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Highly-ordered single-layer MoS_2 on the anisotropic Ag(110)

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Transition-metal dichalcogenide (TMDC) single layers, such as MoS_2 and WS_2 on Au(111), could be grown by physical vapor deposition with a single-orientation and high-quality making them suitable for their exploitation in applications in valleytronics devices [1-3]. In that case, the templating effect and the crystalline symmetry of the *fcc* substrate have been accounted for the high-quality and single-orientation of the TMDC single layer. Herein, we show that it is possible to grow highly-ordered single-layers of MoS_2 on the anisotropic Ag(110) surface. The growth is achieved in two steps, with an initial formation of MoS_2 nanoclusters that act as seeds for the growth of the complete layer. By means of core-level and valence band photoemission spectroscopy, we investigate the electronic structure of the interface, revealing a metallicity of the single-layer MoS_2 induced by the Ag substrate. X-ray photoelectron diffraction (XPD) reveals the coexistence of an equal amount of mirror-oriented MoS_2 crystalline domains on the surface. Low-energy electron diffraction (LEED) and scanning tunneling microscopy (STM) measurements show the formation of a complex superstructure, accounting for additional moiré-induced electron diffraction spots and striped patterns in the STM topography images. Based on the analysis of these results, we identify a structural atomic model for the MoS_2/Ag(110) interface, with the formation a moiré superstructure and a strain of the MoS_2 lattice of about 3% along the [1-10] direction of the substrate.

References

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[2] Bignardi L. *et al.*, Phys. Rev. Mat. 3, 014003 (2019).
[3] Eickholt P. *et al.*, Phys. Rev. Lett. 121, 136402

Figures

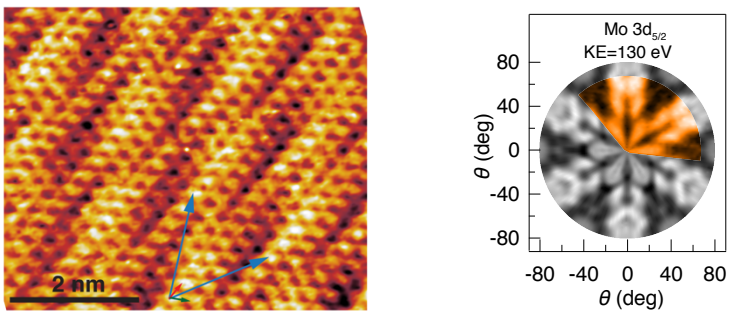

Figure 1: (left) STM image of single layer MoS_2 on Ag(110). The periodicity of the moiré is indicated with blue arrows. (right) XPD pattern sourcing from Mo $3d_{5/2}$ (hv=360 eV, electron kinetic energy=130 eV).