

## Supplementary Information

# Synthesis of Monolayer MoSe<sub>2</sub> With Controlled Nucleation via Reverse-Flow Chemical Vapor Deposition

Siyuan Wang<sup>1,2,†</sup>, Guang Wang<sup>2,†,\*</sup>, Xi Yang<sup>3</sup>, Hang Yang<sup>2</sup>, Mengjian Zhu<sup>3</sup>, Sen Zhang<sup>2</sup>, Gang Peng<sup>2</sup> and Zheng Li<sup>1,\*</sup>

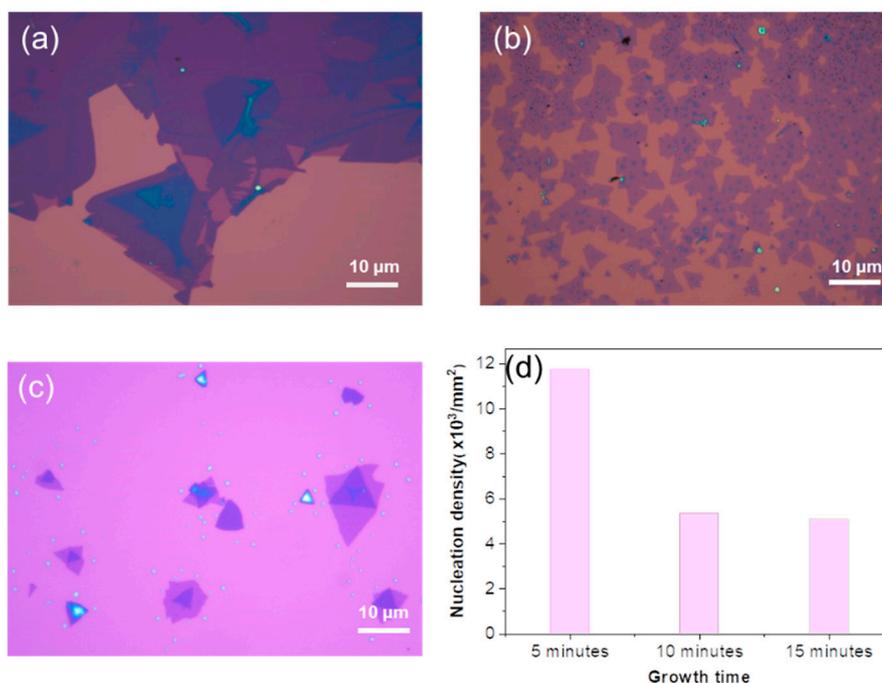
<sup>1</sup> School of Material Science and Engineering, Xiangtan University, Xiangtan 411105, China

<sup>2</sup> College of Liberal Arts and Sciences, National University of Defense Technology, Changsha 410073, China

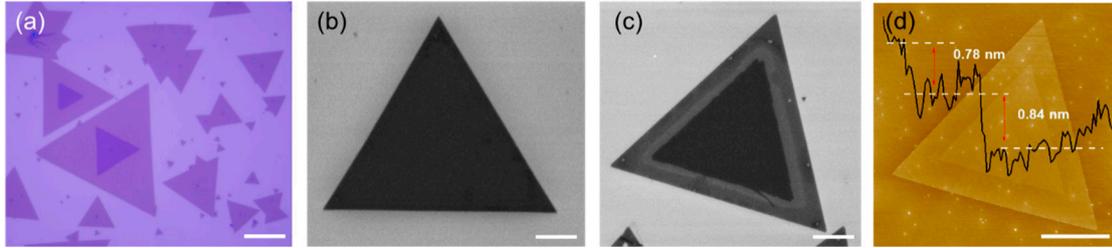
<sup>3</sup> College of Advanced Interdisciplinary Studies, National University of Defense Technology, Changsha 410073, China

\* Correspondence: wangguang@nudt.edu.cn (G.W.); lizheng@xtu.edu.cn (Z.L.)

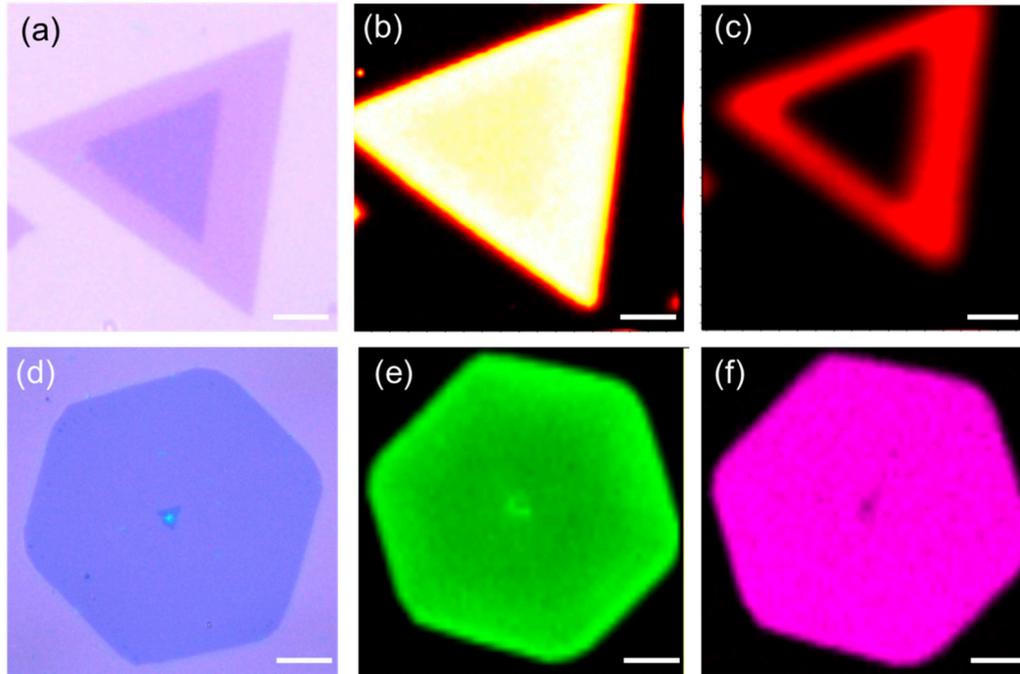
† Siyuan Wang and Guang Wang contributed equally to this work.



