MAR15-2014-004769

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Extrinsic spin Hall effect in graphene[1]

TATIANA RAPPOPORT, Universidade Federal do Rio de Janeiro

The intrinsic spin-orbit coupling in graphene is extremely weak, making it a promising spin conductor for spintronic devices. In addition, many applications also require the generation of spin currents in graphene. Theoretical predictions and recent experimental results suggest one can engineer the spin Hall effect in graphene by greatly enhancing the spin-orbit coupling in the vicinity of an impurity. The extrinsic spin Hall effect then results from the spin-dependent skew scattering of electrons by impurities in the presence of spin-orbit interaction. This effect can be used to efficiently convert charge currents into spin-polarized currents. I will discuss recent experimental results on spin Hall effect in graphene decorated with adatoms and metallic cluster [1,2] and show that a large spin Hall effect can appear due to skew scattering. While this spin-orbit coupling is small if compared with what it is found in metals, the effect is strongly enhanced in the presence of resonant scattering, giving rise to robust spin Hall angles. I will present our single impurity scattering calculations done with exact partial-wave expansions [3] and complement the analysis with numerical results from a novel real-space implementation of the Kubo formalism for tight-binding Hamiltonians [4].

[1] J. Balakrishnan et al., Nat. Phys. 9, 284 (2013).
[2] J. Balakrishnan et al., Nat. Commun. 5, 4748 (2014).
[3] A. Ferreira, T. G. Rappoport, M. A. Cazalilla, A. H. Castro Neto, Phys. Rev. Lett. 112, 066601 (2014).
[4] Jose H. Garcia, Lucian Covaci and Tatiana G. Rappoport, arXiv:1410.8140.

[1]The author acknowledges the Brazilian agencies CNPq, CAPES, FAPERJ and INCT de Nanoestruturas de Carbono for financial support