MAR17-2017-020759

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Advances in graphene spintronics

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I will give an overview of the status of graphene spintronics, from both scientific as technological perspectives. In the introduction I will show that (single) layer graphene is the ideal host for electronic spins, allowing spin transport by diffusion over distances exceeding 20 micrometers at room temperature. I will show how by the use of carrier drift, induced by charge currents, effective spin relaxation lengths of 90 micrometer can be obtained in graphene encapsulated between boron-nitride layers[1]. This also allows the controlled flow and guiding of spin currents, opening new avenues for spin logic devices based on lateral architectures. By preparing graphene on top of a ferromagnetic insulator (yttrium iron garnet (YIG)) we have shown that we can induce an exchange interaction in the graphene, thus effectively making the graphene magnetic[2]. This allows for new ways to induce and control spin precession for new applications. Finally I will show how, by using two-layer BN tunnel barriers, spins can be injected from a ferromagnet into graphene with a spin polarization which can be tuned continuously from -80% to 40%, using a bias range from -0.3V to 0.3V across the barrier[3]. These unique record values of the spin polarization are not yet understood, but they highlight the potential of Van der Waals stacking of graphene and related 2D materials for spintronics. [1] J. Ingla Aynes et al., Eighty –eight percent directional guiding of spin currents with 90 micrometer relaxation length in bilayer graphene using carrier drift, Nano Lett. 16, 4825 (2016) [2] C. Leutenantsmeyer et al., Proximity induced room-temperature ferromagnetism in graphene probed with spin currents, 2D Mater. 4, 014001 (2017) [3] M.Gurram et al., Giant electric field controlled spin polarization in ferromagnet/bilayer boron nitride/graphene tunneljunctions, submitted to Nat. Comm.