Spin transport in polycrystalline graphene and graphene/TMDC heterostructures

Aron W. Cummings[1]
José Garcia[1] and Stephan Roche[1,2]

[1] *Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology, Campus UAB, 08193 Barcelona, Spain*
[2] *ICREA - Institució Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain*

aron.cummings@icn2.cat

Abstract

Owing to its small spin-orbit coupling (SOC) and hyperfine interaction, graphene is predicted to be an efficient carrier of spin [1], and is thus promising for spintronics applications [2]. While measured spin lifetimes are now quite satisfactory, in the nanosecond range [3,4], there is still room for optimization of spin transport in this material. In addition, applications that rely on the spin Hall effect or spin orbit torque require a large SOC.

In this talk I will present numerical studies of spin transport in polycrystalline graphene (PG), and in graphene on transition metal dichalcogenides (TMDCs). In PG, grain boundaries (GBs) impede charge transport and are generally unfavorable [5]. However, numerical simulations indicate that under the right conditions GBs may actually be beneficial to spin transport (see Fig. 1). Meanwhile, proximity to a TMDC can significantly enhance the SOC in graphene, making it potentially useful for applications requiring large SOC while also taking advantage of its superior charge transport properties. I will present numerical simulations detailing the impact of this enhanced SOC on the spin lifetime, as well as on phenomena such as weak antilocalization and the spin Hall effect.

References

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Figures

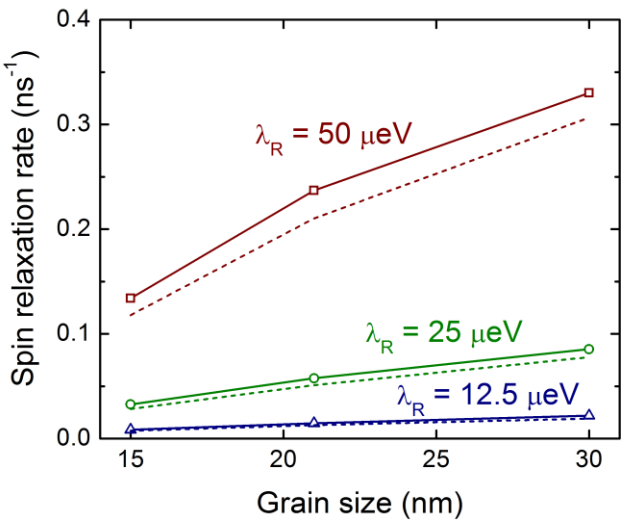

Figure 1: Spin relaxation rate as a function of grain size in polycrystalline graphene, for different values of Rashba SOC. Solid lines are from numerical simulations, and dashed lines are estimates based on the Dyakonov-Perel mechanism of spin relaxation. Consistent with this mechanism, smaller grains correspond to longer spin lifetimes.