

Supporting Information

Van der Waals epitaxial growth and optoelectronics of a vertical MoS₂/WSe₂ p-n junction

Yu XIAO,¹ Junyu QU,¹ Ziyu LUO,¹ Ying CHEN,¹ Xin YANG,¹ Danliang ZHANG,² Honglai LI,¹ Biyuan ZHENG,¹ Jiali YI,¹ Rong WU,¹ Wenxia YOU,¹ Bo LIU,¹ Shula CHEN,^{1,*} Anlian PAN,^{1,*}

¹ Key Laboratory for Micro-Nano Physics and Technology of Hunan Province, College of Materials Science and Engineering, Hunan University, Changsha 410082, China

² School of Materials Science and Engineering, Key Laboratory for Micro-Nano Physics and Technology of Hunan Province, Hunan University, Changsha 410082, China

E-mails: shuch@hnu.edu.cn, anlian.pan@hnu.edu.cn

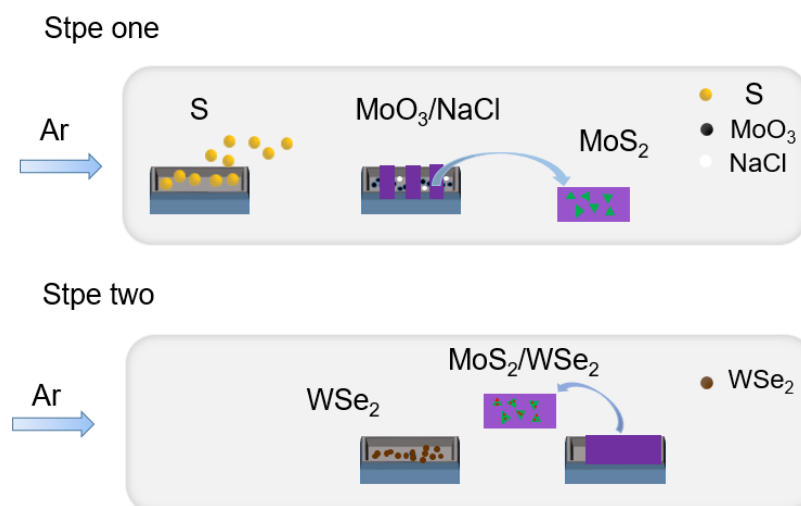


Fig. S1 Schematic view of CVD growth of MoS₂/WSe₂ vertical heterostructures.

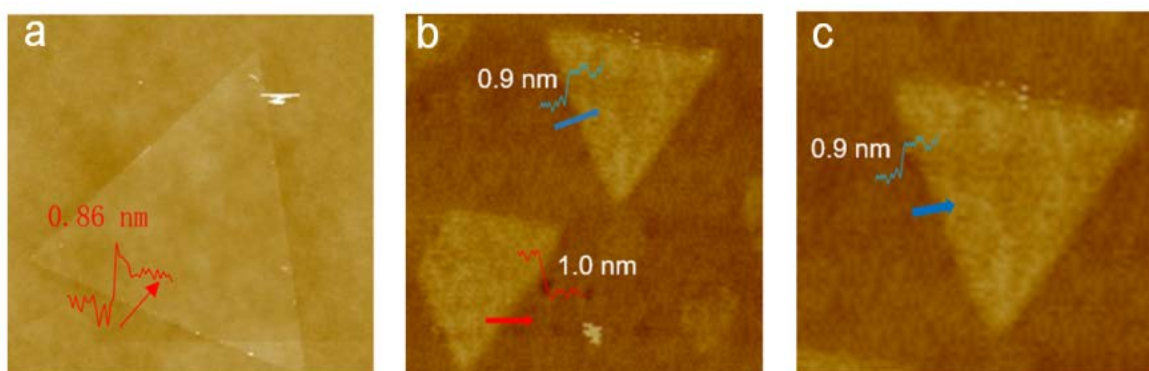


Fig. S2 Atomic force microscopy (AFM) image of the MoS₂ and the MoS₂/WSe₂ heterostructures. (a) AFM image of MoS₂. (b) AFM image of WSe₂. (c) AFM image of single WSe₂ triangle.

