Nanoscale probing the electronic transport in transition metal dichalcogenides by conductive atomic force microscopy

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Abstract

Transition metal dichalcogenides (TMDs), such as MoS_2, have attracted an increasing scientific interest because of their unique and tunable electronic structure, holding great promise for applications in electronics and optoelectronics. However their electronic properties are strongly affected by peculiar nanoscale defects/inhomogeneities (point or complex defects, thickness fluctuations, grain boundaries,..) which are intrinsic of these materials or introduced during device fabrication processes. This paper reviews recent applications of conductive atomic force microscopy (C-AFM) to the investigation of nanoscale transport properties in TMDs, discussing the implications of the local phenomena in the overall behavior of TMD-based devices [1]. Current mapping and spectroscopy by C-AFM provided information on the Schottky barrier uniformity and shed light on the mechanisms responsible of the Fermi level pinning commonly observed at metal/TMD interfaces [1]. Methods for nanoscale tailoring of the Schottky barrier in MoS_2 for the realization of ambipolar transistors are also illustrated [2]. Experiments on local conductivity mapping in monolayer MoS_2 grown by chemical vapor deposition (CVD) on SiO_2 substrates are discussed, providing a direct evidence of the resistance associated to the grain boundaries between MoS_2 domains [3].

[1] F. Giannazzo, et al., Nanomaterials **10**, 803 (2020)
[2] F. Giannazzo, at al. ACS Appl. Mater. Interfaces **9**, 23164−23174 (2017).
[3] F. Giannazzo, et al., Phys. Status Solidi RRL **14**, 1900393 (2020).