Direct insight into the opto-electronic properties of 2D materials by atomic force microscopy

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In the last decades, two-dimensional (2D) materials have attracted attention because of superior opto-electronic properties combined with mechanical flexibility and robustness. In this perspective, various experimental strategies have been presented to trigger novel functional properties at the nanoscale, including synthesis engineering [1] and shape transformation of the 2D layers in arbitrary complex geometries [2].
Here, we will pay attention to nanoscale investigation of the 2D materials by means of atomic force microscopy aiming at determining key points for nanotechnology applications. Consideration will be given to 2D materials belonging to the class of transition metal dichalcogenides as well as to some emerging monoelemental Xenes, like phosphorene.[3]

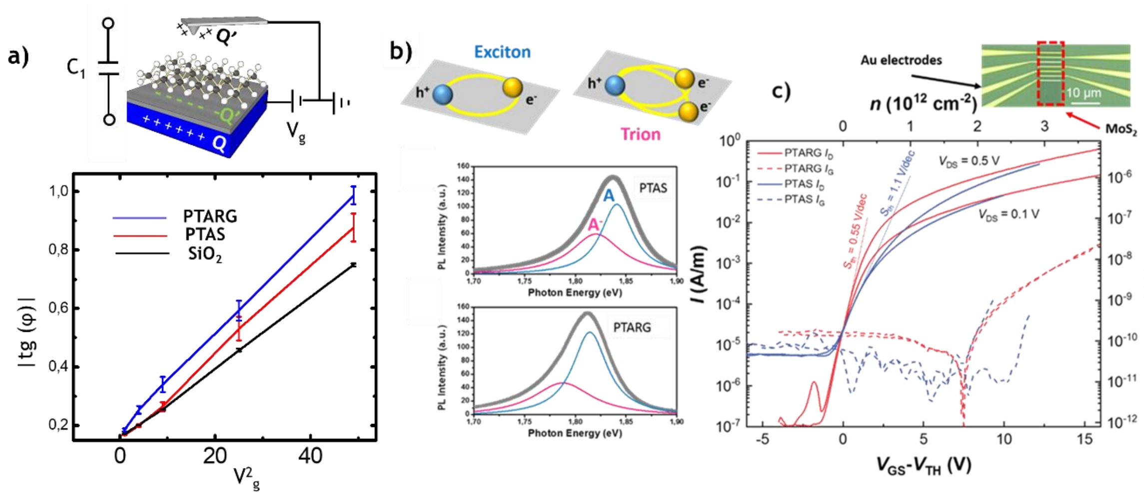

Fig. 1. (a) Electrostatic Force Microscopy investigation of two MoS_2 monolayers obtained by chemical vapour deposition with homemade engineered seeding promoters (PTAS and PTARG). (b) Sketch of the bound state of one hole and two electrons, also called trion. In the plots, micro-photoluminescence spectra of the two monolayers showing different neutral (A) and negative (A^-) trion populations. (c) The electrical transfer characteristics of field-effect transistors fabricated using the two monolayers.

References:

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[2] C. Martella *et al.*, *Adv. Mater.*, vol. 29, no. 19, pp. 1605785–1605785, May 2017
[3] G. Faraone *et al., Phys. status solidi – Rapid Res. Lett.*, vol. 15, no. 8, p. 2100217, Aug. 2021