Abstract for an Invited Paper
for the MAR10 Meeting of
The American Physical Society

Electronic spin transport, spin precession and spin relaxation in graphene field effect transistors

BART VAN WEES, university of groningen

After an introduction of spintronics in graphene I will describe our recent measurements of spin transport in graphene field effect transistors. Using a non-local geometry, with seperated ferromagnet injector and detector circuits, we were able to study the injection, transport, relaxation, precession and detection of carrier spins in great detail, in both the metallic electron and hole regimes as well as at the Dirac charge neutrality point. We found that: a) Carriers can carry spins in graphene, with typical spin relaxation lengths of 1 to 2 micrometers [1]. b) The spin relaxation times were found to be in the order of 100 to 200 ps, and the spin relaxation of spins directed perpendicular to the graphene plane was found to be slightly faster that spins oriented parallel to the plane [2]. c) Spin transport occurs by diffusion. It was found however that carrier drift, induced by applying large electric fields in the graphene layer could speed up or slow down the transport of spins [3]. d) We found that the spin relaxation is most likely limited by the carrier impurity potential scatterering, probably by the Elliot Yafet mechanism. No appreciable change was observed in graphene nanoribbons down to 100 nm width [4]. e) By changing the diffusion coefficient by changing the carrier density we were able to observe that an increase in the diffusion constant, and thus in the momentum scattering time, is accompanied by a similar increase in in the spin relaxation time [5]. When extraploating these resulst to high mobility (suspended) graphene, this implies that spin relaxation lengths approaching 100 micrometers might be possible at room temperature. Also it was found that the diffusion constants for charge and spin are similar within less than 10%. f) Finally I will present recent results where we compare spin transport in single and N-layer graphene (with N ranging for 2 to 20) We find an increase in the spin relaxation time when the number of layers is increased. Possible mechanisms will be discussed. [1] N. Tombros *et al.*, Nature 448, 571 (2007) [2] N. Tombros *et al.*, Phys. Rev. Lett. 101, 046601 (2008) [3] C. Jozsa *et al.*, Phys. Rev. Lett. 100, 236603 (2008), C. Jozsa *et al.*, Phys. Rev. B79, 081402 (2009) [4] M. Popinciuc *et al.*, to be published in Phys. Rev. B, arXiv: 0908.1039 [5] C. Jozsa *et al.*, to be published in Phys. Rev. B, arXiv: 0910.1054 [6] T. Maassen, in preparation.