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KISS exfoliation of quantum materials for surface science studies

Two-dimensional (2D) materials offer a versatile platform for exploring novel quantum phenomena and designing nanostructures with tailored functionalities. However, techniques such as photoemission spectroscopy, commonly used in 2D material studies, impose strict requirements for sample quality, uniformity, surface cleanliness, and size. Achieving these standards via traditional mechanical exfoliation in glove boxes is often challenging.

In this presentation, I will introduce an innovative in situ exfoliation method for 2D materials performed directly under ultra-high vacuum conditions [1]. This approach yields large flakes with exceptional crystallinity and surface purity. Our experiments focused on exfoliating various semiconducting and metallic transition metal dichalcogenides onto Au, Ag, and Ge substrates, demonstrating the broad applicability of this technique. The materials were characterized using angle-resolved photoemission spectroscopy, a well-established surface analysis technique.

Crucially, this method is straightforward, requiring no specialized equipment, making it ideal for studying the electronic structure of air-sensitive 2D materials. The entire sample preparation and exfoliation process occurs within an ultra-high vacuum environment, ensuring pristine sample conditions throughout.

[1] A. Grubišić-Čabo et al.„ In-situ exfoliation method of large-area 2D materials, Advanced Science 10, 2023; DOI: 10.1002/advs.202301243, 2023

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