X-ray photoelectron spectroscopy of high-throughput mechanically exfoliated van der Waals materials

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X-ray photoelectron spectroscopy (XPS) is a widely used and easily accessible characterization technique for analysing the chemical composition of materials [1]. However, investigating the composition of van der Waals (vdW) flakes by XPS is challenging due to the typical spot size of the XPS setups compared to the dimensions of flakes, which are usually 10^{-3} folds smaller. In this work, we demonstrate the feasibility of quantitative elemental analysis of vdW materials by using high-throughput mechanical exfoliations [2], which favours the dispersion of vdW flakes over areas of the order of the cm^2 using minimal quantities of materials (about 10 µg). In this talk, I will discuss the XPS characterization of MoS_2, graphite, WeS_2 and $FePS_3$ produced by this method. The measurement of their main core levels with high resolution demonstrates the absence of significant contamination during the transfer method. In the case of air-sensitive $FePS_3$, I will discuss the glove box fabrication and its degradation in air. Overall, this research opens the possibility of evaluating the purity of commercial or lab-synthesized flakes and paves the way towards a more systematic comparison between the composition of vdW materials produced and used among different laboratories.

References

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[2] Sozen, Y., Riquelme, J. J., Xie, Y., Munuera, C. & Castellanos-Gomez, A. Small Methods 7, (2023) 2300326.

Figures

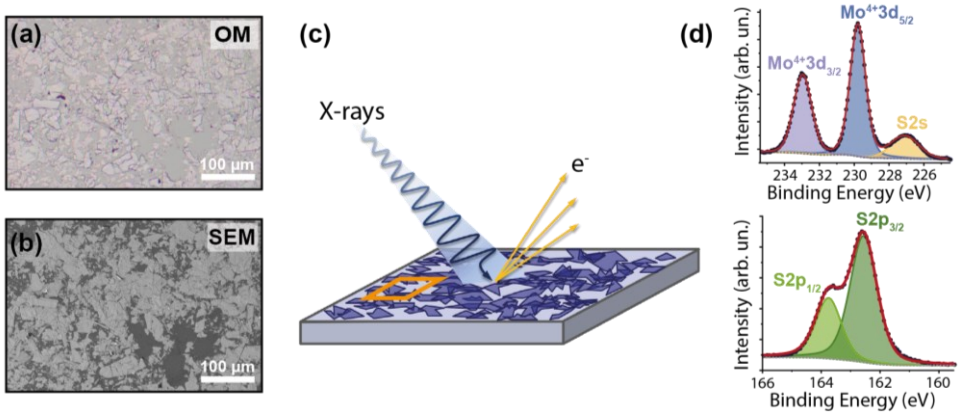

Figure 1: Morphological characterization of MoS_2 transferred flakes by (a) optical microscopy and (b) scanning electron microscopy. (c) Schematic diagram of the transferred flakes and the XPS procedure. (d) Mo 3d and S 2p core levels recorded for a MoS_2 sample prepared with the transfer technique explored in this work.