Master Nanochemistry

Internship subject

Synthesis of powdered and thin-films photo and thermo switchable molecular materials

Confidential subject: No

Subject open to M2: Yes **to M1-RIT:** Yes **to M1:** Yes

Subject adapted to LabTraining: Non

Summary

The internship aims at synthesizing new switchable coordination polymers, combing functional photo-sensitive ligands and thermally-controllable spin crossover metallic centers. These molecular materials will be characterized (optically and magnetically) then thin layer deposits will be fabricated and analyzed by microscopic techniques. Possible applications of these hybrid materials as memory devices, for gas storage or biology will be investigated with the support of local and international collaborators.

Detailed subject

Switchable molecular materials are intensively investigated because of their possible applications as memory devices, for optics or gas storage. Indeed, these compounds are able to switch between (in most cases) two stable states, by means of an external stimulus (temperature, light, pressure…): consequently, they stand as excellent candidates for future electronic engineering or applications in biology. Among the switchable materials, spin-transition (magneto and thermochromic) complexes and photochromic organic materials are the most studied to date: however, the number of systems described in the literature combining the two properties remains extremely limited (<10). This project proposes a new pathway in coordination chemistry by combining spin transition and photochromism: the targeted compounds are polymeric 2D and 3D coordination complexes (Hofmann clathrates) for which a synergy (or at least coexistence) between photo and thermochromic properties is expected, providing multi-stable materials. The internship will first focus on the synthesis of these hybrid systems and their characterizations (optical and magnetic measurements, powder or single crystal X-ray diffraction…). Then thin molecular films will be prepared and analyzed *via* spectroscopic (UV-visible, Raman, Infra-Red) and microscopic techniques (AFM, MEB), surface grafting being an essential step to the completion of this work toward future applications. This project will benefit from already established local (Institut Néel, CEA: electronics devices: INSERM: oncologic target) and international collaborations (Univ. Rikkyo, Tokyo: organic switches and Germany, Univ. Freiburg: layer by layer deposit).

Related Publications

A.Bakkar, **S. Cobo** et al., Nanoscale 2018, 10, 5436; A.Bakkar, **S. Cobo** et al., *Dalton Trans., 2016,* **45**, 13700; **S. Cobo** et al., *Angew. Chem. Int. Ed., 2006*, **45***,* 5786 (*VIP paper)*; G. Molnar, **S. Cobo** et al., *Adv. Mater. 2007,* **19***,* 2163. (*VIP paper)*

Background and skills expected

The student will synthesize new functional ligands and their corresponding coordination polymers. Then his/her work will be devoted to the characterization of the samples (optical: UV-vis spectroscopy and magnetic: Faraday's balance). Thin layer molecular deposits will be fabricated by the layer by layer techniques and analyzed by microscopic techniques. *A mixed "physical-chemistry" student profile would be a plus for this internship.*

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Laboratory : Département de Chimie Moleculaire

Team/Group : CIRE (Chimie Inorganique Redox)

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This Master internship could be followed into a PhD within the same research area: Yes

The CIRE group is highly interested in hiring a M1 or M2 student on the project, for possible/wished extension as PhD student.