Graphene-interfaced heterostructures for spintronics

Regina Galceran
Z.M. Gebeyehu, A. Arrighi, M.J. Esplandiu, L. Camosi, F. Bonell, G. Sauthier, J.F. Sierra, A. I. Figueroa, I. Fernández-Aguirre, C. Gómez, M. V Costache, S. O. Valenzuela
Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and BIST, Campus UAB, Bellaterra, 08193 Barcelona, Spain
regina.galceran@icn2.cat

Topological insulators (TI) are materials with large spin-orbit coupling that possess insulating bulk but conductive topologically protected surface states (TSS), of great interest in spintronics due to their spin-momentum locking. When in contact with a ferromagnet (FM), any spin-polarized current or spin accumulation (originated by the TSS, spin Hall effect or Rashba) can interact with the magnetization of the ferromagnet. The generated spin torques have already proven their potential in all-electric switching of magnetic layers. However, to ensure the TSS origin of the spin torques, as well as to maximize their efficiency, particular attention must be paid to interfaces. For heterostructures involving air-sensitive or reactive elements, oxidation or intermixing at interfaces may hinder the performance of the device. Such is the case of heterostructures of TI– ferromagnet (FM) studied for spin-orbit torques. Previous studies in TI/FM heterostructures showed unavoidable intermixing at direct TI/NiFe interfaces due to the Te diffusion out of the Bi_2Te_3 [1]. They demonstrated that intercalating a thin nonmagnetic spacer (Al, Ag…) between the TI and NiFe helped in suppressing the interface diffusion, and gave compelling evidence that intermixing leads to suppression of spin-orbit torques. In this talk we will discuss the effect of introducing a graphene spacer between the topological insulator and the ferromagnet. This TI-graphene-ferromagnet heterostructure is predicted to lead to enhanced and low-dissipation spin-orbit-torques [2]. With this motivation in mind, our aim is to use graphene as a barrier against oxidation and interdiffusion while preserving the spin texture of the underlying topological insulator. We experimentally demonstrate how we can prevent TI oxidation by using a graphene layer and how this layer can be useful to avoiding intermixing.

References

[1] F. Bonell et al., Nano Lett., vol. 20 (2020), pp. 5893–5899
[2] M. Rodríguez-Vega et al., Phys. Rev. B 96 (2017), 235419

Figures

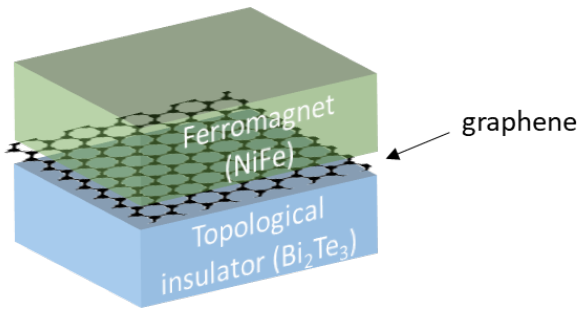

Figure 1: Sketch of the studied system.