Band-Structure Spin-Filtering in Vertical Spin Valves Based on CVD Grown WS_2

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Spintronics has opened a new paradigm through the use of the spin variable as the vector of information and has been largely applied from hard drives read-heads to the STT-MRAMs. While very recent, the introduction of 2D materials in Magnetic Tunnel Junctions (MTJs) has already shown some promising properties[1]. Graphene and the 2D insulator h-BN have been the first 2D materials to show strong impact on spin transport in MTJs. The recent advent of the wide TMDC family of 2D semiconductors opened new opportunities for further tailoring of spintronics properties. We will present results on the scarcely studied WS_2. We will detail a protocol using laser lithography technology to fabricate spin valves based on CVD grown WS_2, with step by step characterizations in support (Raman spectroscopy, photoluminescence, and AFM measurements). We will finally show our first spin transport measurements obtained in a CVD WS_2 based MTJ. Our measured MR signals, above state of the art for 2D semiconductor based MTJs, validates our integration approach. We observe that the spin signal extracted from a ferromagnetic electrode can be tuned by placing atomically thin WS_2 on top of it. Furthermore the thickness of WS_2 significantly affects the extracted spin polarization of the 2D/FM interface. We discuss that trend using the peculiar band structure of WS_2, supported by DFT calculations, leading to thickness dependent spin filtering. Our work opens the way to the integration of different members of the very large TMDCs family, in order to reveal their spin transport properties in MTJs[3].

References

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Figures

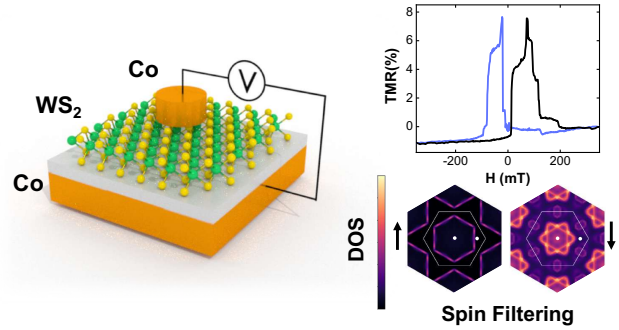

Figure 1: Scheme of the figure, magnetotransport measurement and Cobalt spin-split Fermi Surface