Charge transport through functionalized multiwall carbon nanotubes

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Carbon-based nanostructures[1] are promising for integration in future quantum electronic devices. It has been shown that the spin diffusion length in such materials is large enough to be suitable for storing or propagating spin information[2,3]. Both in carbon nanotubes (CNT) and graphene, experiments highlighted long spin diffusion lengths (>50µm) but there exists strict conditions about contact resistances for injecting efficiently spins from a ferromagnet to the nanotube. An experimental way to achieve efficient spin injection is to intercalate a tunnel barrier. We study the role of a molecular tunnel barrier for this system.

We characterize multiwall CNT whose external shell is functionalized with organic molecules (Bis-Thienyl-Benzene, Nitro-Benzene-Diazonium). Our chemical functionalization process is an in-solution covalent grafting process based on diazonium radicals[4]. By forming a stable C-C bond with the molecule, the carbon atoms of the outer shell change their sp2 configuration into a sp3, changing the electronic properties of the outer shell[5] and pushing the electrons towards the inner shells, which properties are usually not probed. In order to study the influence of this functionalization on charge transport properties, we performed electrical experiments at low temperatures.

In this talk we will, in a first part, describe the fabrication process illustrated with an AFM study of the different interfaces (nanotube/molecules and ferromagnetic/molecules on nanotubes). Then, we will present transport experiments on bare and functionalized nanotubes, and discuss about the role of the molecular barrier on the electronic transport properties (injection and propagation).

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