

Supporting information

Morphological Evolution of $\text{Mo}_x\text{W}_{1-x}\text{S}_2/\text{MoS}_2$ Heterostructures Modulated with Growth Dynamic Process by One-step Chemical Vapor Deposition

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Table S1 Precursor quantity with different Mo:W

Mo:W	$\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ (mg)	$\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$ (mg)
10:1	33.0	4.5
2:1	24.2	16.5
1:2	12.1	33.0
1:10	3.3	45.0

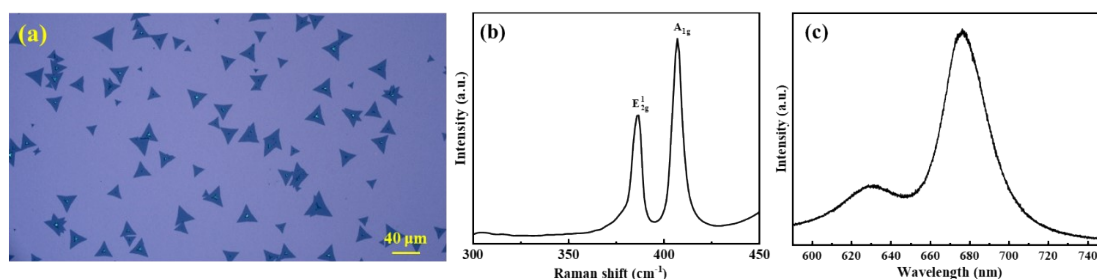


Fig. S1 (a) OM image, (b) Raman spectrum, and (c) PL spectrum of MoS_2 grown by Na_2MoO_4 solution

The Raman peak positions of MoS_2 are 386.8 cm^{-1} and 407.1 cm^{-1} , respectively, the relative distance of the two peaks is 20.3 cm^{-1} (see Fig.S1(b)). The result is in good agreement with the monolayer MoS_2 grown based on VLS.¹ In addition, according to Fig.S1(c), the main PL

peak of MoS₂ is 673 nm, corresponding to direct band gap of 1.84 eV.

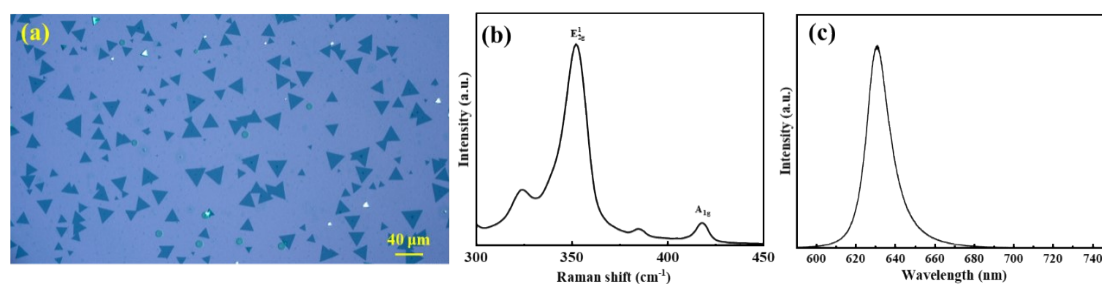


Fig. S2 (a) OM image, (b) Raman spectrum, and (c) PL spectrum of WS₂ grown by Na₂WO₄ solution

The in-plane vibration peak (E_{2g}^1) of WS₂ is 351 cm⁻¹, while the out-of-plane vibration peak (A_{1g}) is 416 cm⁻¹ in Fig.S2(b), and the frequency difference between the two vibration peaks is shown to be ~65 cm⁻¹. This result indicates that it is monolayer of WS₂.² In Fig. S2(c), the PL peak of WS₂ is 630 nm and its band gap is 1.97 eV.

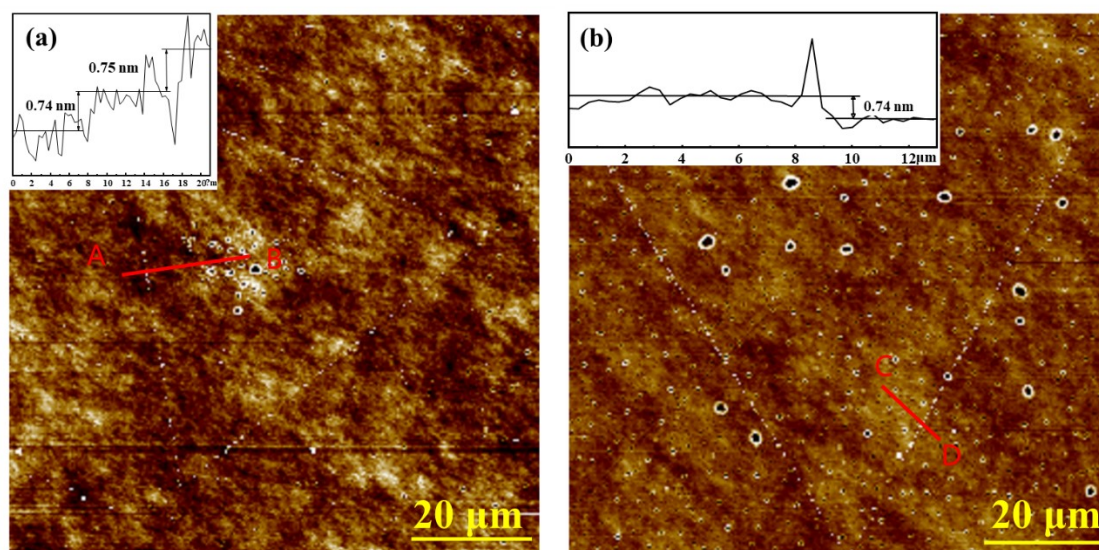


Fig. S3 AFM morphology and thickness of the heterostructure at Mo:W of (a) 2:1 and (b) 1:2

References

- S1. Chen Long, Lingyu Zang, Luhua Chen, Jinchao Wu, Chengming Jiang and Jinhui Song, *CRYSTENGCOMM*, 2021, **23**, 5337-5344.
- S2. Hang Liu, Guopeng Qi, Caisheng Tang, Maolin Chen, Yang Chen, Zhiwen Shu, Haiyan Xiang, Yuanyuan Jin, Shanshan Wang, Huimin Li, Miray Ouzounian, Travis Shihao Hu, Huigao Duan, Shisheng Li, Zheng Han and Song Liu, *ACS APPL MATER INTER*, 2020, **12**, 13174-13181.

