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Electrical spin injection into Si with Ni/graphene contacts CONNIE H. LI, OLAF M. J. VAN 'T ERVE, JEREMY T. ROBINSON, BERRY T. JONKER, Naval Research Lab — Graphene, a single layer of sp2 bonded C atom, provides a highly uniform barrier with well-controlled thickness and minimal defect, has been shown to be a viable tunnel barrier in magnetic tunnel junctions [1]. More recently, we have further demonstrated that it also circumvents the conductivity mismatch between a FM metal and semiconductor, whilst lowering the resistance area product [2]. Excellent spin filtering has also been predicted across graphene-magnetic metal (e.g., Ni, Co) interfaces, due to electronic structure overlap for only the minority spin [3]. This spin filtering effect is also accumulative, with predicted spin polarization reaching 100% with multiple layers (>5) of graphene, and is also robust against interface roughness and disorder [3]. Here we explore electrical spin injection into Si utilizing this spin filtering effect in a Ni/graphene/Si structure. We observe Hanle precession of the electron spin accumulation in the semiconductor, where the extracted spin lifetime from the Lorentzian fit to the Hanle data, $\sim$ 160 ps, is consistent with those observed for this Si carrier density (1E19) with other FM contacts (NiFe) and tunnel barriers (SiO2, Al2O3, graphene) [2,4], confirming spin injection and accumulation in the Si. Results comparing single and multiple layer graphene tunnel barriers will also be presented.

[1] Cobas et al., Nano Lett., 12, 3000 (2012)
[2] van 't Erve et al., Nat. Nano., 7, 737 (2012)
[3] Karpan et al., Phys. Rev. Lett. 99, 176602 (2007); Phys. Rev. B. 78, 195419 (2008); Phys. Rev. B. 84, 153406 (2011).
[4] Li et al., Nat. Comm., 2, 245 (2011)

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