INTERNSHIP PROPOSAL

(One page maximum)

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Thesis possibility after internship: YES
Funding: YES/NO If YES, which type of funding: ED PIF

Properties of chiral molecule / metallic interfaces

Molecular spintronics combines the use the electron spin for transport and storage with the use of molecular materials. One of the major challenges is to have efficient spin injection current in the molecular layer. For this, chiral molecules appear as promising candidates. Indeed, chiral molecules are present in the form of two non-superimposable enantiomers due to the absence of inversion center (figure 1). They then offer the unique possibility of being able to create spin selectivity at the interface with a metal. This effect, known as the CISS (chiral induced spin-selectivity) effect, was demonstrated in the early 2000s on monolayers of lysine molecules, long carbon chains, adsorbed on Au [1]. But, the origin of this effect is still widely debated [2]. Experimentally, the CISS effect brings together all the phenomena for which the chirality of molecular species influences the spin selectivity of various electronic processes, whether for transmitted electrons [3,4], for transport measurements [5, 6] or even during chemical reactions. Interestingly, recent studies demonstrate that CISS effect can be measure at the level of a single molecule [7]. To enhance the spin selectivity at the interface, it is mandatory to control the molecule/metal interface.

In this context, the internship, that can be followed by a thesis, will focus on the interfaces between chiral molecules and metallic or ferromagnetic substrates in order to understand their properties. For this, measurements by scanning tunneling microscopy (STM) will be carried out. For the structural properties, it will be important to understand how chiral molecules adsorb on different metallic substrates. Furthermore, tunneling spectroscopy will provide access to the electronic properties of molecules and will enable to characterize the CISS effect and the transport through molecular orbitals at the molecular level.

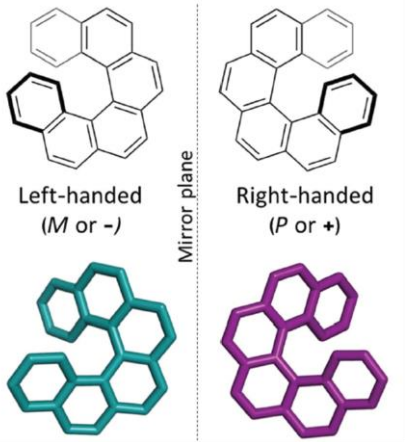

Figure 1: Scheme of [6]-helicene molecules

[1] Ray et al., Science 283, 814-816 (1999).
[2] Evers el al., Advanced Materials, 2106629 (2022).
[3] Göhler et al., Science 331, 894-897 (2011).
[4] Kettner et al., The Journal of Physical Chemistry Letters 9, 2025-2030 (2018).
[5] Rodríguez et al., J. Am. Chem. Soc. 144, 24 (2022).
[6] Giaconi et al., ACS Nano, 17, 15189-15198 (2023).
[7] Safari et al., Small, 2308233 (2023).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: NO Theoretical Physics: NO