MoS_2-based vertical spintronic devices

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Since the discovery of graphene in 2004, 2D materials have attracted a huge attention thanks to their amazing properties at the single layer level. 2D materials encompass compositions including almost all the elements of the periodic table and offer an extremely rich variety of functionalities that cover the whole range of electronic and magnetic properties [1]. More interestingly, a key asset of 2D materials is the possibility of combining the best of their properties altogether in multilayers to obtain new materials with enhanced or new functionalities, making them very appealing for next generation functional devices [2].
Concerning the spintronics field, where interfaces play a fundamental role on device performances, the large range of properties offered by 2D materials and, most important, their intrinsic two dimensional nature that presents them as "pure interfaces", make them perfect candidates to be used as Lego building blocks towards the ultimate miniaturization and engineering of spintronic devices. Despite this great potential, very few results exist up to date on the integration of 2D materials beyond graphene into spintronic devices, even the simplest ones as magnetic tunnel junctions (MTJs) [3,4].
Here we will focus on MoS_2 as prototypical 2D material of the transition metal dichalcogenide (TMDC) family. We will first report investigation of vertical transport through mechanically exfoliated MoS_2 flakes on $Co/(Al_2O_3)$ ferromagnetic electrode using a local atomic force microscopy (AFM) approach that allows us to correlate transport properties at the local level with flakes structure (Figure1).
Finally, we will show successful integration of mechanically exfoliated MoS_2 flakes in real devices, as $Co/(Al_2O_3)/MoS_2/Co$ MTJs, and first magneto-transport measurements will be presented at high and low temperature.
These findings represent an advance in the understanding of vertical transport mechanisms through MoS_2 thin layers and are an important step forward in the integration of other TMDCs into 2D-based MTJs.

References

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Figures

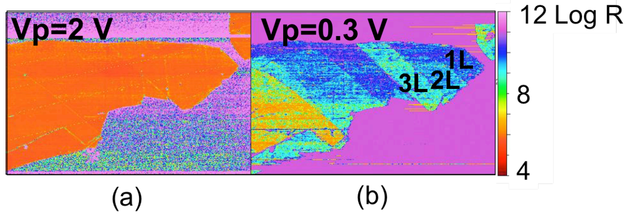

Figure 1: Peak force AFM measurement of vertical conduction in MoS_2 flakes on Co/Al_2O_3 substrate at two polarization biases: (a) 2 V and (b) 0.3 V. Remarkably, at low bias 1L results to be less conductive than multilayers, suggesting that different transport regimes are playing a role.