunities for next-generation optoelectronic devices. However, effective design strategies that directly link material/device architecture with functions and performance optimization remain to be fully established. Here, we present a systematic investigation of VI Group Bismuthide-based photodetectors, including Bi_2Se_3 , Bi_2Te_3 and Bi_2S_3 thin films. We demonstrate: (1) 2D Bi_2Se_3 -based optoelectronic synaptic devices exhibiting persistent photoconductivity and nonvolatile photoresponse for neuromorphic vision sensing and computing via defect engineering^[1]; (2) self-powered broadband photodetectors based on Bi_2Te_3 heterostructures realized through doping and carrier-blocking interface design^[2-3]; (3) flexible photodetectors with highly ordered Bi_2S_3 thin film composed of triangular building units enabled by surface engineering^[4]. Benefiting from the narrow bandgaps and strong light-matter interaction of VI-group bismuthides, these devices exhibit broadband photoresponse spanning the UV-visible-NIR region (254–2275 nm), with specific detectivities ranging from 10^9 to 10^{13} Jones depending on device architecture and wavelength. This work highlights design principles and engineering strategies for constructing functional photodetectors based on 2D VI-group bismuthides thin films, providing insights for future broadband and intelligent optoelectronic systems.

References

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Figures

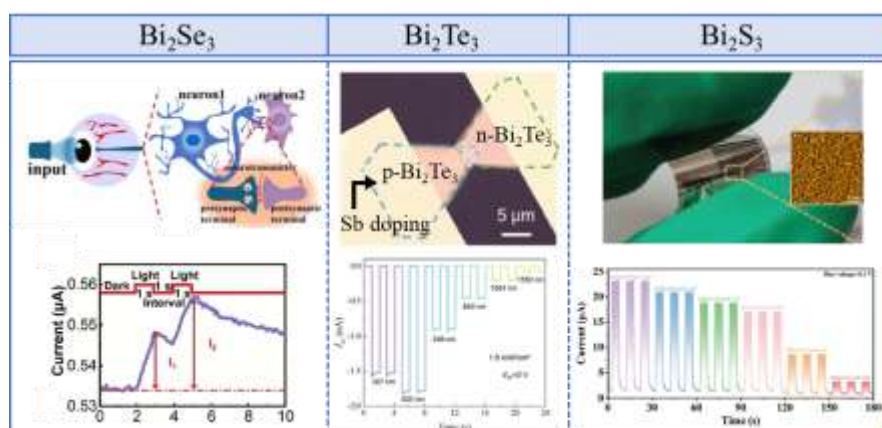


Figure 1: VI-group bismuthides thin films for functional optoelectronic devices.