Open Post-doctoral position (12 months with possible extension to 24)

Hybrid graphene devices based on switchable spin-crossover materials

Place. Institut de Chimie Moléculaire et des Matériaux d'Orsay (ICMMO), Université Paris-Saclay, 91405 Orsay, France

Overall objective of the project. The main objective of the project is to design two-dimensional thin and ultra-thin films of switchable (spin-crossover) molecular materials on Graphene substrates in order to build bistable hybrid devices, as schematized in Figure 1. The active molecules deposited on graphene will be addressed by multiple stimuli (such as light, stress, temperature and electric field) and the reading will be performed by measuring the transport through the graphene layer of the device.

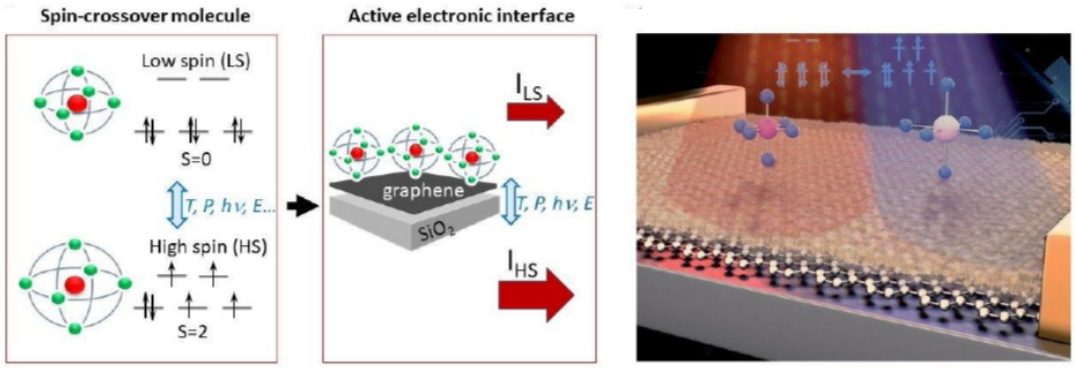

Figure 1. Schematic view of the electronic configurations of a Fe(II) spin crossover complex and of the hybrid device

Goal of the present work. We aim at achieving bistability at temperatures as close as possible to ambient one in a hybrid device containing a layer of the molecules. The switchable complexes are, therefore, required to possess specific electronic and chemical properties. For example, chemical stability towards graphene and towards metallic substrate, that will first be used to characterize the films, is a necessary condition for the molecules to keep their integrity on the substrates. Furthermore, since the deposition will be performed in Ultra High Vacuum (UHV) conditions, the sublimation temperature must be controlled. The three groups contributing to this project have acquired expertise in this area.[1,2,3,4]
The post-doctoral research work will, therefore, focus on the preparation and the full characterization (routine techniques) of new spin-crossover complexes based on Fe(II) and using proper chelating ligands in order to ensure a large thermodynamic stability and specific interaction of the molecules with the graphene layer.

Required skills and expertise acquired during the contract. The candidate must possess expertise in coordination chemistry (first row transition metal ions) including an excellent knowledge in the chemistry of organic ligands. Knowledge in spectroscopy and/or in Atomic Force Microscopy (AFM) will be an added-value. The post-doc will have the opportunity to acquire knowledge in magnetic measurements and eventually in spectroscopy, if these expertise are lacking. She/He will also have the opportunity to deposit molecules on different substrates and use different techniques to characterize them.

Documents. A Curriculum Vitae including the names of two referees and a short letter describing the main expertise of the candidate can be sent to Talal Mallah (talal.mallah@universite-paris-saclay.fr) and to Marie-Laure Boillot (marie-laure.boillot@universite-paris-saclay.fr).

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[1] K. Bairagi *et al.* Molecular-scale dynamics of light-induced spin cross-over in a two-dimensional layer, *Nat. Comm.*, 2016, **7**, 12212.
[2] O. Iasco *et al.* The disentangling of hysteretic spin transition, polymorphism and metastability in bistable thin films formed by sublimation of bis(scorpionate) Fe(II) molecules, *J. Mater. Chem. C*, 2017, **5**, 11067-11075.
[3] N. Konstantinov *et al.* Electrical read-out of light-induced spin transition in thin film spin crossover/graphene heterostructures, *J. Mater. Chem. C*, 2021, **9**.
[4] Y. F. Tong, *et al.* Voltage-Induced Bistability of Single Spin-Crossover Molecules in a Two-Dimensional Monolayer, *J. Phys. Chem. Lett.*, 2021, **12**, 11029-11034.