POSTDOC, Scanning Probe Microscopy - Material Sciences
LCC, CNRS, TOULOUSE, FRANCE

Scanning probe microscopy investigation of the spin transition in nano-objects

Spin crossover (SCO) compounds are inorganic complexes which display phase change behavior between the so-called high spin and low spin electronic states. As in any material, the phase stability and transformation kinetics are size dependent. In particular it was shown that the spin transition temperature (or more generally speaking the phase diagram) is strongly affected at the nanoscale. The experimental and theoretical investigations of the underlying physical mechanisms are relatively recent and demand further efforts. Nevertheless, the outstanding properties of SCO nanomaterials make them already very interesting for several technological applications. Indeed the spin state switching in SCO nanoobjects (nanoparticles, thin films, nanopatterns, etc.) is accompanied by a spectacular change of various material properties, including magnetic, optical, electrical and mechanical ones, providing scope for applications in nanoelectronic, spintronic, nanophotonic and nanomechanical devices. For example, they have been proposed for diffractive gas sensors, micro and nanoelectromechanical actuators (MEMS, NEMS), thermocromic pigments, photonic waveguides, switchable THz filters and nanothermometers [*Chem Soc Rev. 2011, 40, 3313*].

Conventional experimental approaches used to characterize bulk SCO materials (magnetometry, X-ray diffraction, calorimetry, Mössbauer, electronic and vibrational spectroscopies), are often not well adapted to investigate nanoscale SCO objects due to the low amount of matter, and new technics are needed to characterize them. In particular, there is a need for high spatial resolution microscopy tools as well as for high sensitivity methods able to detect and/or induce molecular spin-state changes in very small amounts of matter, ideally in a single, isolated nano-object. Beyond their high resolution and/or high sensitivity, these new experimental approaches can provide also information on material properties, which are either difficult to access by conventional methods or not so relevant at other size ranges.

This 2-years postdoctoral project proposes to investigate – in collaboration with a starting PhD student - the evolution of the elastic and optical properties during the spin transition using combined atomic force microscopy (AFM), near-field scanning optical microscopy (NSOM) and Raman microspectroscopy measurements [*Adv. Mater. 26, 2889, 2014, Nanoscale 5, 7762 2013*]. These techniques should allow to detect the correlations between the electronic structure change and the lattice dynamics in SCO materials at different size scales and pave the way for potential applications of these materials in MEMS/NEMS devices.

We seek for a motivated candidate with a solid academic background in experimental physics or physico-chemistry and a good knowledge of AFM and related techniques – <u>proven by first authored publications in the field.</u>

Start date: as soon as possible
Deadline for candidature: 1st December 2015
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