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2D Materials for Magnetic Tunnel Junctions

Spin-based electronics is at the heart of widely distributed applications (such as sensors, hard drives read heads, MRAMs…), and has recently been highlighted as a main contender for post-CMOS approaches (spin logics, stochastic, neuromorphic and quantum computing). In this context, 2D materials have opened novel exciting opportunities in terms of functionalities and performances for spintronics devices. To date, it is mainly graphene properties for efficient spin transport which have been put forward. Here we will present experimental results on another venue: 2D materials integration in the prototypical spintronics device, the magnetic tunnel junctions (MTJ).

We will first present experiments based on a large-scale low temperature catalyzed chemical vapor deposition (CVD) step to integrate graphene directly on ferromagnetic spin sources [1]. We will show that the graphene passivation layer can prevent the oxidation of a ferromagnetic spin source, in turn enabling the use of novel humid/ambient low-cost processes (such as ALD) for spintronics. Importantly, the use of graphene on ferromagnets allows to preserve a highly surface sensitive spin current polarizer/analyzer behavior and adds new enhanced spin filtering property that will be discussed [2]. We will then present results concerning 2D materials beyond graphene for MTJs. Characterizations of complete spin valves making use of 2D insulator h-BN as a tunnel barrier grown by CVD on Fe or Co will be discussed. Observed strong spin signals and inversion of the spin polarization will be presented (with ab-initio calculations in support) in light of h-BN hybridization with ferromagnetic metal in contact [3]. We will finally show our most recent experiments making use of 2D semiconductors, highlighting fundamental interfacial spin polarization processes [4]. These experiments unveil the strong potential of 2D materials for spintronics.

References

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