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Title of the Presentation: Controllable synthesis of wafer-scale single-crystal MoS_2 films

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Short Biography:

Pengfei Yang reveiced her B.S. degree in Shandong University in 2016. She is currently a Ph.D. candidate under the tutelage of Professor Yanfeng Zhang at Peking University of China. She is expected to get the Ph. D. degree in in July, 2021. Her research interests center on controllable synthesis and applications of 2D materials.

Abstract:

Two-dimensional (2D) semiconducting transition metal dichalcogenides (TMDs) have emerged as attractive platforms in next-generation nanoelectronics and optoelectronics for reducing device sizes down to a 10 nm scale [1−3]. To achieve this, the controlled synthesis of wafer-scale single-crystal TMDs with high crystallinity has been a continuous pursuit. However, previous efforts to epitaxially grow TMDs films on insulating substrates (*e.g.*, mica and sapphire) failed to eliminate the evolution of antiparallel domains and twin boundaries, leading to the formation of polycrystalline films. Herein, we report the epitaxial growth of wafer-scale single-crystal MoS_2 monolayers on vicinal Au(111) thin films [4], as obtained by melting and resolidifying commercial Au foils. The unidirectional alignment and seamless stitching of the MoS_2 domains were comprehensively demonstrated using atomic- to centimeter-scale characterization techniques. By utilizing onsite scanning tunneling microscope characterizations combined with first-principles calculations, it was revealed that the nucleation of MoS_2 monolayer is dominantly guided by the steps on Au(111), which leads to highly oriented growth of MoS_2 along the ⟨110⟩ step edges. This work, thereby, makes a significant step toward the practical applications of MoS_2 monolayers and the large-scale integration of 2D electronics.

[1]P. Yang, Y. Zhang* et al., Nat. Commun. 9, 979 (2018).
[2]P. Yang, Y. Zhang* et al., ACS Nano 13, 3649 (2019).
[3]P. Yang, Y. Zhang* et al., ChemNanoMat, 3, 340 (2017)
[4]P. Yang, Y. Zhang* et al., ACS Nano 14, 5036 (2020)

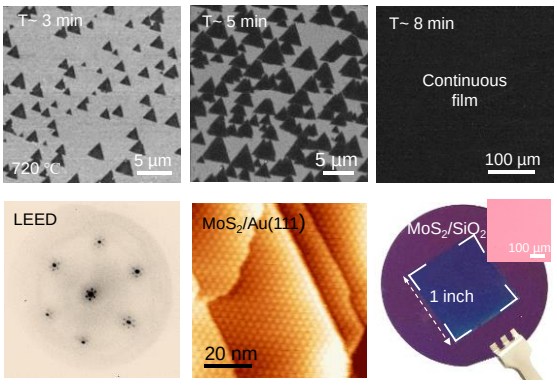

Fig. 1. Wafer-scale uniform monolayer MoS_2 single-crystal films