**SUJET DE STAGE DE MASTER**
**2ème année**

**Internship offer**

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|---|---|
| **Laboratory: LPEM-UMR8213 (ESPCI ParisTech)**<br>**Director: R. Lobo**<br>**Address: 10, rue Vauquelin-75005 Paris** | |

**Persons in charge of the internship: Brigitte Leridon (ESPCI)/Clément Barraud (MPQ)**
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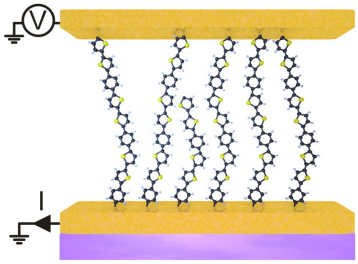
## *Hybrid molecular junctions combining superconductors, magnetic materials and molecules*

**Molecular electronics[1,2] aims at reducing electrical devices into a single molecule. In the last decades, demonstrations of electrical functions such as diodes, optical switches, superconductivity and memories have been demonstrated using hybrid devices with molecules. Fundamental question however remains concerning for instance charge, spin and even Cooper pair transport through the organic environment and through the inferfaces.**

**In this project, we propose to study the transport properties of junctions[3] embedding electro-grafted polythiophene molecules between two electrodes. Those two electrodes will be either both superconducting or superconducting and ferromagnetic. The electrografting process allows to form a covalent chemical bond between the molecule and the metal. The deep impact of this chemical bond for the charge/spin injection properties is still under investigation and is one subject of this research.**




**The student will be in contact first with the ITODYS lab (Prof. J-C Lacroix and P. Martin) for the molecules deposition on Co or Nb surfaces. She/he will have then to characterize those hybrid heterostructures (ferromagnetic metal/molecules) by different techniques: Atomic Force Microscopy at the MPQ laboratory, eventually SQUID magnetometry to reveal the magnetic properties of those heterostructures at the LPEM at ESPCI and X-ray Photoelectron Spectroscopy to reveal the presence of chemical elements and bonds between them at the ITODYS lab.**
**Hybrid devices will be realised and transport measurements will be performed after demonstration of non-contaminated interfaces.**

**For this project, we are looking for an excellent and motivated student as the use of different techniques in different labs requires to be polyvalent, quick-to-react, experiments-oriented and well-organized. Do not hesitate to contact us for more information.**

[1] M. Ratner, Nat. Nanotechnol. **8**, 378 (2013).
[2] S. V Aradhya and L. Venkataraman, Nat. Nanotechnol. **8**, 399 (2013).
[3] T. Fluteau, C. Bessis, C. Barraud, M.L. Della Rocca, P. Martin, J.-C. Lacroix, and P. Lafarge, J. Appl. Phys. **116**, 114509 (2014).

**Methods and techniques: micro-patterning (MPQ, ESPCI) electrografting (coll. with ITODYS), SQUID magnetometer (ESPCI), , transport experiments (MPQ, ESPCI).**

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