MANIPULATING INTRINSIC PROPERTIES OF FERROELECTRIC DOMAIN WALLS

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Since the discovery that domain walls in ferroic systems can present electric and magnetic properties distinct from the domains, new options are open for the development of unexplored nanoelectronic devices based on the properties of the domain walls [1]. Domain walls in ferroic materials are homointerfaces, that can be manipulated by external fields (magnetic, electric or mechanical), allowing the modulation of their intrinsic properties viewing to improve novel functionalities.

Domain walls in ferroelectric materials (FEDW) can be engineered via strain [2] and manipulated by switching processes [3] to display "head-to-head" or "tail-to-tail" polarization configuration, in such a way to generate charged domain walls (CDWs), with bounded charges that influence their electric properties and from the surrounding material. Piezoelectric force (PFM) and Conductive Force Microscopy (c-AFM) are among the most effective techniques to manipulate and characterize FEDW at nanoscale.

In this talk, will be presented recent results of the ongoing work in our group concerning the local characterization and manipulation of FEDWs. It will be shown that for PZT thin films, grown on different conditions, very different domain and domain wall configuration can be manipulated. For epitaxial films, the mismatch between the film and substrate drastically changes the domain configuration, while in polycrystalline films, grain size and thickness play the key role. Local electrical current measurements with c-AFM reveal, at relative moderated voltages, enhanced conductivity in 90° a/c DWs while the domains remain insulating. With PFM electrical active domain walls can be manipulated (created and erased). For higher voltages spots of enhanced conductivity are also observed in the domains, which can be related to filamentary conduction assisted by oxygen vacancies and defects. Finally we will show the results obtained with local I-V measurements in films with different electrodes which helps to elucidate the conduction mechanisms of FEDWs.

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