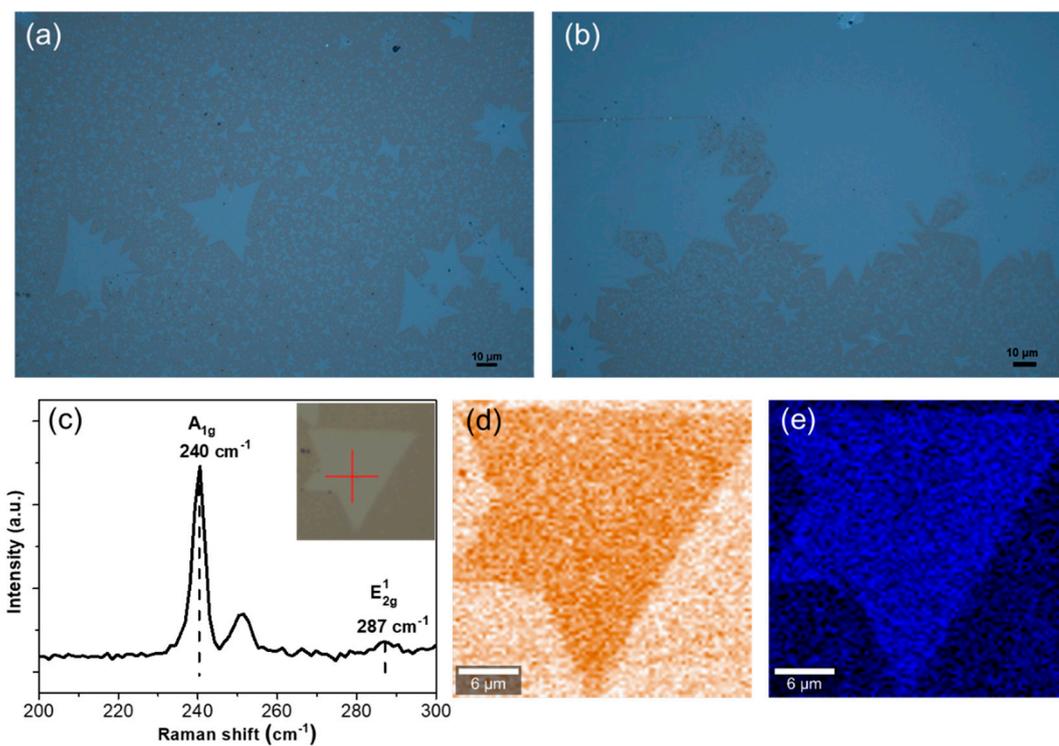
**Figure S1** Optical images of MoSe<sub>2</sub> flakes (a) with poor uniformity and (b) excessive nucleation with forward-flow. (c) uniform morphology without optimized reverse-flow. (d) Variation of nucleation density with growth time.



**Figure S2** (a) Optical images of MoSe<sub>2</sub> flakes. SEM images of (b) monolayer and (c) bilayer MoSe<sub>2</sub> flakes. (d) AFM image shows height profile of the bilayer MoSe<sub>2</sub> flake.



**Figure S3** (a) The optical image, (b) Raman ( $A_{1g}$  mode,  $240\text{ cm}^{-1}$ ) and (c) PL (807 nm) peak intensity map of a triangular bilayer MoSe<sub>2</sub> flake, respectively. (d) The optical image, Raman peak intensity map of (e)  $A_{1g}$  mode ( $240\text{ cm}^{-1}$ ) and (f)  $E_{2g}^1$  mode ( $287\text{ cm}^{-1}$ ) of a hexagonal MoSe<sub>2</sub> flake, respectively. The scale bar is  $10\text{ }\mu\text{m}$ .



**Figure S4** The optical images of monolayer (a) MoSe<sub>2</sub> flakes and (b) MoSe<sub>2</sub> films grown on sapphire (0001) substrate. (c) Raman spectrum of monolayer MoSe<sub>2</sub> grown on sapphire substrate. Raman peak intensity map of (d) A<sub>1g</sub> mode (240 cm<sup>-1</sup>) and (e) E<sub>2g</sub><sup>1</sup> mode (287 cm<sup>-1</sup>) of monolayer MoSe<sub>2</sub> flake, respectively.