Spatiotemporal Imaging and Interface Control in First-Order Phase Transitions of Spin-Crossover Single Crystals.

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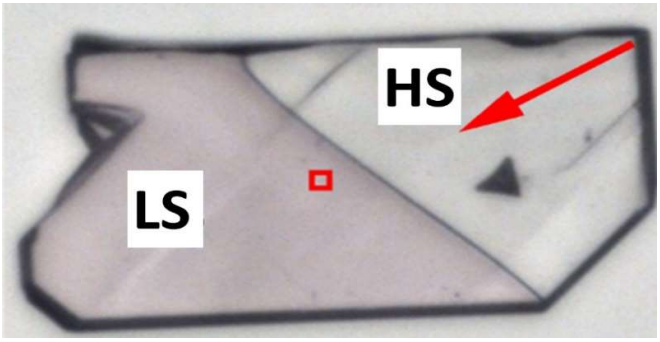
Abstract

The imaging of the spatiotemporal dynamics of the spin transition phenomenon by optical microscopy (OM) at the scale of one single crystal has recently emerged as a highly efficient method allowing a deep understanding of the macroscopic behavior of spin crossover (SCO) materials along their transformation between the low-spin (LS) and high-spin (HS) states. In this communication, we will show some typical examples [1] of real time transformation of SCO single crystals exhibiting first-order transitions with well-defined front interfaces (see Fig. 1 for the case of $\{Fe(2pytrz)_2[Pd(CN)_4\}.3H_2O$). The velocities, shapes and orientation of the HS/LS interfaces will be discussed in relation with the macroscopic shape of the crystals and the structural transformations of the unit cells along the LS to HS transitions. Under light, the SCO solids display photo-induced phenomena through LIESST (Light-Induced Excited Spin-State Trapping) effect. When this process competes with thermal relaxation, Light-Induced Thermal Hysteresis (LITH) effect is obtained. Both of these phenomena and their spatiotemporal features have been characterized by OM, showing very different features.

Finally, we will demonstrate that light irradiation can be used as a relevant and efficient stimulus leading to control the front interface as well as to select the nucleation point at which the spin transition can be triggered in a reversible way, although the latter effect is usually a stochastic process in thermal transitions. Overall, the spatiotemporal properties of the nucleation, growth and propagation of the spin domains will be discussed and their microscopic modelling [2] will be presented.



1. H. Fourati et M. Ndiaye, N. Belmouri, S. Triki and K. Boukheddaden, *Phys. Rev. B. 105,* 174436 (**2022**).
2. N. di Scala, N. E. I. Belmouri, M. A. Paez Espejo, and K. Boukheddaden, *Phys. Rev. B.*, 106, 144107 (**2022).**
3. Nour El Islam Belmouri, Nicolas di Scala, Kamel Boukheddaden, J. Phys. and Chem. of Solids. 190 (2024) 111985.

Biography

The author completed his Ph.D. in Physics in 1993 from the Université Pierre and Marie Curie in Paris. He was an Assistant Professor at the University of Versailles (1994), then Associate Professor in 1995. He became a full Professor in the same University in 2005. His main field concerns the thermo- and photo-induced phenomena in switchable molecular solids (spin-crossover, Prussian blue analogs and charge transfer solids). He is interested in both equilibrium and non-equilibrium properties accompanying first-order phase transitions. His current work focusses on the experimental control of the front interfaces and their modeling using statistical mechanics models. K.B. has co-authored more than 240 papers in well recognized physics and chemistry journals, including 12 book chapters on physics and guest editions. His h-index is 48 in WOS with more than 7000 citations.

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