The spin-dependent electronic properties at the interface between a ferromagnet and an organic semiconductor

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Research toward designing electronic components with enhanced functionality has in recent years targeted the rich physics that takes place at the interface between a ferromagnetic and an organic semiconductor (OS). Effects ranging from ferromagnetic coupling between a molecule's transition metal site and the ferromagnet [1], to metallic [2], spin-polarized states induced on the molecule by the interface's chemical bonds [3] have been subsumed in a recent analysis [4] by Sanvito *et al.* as signatures of a "spinterface" that can craft spin-polarized transport [3,5]. While recent experiments provide convincing indirect evidence [3] on the existence of this spinterface, these reports neither confirm the intrinsic nature of the effect [5], nor do they discuss an isolated spinterface [6].

To single out the spintronic properties of the interface of an OS with a ferromagnetic substrate, we have started recently to perform spin-polarized photoemission experiments at the synchrotron SOLEIL at Paris. First experiments with phthalocyanine as OS deposited on Co(001) gave evidence for the existence of strongly spin-polarized interface states close to the Fermi energy. This is of particular importance as this leads to a strong spin filtering close to the Fermi energy of electrons traversing the molecular film and might therefore have important implications for future devices based on such an interface.

Complementary studies on these interfaces by means of spin-polarized electron scattering are performed at the IPCMS. In these experiments spin-polarized electrons are spin-analyzed after being reflected from the sample. By measuring the motion of the spin polarization which is due to the interaction of the electrons with the ferromagnetic system [7,8], we are able to get information about the spin-dependent properties at the interface [9,10].

In the framework of this thesis project we will study other OS as well as other ferromagnetic substrates in order to find out how the properties of the interface (interface states, spin-dependent electron reflection coefficients, etc.) depend on the particular choice of the interface. The results will be analyzed in close collaboration with a theoretical group at the IPCMS.

References

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