Heterojunction transfer method

1. Spin-coat the sample with PMMA on the homogenizer for one minute;
2. Heat the glued sample at 160°C for 5 min to evaporate the anisole solvent;
3. Cut the four corners of SiO₂/Si;
4. Put it in 2 mol/L KOH and soak at room temperature for about 6 hours. The PMMA film with the material will automatically separate from the SiO₂/Si substrate and float to the surface of the solution;
5. Take out the membrane, clean it in deionized water, and adhere to the prepared copper mesh;
6. Put the copper mesh in an oven at 60 °C to dry the deionized water and to make the PMMA film adhere to the copper mesh closely;
7. Remove PMMA in acetone solution, soak for about 5 minutes, and remove the copper mesh. At this time, only the nanosheets are left.

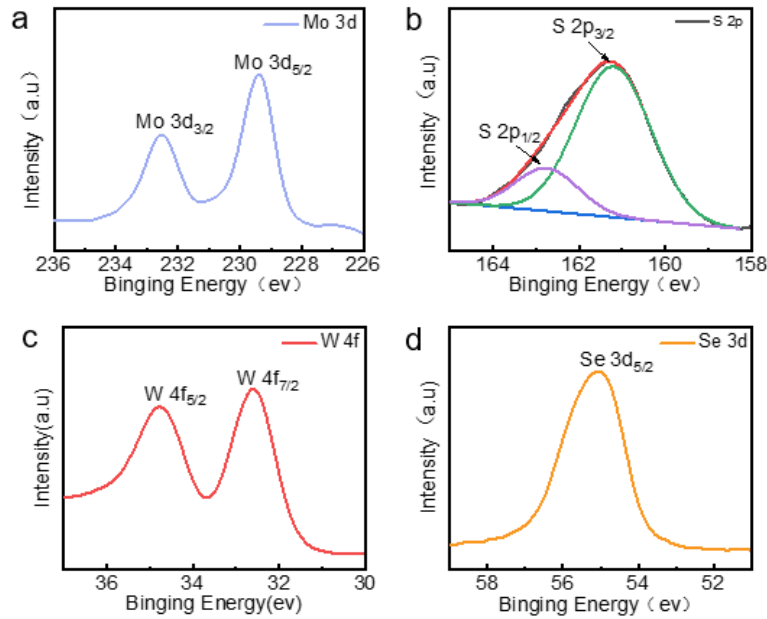


Fig. S3 Chemical states of Mo, S, W and Se in the MoS₂/WSe₂ heterostructures, measured by X-ray photoelectron spectroscopy.

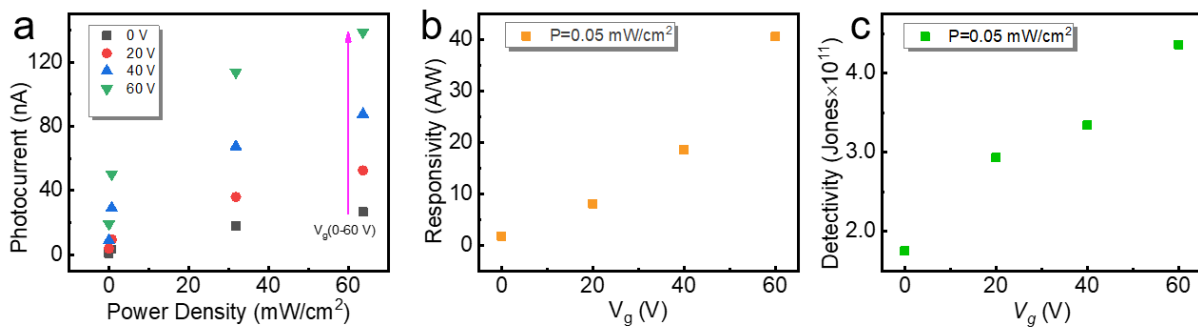


Fig. S4 (a) Photocurrent plots under different values of power and gate voltage ($V_{ds}=1$ V). (b) Photoresponsivity of the photodetector at various gate voltages ranging from 0 to 60 V ($V_{ds}=1$ V). (c) Detectivity of the photodetector at various gate voltages ranging from 0 to 60 V ($V_{ds}=1$ V).