Highly-Ordered MoS_2 Single Layers on the Anisotropic Ag(110)

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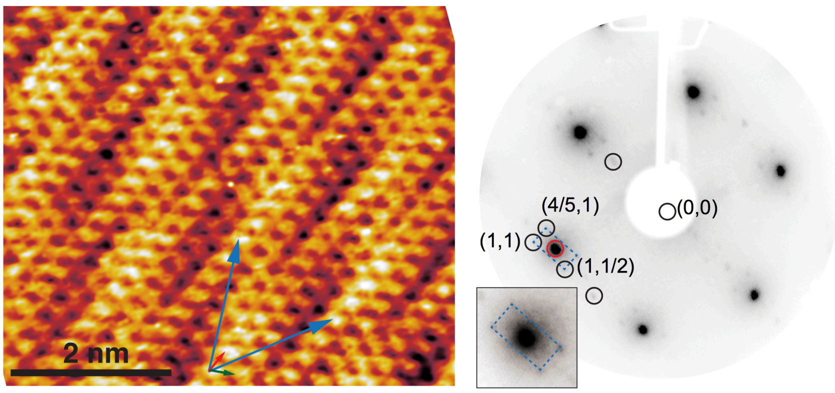
The growth of single-layer molybdenum disulfide (MoS_2) by physical vapor deposition on metals was thought to rely on the templating effect induced by the crystalline symmetry of substrate in guiding the orientation of the overlayer [1,2]. In this contribution we show that it is possible to grow highly-ordered single layers of MoS_2 on the anisotropic Ag(110) surface, which has a rectangular surface cell and thus does not match the symmetry of the hexagonal unit cell of MoS_2. The growth is achieved in two steps, with an initial formation of nanoclusters that act as seeds for the growth of the complete layer. Our work features a combination of different surface science techniques, aiming to provide a complete overview of the properties of the grown layer and of the interface. By means of core-level and valence band photoemission spectroscopy we investigated the electronic structure of the interface, revealing a metallicity of the overlayer induced by the substrate. X-ray photoelectron diffraction revealed 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 showed the formation of a complex superstructure, observable in the form of additional moiré induced diffraction spots in LEED and striped patterns in the STM topography images. Based on the analysis of these results, we identified a structural atomic model for the MoS_2/Ag(110) interface, with the formation a moiré superstructure resulting in a strain of the MoS_2 lattice of about 3% along the [1-10] direction of the substrate.



(left) STM image of MoS_2 on Ag(110) showing the S atoms in the top S layer and the moiré superstructure. (right) LEED pattern (E_B=120 eV) acquired on the same sample showing the additional spots due to the moiré superstructure.

References:
[1] Grønborg *et al.*, Langmuir **31**, 9700 (2015).
[2] Bana H. *et al.,* ArXiV preprint 1802.02220.