Quantum transport across an hybrid molecular wire

ADVISOR : LAURENT LIMOT
INSTITUT DE PHYSIQUE ET CHIMIE DES MATÉRIAUX DE STRASBOURG (IPCMS)
23, RUE DU LOESS, 67034 STRASBOURG, FRANCE
TEL.: +33 388 10 70 21 ; E-MAIL: LIMOT@IPCMS.UNISTRA.FR
WEB: WWW-IPCMS.U-STRASBG.FR/STMIPCMS

A possible way to carry out the downscaling of electronic devices is through the manipulation of a single molecule or molecular complex as these could constitute the active components within an hybrid metal-molecule architecture. This approach, also known as molecular electronics, has been growing promisingly driven by the advancement in fundamental aspects as well as in applications. One of the most urgent matters to address in this domain is the quality of the metal-molecule contact, which can dramatically alter electron transport. An increased control of this factor could open up the exciting prospect of engineering the desired electric response into a molecule. Our approach consists in using a Scanning Tunneling Microscope (STM) in both tunneling and contact regimes to accurately probe and modify the transport properties of a single molecule on a metal surface. For example, wa have recently shown how to produce an Esaki diode using a molecular tip [1]. The measurements are carried out at low temperature and in ultrahigh vacuum to ensure a clean and reproducible experimental environment.

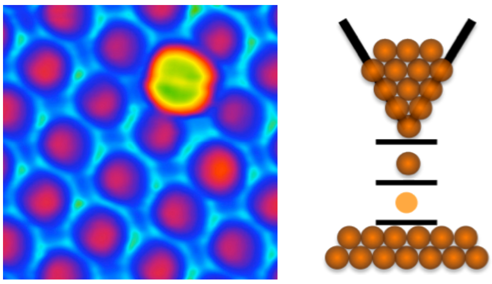

Figure 1: STM image of the molecular wire (top view) and schematics of a two-terminal measurement were the STM tip is brought into contact with the hybrid molecular wire (black line: aromatic cycles; dots: metal atoms).

The starting point to elaborate such a circuit is to possess a molecular wire. The orignal aspect of the present research project will consist in exploiting an STM to study electron transport of a hybrid molecular wire alternating aromatic cycles and metallic centers (Fig. 1). The wire will be elaborated *in situ* by self-assembly [2] and then coupled to the tip in order to form a two-terminal device (Fig. 1). We possess an internationally recognized knowhow in the elaboration of molecular junctions of this kind [3,4]. The research project will also be devoted at characterizing the spin transport across these wires. To do so, electrons will be spin polarized by employing a magnetic tip [5]. The ability to manipulate the electron spin in organic molecular materials offers in fact a complementary approach to molecular electronics. In this regard, we were the first to succeed in imaging by SP-STM (spin-polarized STM) the stationary spin states of a single molecule [6].

The Ph.D. candidate will be expected to carry out together with other members of the group an ambitious research program related to the present topic. **Two low-temperature STMs** are currently available in the group. Theoretical support will be available locally and from international collaborations we have built over the past years.

We are looking for highly motivated candidates with a Scientific Master degree. They should have a background in physics or physical chemistry, and a good knowledge in material science. Taste and skills for experimental work are desirable. Candidates are invited to send a curriculum vitae, possibly accompanied by supporting letters.

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[3] N. Néel, J. Kröger, L. Limot, T. Frederiksen, M. Brandbyge, R. Berndt, Phys. Rev. Lett. **98**, 065502 (2007)
[4] D.-J. Choi, M. V. Rastei, P. Simon, L. Limot, Phys. Rev. Lett. **108**, 266803 (2012)
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