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Gate-tunable spin anisotropy in graphene – WS_2 heterostructures at room temperature

When graphene is in proximity to a transition metal dichalcogenide (TMDC), it acquires an enhanced spin orbit interaction (SOI) together with a complex spin texture with out-of-plane and winding in-plane components [1]. Among the relevant consequences of this unique type of SOI, we have unambiguously demonstrated spin to charge (StC) conversion in graphene by proximity of WS_2 at room temperature with high electrical tunability [2]. Notably, StC conversion is accompanied by anisotropic spin dynamics with spin lifetimes that vary orders of magnitude depending on the spin orientation [2]. Such anisotropic features indicate that the strong spin–valley coupling in the TMD is imprinted in the heterostructure and felt by the propagating spins [3].

In this talk, I will present an unprecedented electric-field tunability of the spin dynamics in graphene-WS_2 heterostructures at room temperature. The characteristic spin relaxation varies from highly anisotropic to nearly isotropic when the applied displacement field *D* changes from 0.5 V/nm to -0.5 V/nm (Figure 1) [4]. This finding is unexpected and may indicate the presence of defects or impurities as responsible for the SOI enhancement.

References

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Figures

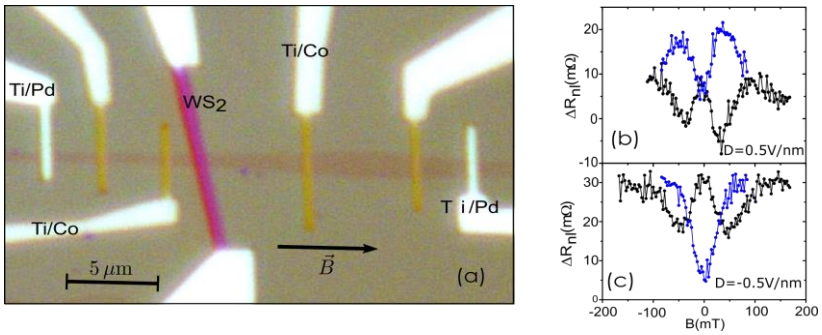

Figure 1: Figure 1: (a) Optical image of a typical spin device, which includes a graphene – WS2 device and two reference pristine graphene devices enclosing it. (b), (c) spin precession response in the graphene–WS2 device for parallel (black) and antiparallel (blue) configuration of the spin injector and detector with in-plane ***B***. (b) For *D* = 0.5 V/nm the maximum (minimum) signal is observed around *B* = 50 mT, which indicates that the out-of-plane spin lifetime is much larger than the in-plane one. (c) For *D* =-0.5 V/nm the maximum (minimum) spin signal is obtained at *B* = 0, a consequence of the nearly isotropic spin relaxation (see [3]).