NanoSaclay
Laboratoire d'Excellence en Nanosciences et Nanotechnologies

Séminaire Labex NanoSaclay

Le 14 juin à 14h à l'ICMMO

Bloch lines, vortices and fast kinks: elements of functional domain boundaries

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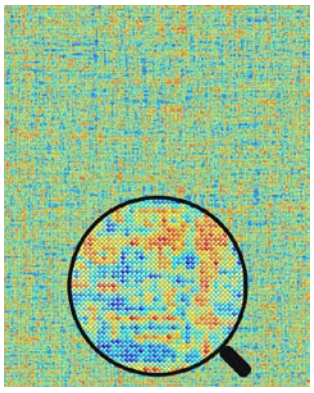
Abstract:

Domain boundary engineering endeavors to develop materials that contain localized functionalities inside domain walls, which do not exist in the bulk [1]. The dominant structural element is, so far, the twin boundary which generates local polarity, superconductivity, and fast ionic transport, to name just a few phenomena. Polarity is generated via the flexoelectric effect and via direct coupling between polar and non-polar order parameters (e.g. biquadratic coupling) [2]. The former determines the orientation of the polarity while the latter allows for polarity inversions in the domain boundary. As a consequence of the inversion, Bloch lines of perpendicular polarity can be created and decorate twin boundaries [3,4]. In addition, vortex structures occur next to twin walls and, in particular, between two parallel walls. Their appearance leads to wall-wall interactions, which have previously been obscure, and play a major part in the pattern formation of twinned nano-structures. These vortices are strongly dependent on external electric fields and constitute an internal instability of the polarity of complex twin patterns[5]. Vortices can induce kinks inside the walls. Computer simulations of such kinks under strain fields have shown that they are extremely mobile. Stress induced movements large exceeded the speed of sound in these materials [6]. I will briefly discuss how these phenomena can be observed (and are modified by) crystal surfaces [7].



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