Towards all-electric spintronics in graphene

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Abstract

Recent reports of sizeable spin–orbit coupling in chemically modified graphene have paved the way for all-electric spintronics in two-dimensional carbon platforms [1]. In this talk, I will overview the progress on spin Hall effect engineering in functionalized graphene [2-3], and discuss the implications of recent findings [4,5]. The main focus will be on spin–orbit coupled graphene obtained via chemisorption of light species and proximity effect to heavy adatoms. I will show theoretically how sharp electron—adatom scattering processes enable an efficient spin Hall current generation (spin Hall angles of the order of 10% [3]) with a low impact on spin relaxation times, making spin–orbit-coupled graphene a promising candidate for processing of neutral spin currents (see Fig. 1). Last, I will present a new proposal for spin-current routing based on the distortion of Dirac cones in graphene-based superlattices [5]. The implications for experiments will be briefly discussed.

References

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[2] Balakrishnan, J. et al. Nat. Comm. **5**, 4748 (2014); Avsar, M. et al. *ibidem*, 4875 (2014)

[3] Ferreira, A. et al. Phys. Rev. Lett. **112**, 066601 (2014); Pachoud, A. et al. Phys. Rev. B **90**, 035444 (2014)

[4] Stabile, A. et al. Phys. Rev. B **92**, 121411(R) (2015)

[5] Martelo, L., and Ferreira, A. (unpublished)

Figures

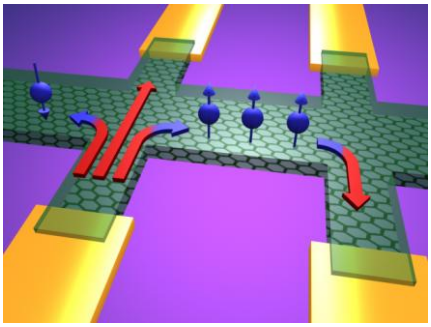

Fig. 1: Direct and inverse Spin Hall effects in a graphene H-bar (Credit: J. Balakrishnan)