Kinetic *In Situ* Single-Layer Synthesis (KISS) Technique of Large-Area 2D Materials Exfoliation for Surface Science Investigation

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Two-dimensional (2D) materials provide an extremely rich platform to investigate novel quantum phenomena and to design nanostructures with desired functionalities [1]. Some of the key techniques employed in studies of 2D materials, such as photoemission spectroscopy, have stringent requirements for the quality, sample size and uniformity, as well as cleanliness of the surface. Achieving these conditions through standard mechanical exfoliation in a glove box is frequently challenging.

In this talk, I will introduce an innovative method for in situ exfoliation of 2D materials conducted directly in ultra-high vacuum conditions. This approach produces large flakes with exceptional crystallinity and purity [2]. Our experiments involved exfoliating various semiconducting and metallic transition metal dichalcogenides onto Au, Ag, and Ge substrates, highlighting the versatility of the technique. The characterization was performed using angle-resolved photoemission spectroscopy, a well know surface characterisation technique.

Importantly, the proposed method is straightforward, simple, and does not require any specialised equipment. This technique is particularly well-suited for electronic structure research on air-sensitive 2D materials, as the entire sample preparation process occurs within an ultra-high vacuum environment.

References

[1] M. Zheng, et al., Exploring Two-Dimensional Materials toward the Next-Generation Circuits: From Monomer Design to Assembly Control Chemical Reviews 118, 2018.
[2] A. Grubišić-Čabo et al.,, In-situ exfoliation method of large-area 2D materials, Advanced Science, In press, doi: 10.1002/advs.202301243, 2023

Figures

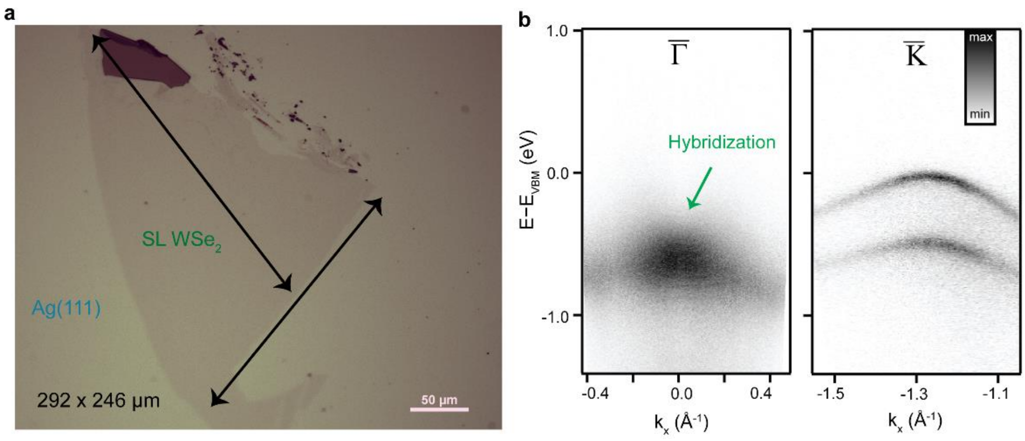

Figure 1: An example of KISS exfoliated flake of WS_2 on Ag(111). a) Optical microscopy image and b) band structure around Γ (left) and K point (right).