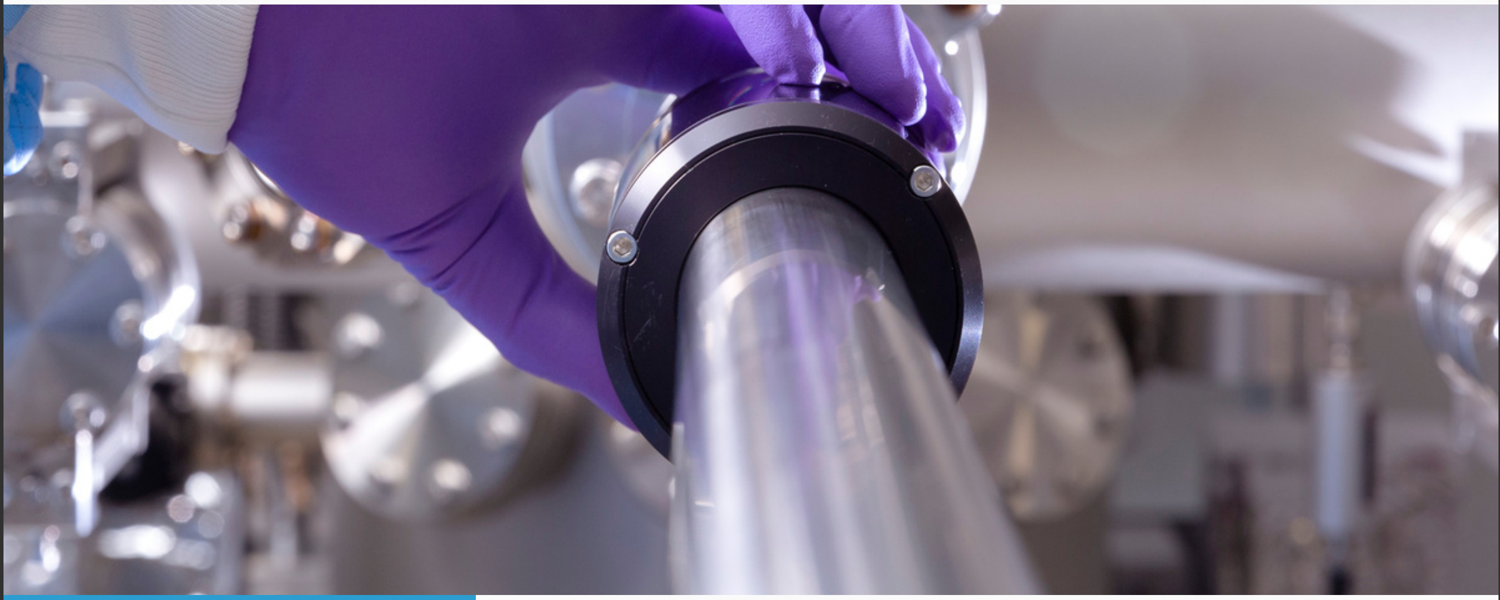
JOB POSITION

Multifunctional spintronic devices based on stimuli-responsive magnetic molecules



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Spin-based electronics uses the electron spin for information processing. A new appealing direction in this emerging area of nanomagnetism consists of using molecules instead of conventional inorganic materials to fabricate a new generation of spintronic devices.

This subarea, known as molecular spintronics, takes advantage of the long spin relaxation times shown by the organic materials as well as the pronounced quantum effects in single-molecule limit. Another advantage comes from the ability of certain molecules to respond to an external stimulus changing its properties.

In this context, Spin-Crossover (SCO) molecules constitute an archetypical example. These metal complexes present a transition between two electronic configurations (Low Spin and High Spin) that can be induced by temperature, light, X-Ray, pressure or electrical fields.

Due to these switching properties, the insertion of these molecules as thin layers in between two ferromagnetic electrodes can afford a new type of molecular spintronic device in which its relevant properties will not only depend on the magnetization of the electrodes, but also on the electronic state of the SCO molecule. Thus, the change in the magneto-resistance can be induced not only by magnetic fields but also by other physical stimuli such as light, pressure or heating.

Objectives of this project

The objective here is to fabricate multifunctional spintronic devices based on this concept. First, a selection of robust SCO materials able to be sublimed on surfaces, while maintaining intact their magnetic properties, will be made. Second, ultrathin films of these materials will be grown and characterized on different magnetic substrates Third, a second electrode will be deposited on these molecular films to complete the device. Finally, the properties of this spintronic device will be characterized by measuring its magneto-resistance, while applying a second stimulus such as light irradiation.

Job description

To develop this project an integrative and multidisciplinary approach is proposed in which materials chemistry (coordination chemistry, in particular) is coupled with physics, materials science and nanotechnology.

Training

The PhD candidate will receive training in materials science (preparation of ultrathin molecular films of the SCO molecules deposited on ferromagnetic electrodes using ultra-high vacuum evaporation techniques; physical and structural characterization of the hybrid heterostructures) and device fabrication (preparation of vertical devices in a clean room, study of their electrical and magneto-electrical properties at different temperatures —from 4K to room temperature— and under light irradiation). The candidate will also develop transferable skills like reporting of results orally and in writing, time management, project planning and management. The PhD will be integrated in a multidisciplinary group leaded by Prof. E. Coronado in which he/she will have access to all the chemical, physical and engineering facilities required toperform the proposed project.

Qualification

The applicant should hold a degree in Physics, Chemistry, Engineering or Materials Science with excellent qualifications (honors degree preferable for international students). Research experience will be considered favourably. The call is open for all nationalities.

Work environment

ICMol is an attractive destination for top talent PhD students. It currently hosts 8 ERC grantees at different stages of theircareers (Advanced, Consolidator and Starting) and Marie Curie Fellows, andsince 2016 has been awarded the seal of excellence "Maria de Maeztu" by the Spanish Government, which recognises top research institutions in Spain.