Selective Growth of 2D Sb2Te3 and Sb2Te3/WS2 Vertical p-n Heterostructures for High-Performance Photodetectors

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Abstract

Abstract: Two-dimensional transition metal dichalcogenides (2D-TMDs) possess appropriate bandgaps and interact through van der Waals (vdW) forces between layers, overcoming the lattice matching issues inherent in traditional heterostructures, enabling the construction of heterostructures with varying bandgap alignments. However, the current main method for creating heterostructures with 2D-TMDs relies on the low-efficiency technique of mechanical exfoliation, which is a barrier to large-scale production. As one of the p-type TMDs, Sb2Te3, can construct various 2D transition metal chalcogenide p-n heterostructures. Therefore, in this paper, large-scale deposition of 2D Sb2Te3 on inert mica substrates was successfully realized, offering valuable insights for creating heterostructures between Sb2Te3 and other two-dimensional layered materials. Building on it, Sb2Te3 is selectively epitaxially grown on WS2 surfaces pre-prepared on SiO2/Si substrates using a two-step chemical vapor deposition method, resulting in the formation of Sb2Te3 /WS2 heterojunctions. Finally, the 2D Sb2Te3 /WS2 optoelectronic devices were prepared, showing rapid response times, with a rise time of 305 μs and a fall time of 503 μs.

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