Spin-orbitronics in graphene/Transition Metal Dichalcogenide heterostructures

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One of the key properties of graphene for spintronics is its capability to transport spins over long distances unaltered. This property originates from its small spin-orbit coupling that concomitantly prevents the electrical manipulation of spins. The heterostructures composed of graphene and transition metal dichalcogenides are recently being used to increase, by order of magnitudes, graphene's spin-orbit coupling, while preserving its extraordinary transport properties. Moreover, these heterostructures induce a special type of spin-orbit interaction that couples the spin and valley degrees of freedom, termed valley-Zeeman.

In this work, we show that the valley-Zeeman spin-orbit coupling effectively enhances the spin Hall and Rashba-Edelstein effects when compared to graphene with traditional spin-orbit interaction such as Rashba or Intrinsic. Additionally, we show that due to the coupling between valley and spin, such enhancement is modulated by the intervalley scattering, a parameter that is generally overlooked when designing devices. Therefore, we will also propose indirect ways to determine it.

References

[1] Jose H. Garcia, Aron W. Cummings, and Stephan Roche, Nano Letters, 17 (2017) 5078-5083.
[2] Aron W. Cummings, Jose H. Garcia, J. Fabian, and Stephan Roche, Phys. Rev. Lett., 119(2017) 206601
[3] Jose H. Garcia, Marc Vila, Aron W. Cummings, and Stephan Roche, Chemical Society Reviews, Invited review (2018) (submitted)

Figures

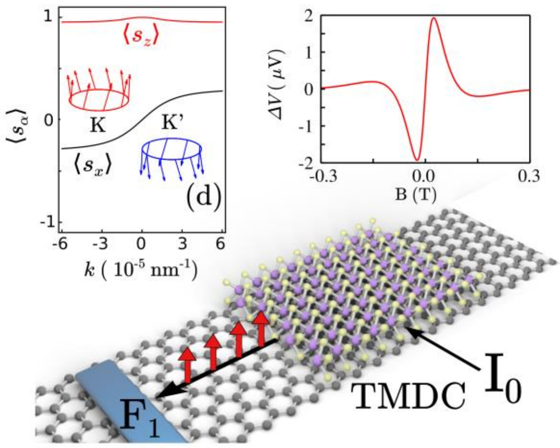

Figure 1: The spin texture of a graphene/Transition Metal Dichalcogenide heterostructure and experimental proposal for the measurement of the spin Hall Effect.

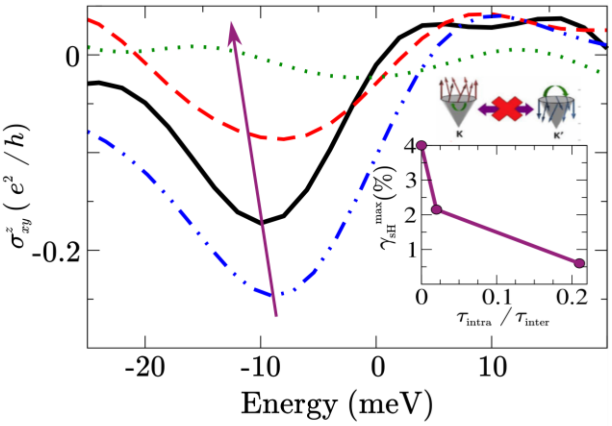

Figure 2: Spin Hall angle for different values of intervalley scattering.