New paradigm in the spatio-temporal properties of spin-crossover single crystals: Interface control and photo-induced dissipative structures

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We investigated the spatiotemporal studies on a spin-crossover single crystal, which exhibits an incomplete thermal spin transition with hysteresis near 100 K. The robust character of the crystals made possible the investigation of both on-cooling and on-heating processes. We observed well-defined transformation fronts between macroscopic high spin (HS) and low-spin (LS) phases. The fronts are almost linear in shape, and propagate through the entire crystals, even in isothermal conditions. The interface orientation was ~ constant and its propagation velocity typically was ~ 1 and 10 µm/s for the on-cooling and on-heating processes, respectively. The videos of the spin transition processes will be shown in real (or accelerated) time. At very low temperature, under light, metastable photo-excited HS states are generated. Increasing temperature with light ON, a competition between the thermally- and photo-induced processes takes place, leading to a new instability, during which we observed the emergence of pattern formation. The latter are attributed to the existence of a regime of dissipative structures. Using microscopic models, we succeeded to simulate the experimental data and explained the physical origin of the stable front orientation as well as that of the front dynamics and the formation of the self-organized structures under light.

Biography:

Dr. Kamel Boukheddaden completed his Ph.D. in 1993 from the Université Pierre and Marie Curie in Paris, France. After Postdoctoral studies at the Department of Physics (Liège, Blegium) 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 2004. His main field concerns the phase transition dynamics in single crystals, their visualization by optical microscopy, the interface control and the emergence of photo-induced self-organized structures. The modeling of these phenomena using elastic models or reaction diffusion equations represent also specific topics of interest.