Growth of Vertical Heterostructures Based on Orthorhombic SnSe/Hexagonal In$_2$Se$_3$ for High-Performance Photodetectors

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Fig. S1 (a) Optical images of the In$_2$Se$_3$ sample on mica substrate. (b) AFM image and height profile of the In$_2$Se$_3$ film. (c) and (d) Optical images of the SnSe/ In$_2$Se$_3$ vertical van der waals heterostructure.
**Fig S2** XRD pattern of the empty mica substrate and the as-grown SnSe/In$_2$Se$_3$. 
Fig S3 (a) AFM image and height profile of the In2Se3 film. (b) Potential profile image of (a). (c) AFM image and height profile of the SnSe nanoplate. (d) Potential profile image of (c).
Fig S4 (a) HRTEM image of In$_2$Se$_3$ film in heterostructure sample (b) Pixel intensity profile of five lattice fringes. (c) HRTEM image of SnSe in heterostructure sample (b) Pixel intensity profile of five lattice fringes.
**Fig. S5** (a) Bright field TEM (BFTEM) image of In$_2$Se$_3$. (b) High resolution TEM (HRTEM) image of the In$_2$Se$_3$ sample. (c) The corresponding SEAD pattern in (b).

**Fig. S6** (a) Dark field (DF) STEM image of In$_2$Se$_3$. (b) and (c) Elements maps of In$_2$Se$_3$ sample showing spatial distribution of Se and In.
Fig. S7 I-V curves of the devices based on the SnSe nanosheet and SnSe/ In$_2$Se$_3$ heterostructure in the dark and the detail I-V characteristic of heterostructure shown in inserted diagram.