New solid state-based refrigeration processes: barocaloric refrigeration ability of spin crossover compounds

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Laboratory: ICMCB, "Switchable Molecules and Materials" and "Chemistry and Electroceramics"groups, Bordeaux

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Spin crossover (SCO) materials can switch between two electronic states upon the application of an external stimulus, most interestingly temperature and pressure. It has been only recently evidenced that with the huge entropy changes observed whenever sharp abrupt crossovers occur, usually coupled with structural 1st order phase transitions, this class of compound is of utmost interest for innovative solid-state refrigeration technologies only recently developed, using either hydrostatic pressure (barocaloric refrigeration) or anisotropic strain (elastocaloric refrigeration) as the driving parameters. We have specifically developed expertise in the fundamental applications of hydrostatic pressure on spin crossover materials and recently devised a fundamental approach for sintering soft molecular materials in centimetric sized ceramics.

In the context of a very ambitious European-driven innovation project aiming to develop innovative refrigeration technologies to address the GreenHouse Gas emission of current vapour compression technology, we aim to use those materials to design and develop a heat exchanger. To provide the fundamental physical data necessary, this project aims first at preparing materials adapted for barocaloric refrigeration, that is that present an abrupt SCO with reduced to non-existant thermal hysteresis, here close to room temperature (molecular materials) or above room temperature (cobalt-based oxides). Synthesized powders will then be used as feed material for sintering processes in order to obtain ceramics as bulk objects to be characterized. The investigations will cover crystallographic, calorimetric and magnetic properties under variable temperature and pressure to extract their refrigeration ability. All those techniques are available at ICMCB, and through collaborations at the national (ANR projects) and European level.

The selected candidate will be hired by CNRS and will be based at the Institute of Condensed Matter Chemistry of Bordeaux (ICMCB). Hosting groups have a long-standing expertise in the synthesis and characterization of spin crossover compounds, with a renowned experience in magnetism, crystallography and pressure measurements. **Contact**: Patrick Rosa (patrick.rosa@icmcb.cnrs.fr) and Olivier Toulemonde (olivier.toulemonde@icmcb.cnrs.fr)

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