Biotemplated polyaniline nanowires as building blocks for spin-valves

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The Tobacco Mosaic Viruse (TMV) has been extensively used as scaffold for the controlled one-dimensional assembly of particles and molecule. While the research in this area was largely focused on understanding the assembly and the fundamental properties of such composites, it now shifts to the fabrication of actual devices with functionalized TMVs as its main building blocks.

Here, we investigated the feasibility of fabricating organic spin valves by using TMV coated with polyaniline (PANi)[1] as the non-magnetic interlayer of the device. In this device, spin-polarized electrons are injected from a first ferromagnetic (FM1) electrode, transported through the conductive polymer-coated TMV, and injected back in a second FM2 electrode, see the inset in Fig.1(a). Depending on the relative orientation of the magnetization of the electrodes**,** two different resistance levels appear in our device.

This magnetoresistance variation is well known for metals and semiconductor as the non-magnetic channel, but just recently it has been demonstrated that organic semiconductors could also be used as spin transporting materials[2]. Indeed, the small spin-orbit interaction and the reduced coupling to nuclear spins make organic semiconductors perfect candidates for spintronic applications.

In this study, a biomolecule is used for the first time as the building block of a spintronic device. Moreover, we have selected polyaniline as the non-magnetic, charge-transporting layer – this conjugated polymer is one of the unique examples of organic semiconductors that can be synthesized in a true metallic state through doping[3]. Therefore, the PANi-TMV device is expected to have superior spin diffusion length, together with its intrinsic long spin relaxation time.

References

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Figures

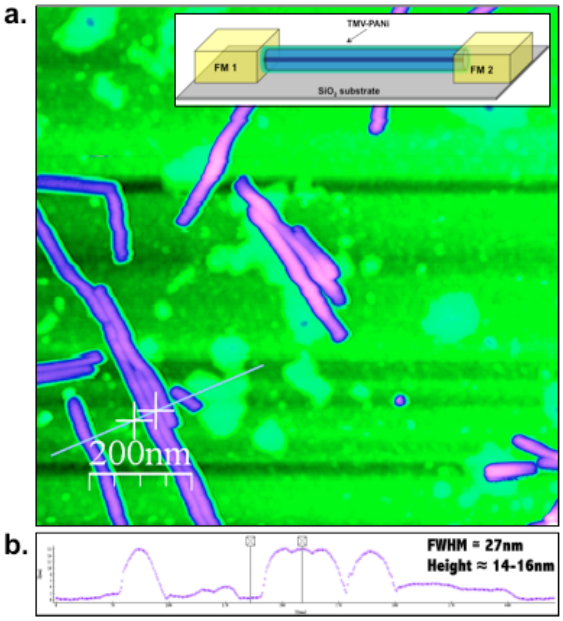

Fig. 1: In (a), an AFM image of the PANi-coated TMV deposited on Si/SiO_2 wafer. The inset shows a schematic view of the TMV-PANi spin-valve. A profile of the coated nanowires is shown in (b), its reduced height is due to the strong interaction of the wires with SiO_2.