MASTER PHYSIQUE ET APPLICATIONS

Master 2 Dispositifs Quantiques

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Internship offer

Laboratory: Laboratoire Matériaux et Phénomènes Quantiques (UMR 7162)
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Spin injection and excitations in organic molecules using spin pumping techniques

Spintronics aim at playing with the spin quantum degree of freedom in addition to the electronic charge[1]. Organic materials like molecules are providing an excellent platefrom for conversing and propagating the spin information[2]. During the past years, the investigation of spin injection physics into organic materials has revealed novel fundamental phenomena occuring at organic molecules/ferromagnetic spin sources[3]. A key element is the quantum hybridization between the molecule and the ferromagnet at the interface deforming and spin polarizing the molecular orbitals[4].

For this internship, we would like to investigate the injection efficiency of a pure spin current from a standard ferromagnetic electrode like Co or NiFe excited at GHz frequencies[5] into an organic film. After propagation into the organic film, the pure spin current will then be detected thanks to inverse spin Hall effect by a second electrode made of Pd or Pt. The parameters of interests are the spin injection efficiency, the spin diffusion length within the organic film and the efficiency of the detection method. We will thus play with different devices configurations and materials to investigate the spin response of the device and to determine the critical parameters for an efficient spintronics device.

For this internship, we are looking for a highly motivated student to implement in our lab a coupling between the GHz research activity and organic spintronics devices. The intern will be in charge of the nanofabrication, the characterization and the measurements of the devices.

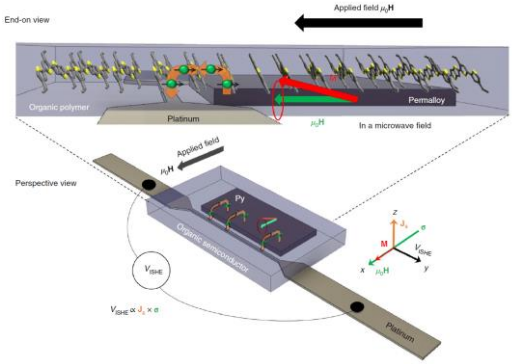

Fig.1. Spin pumping experiment from a NiFe electrode for injecting pure spin currents into an organic polymer. Taken from [6].

1. Fert, A. Nobel Lecture: Origin, development, and future of spintronics. Rev. Mod. Phys. 80, 1517–1530 (2008).
2. Sanvito, S. & Rocha, A. R. Molecular-Spintronics : the art of driving spin through molecules. J. Comput. Theor. Nanosci. 3, 624–642 (2006).
3. Barraud, C. et al. Unravelling the role of the interface for spin injection into organic semiconductors. Nat. Phys. 6, 615–620 (2010).
4. Galbiati, M. et al. Spinterface: Crafting spintronics at the molecular scale. MRS Bull. 39, 602–607 (2014).
5. Hellman, F. et al. Interface-induced phenomena in magnetism. Rev. Mod. Phys. 89, (2017).
6. Wang, S. J. et al. Long spin diffusion lengths in doped conjugated polymers due to enhanced exchange coupling. Nat. Electron. 2, 98–107 (2019).

Methods and techniques: micro and nanofabrication in clean-room environment, structural characterizations by atomic force microscope, electrical transport and magnetotransport measurements from 1K to 300K.

Possibility to go on with a PhD ? Yes
Envisaged fellowship ? EDPIF