MAR13-2012-020198

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Graphene-based magnetic tunnel junctions

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Graphene's in-plane transport has been widely researched and has yielded extraordinary carrier mobilities of 10^5 cm^2/Vs and spin diffusion lengths of exceeding 100μm. These properties bode well for graphene in future electronics and spintronics technologies. Its out-of-plane transport has been far less studied, although its parent material, graphite, shows a large conductance anisotropy. Recent calculations [1,2] show graphene's interaction with close-packed ferromagnetic metal surfaces should produce highly spin-polarized transport out-of-plane, an enabling breakthrough for spintronics technology. In this work, we fabricate and measure FM/graphene/FM magnetic tunnel junctions using CVD-grown single-layer graphene. The resulting juctions show non-linear current-voltage characteristics and a very weak temperature dependence consistent with charge tunneling transport. Furthermore, we study spin transport across the junction as a function of bias voltage and temperature. The tunneling magnetoresistance (TMR) peaks at two percent for single-layer graphene junctions and exhibits the expected bias asymmetry and a temperature dependence that fits well with established spin-polarized tunneling models. [3] Results of mutli-layer graphene tunnel junctions will also be discussed.

References:

[1] Karpan et al., Phys. Rev. Lett. 99, 176602, 2007.
[2] Yazyev and Pasquarello, Phys. Rev. B. 80, 035408, 2009.
[3] Cobas et al., Nano Letters 12, 3000, 2012.