Nanoscale piezoelectricity due to symmetry breaking: an Atomic Force Microscopy study

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Electromechanical coupling is ubiquitous in nature and directly underpins sensing/actuating functionalities of various systems. Rapidly developing Piezoresponse Force Microscopy (PFM) and Electromechanical Strain Microscopy (ESM) techniques offer an amazing opportunity to explore electromechanical activity at the nanoscale with a few nm resolution that allows to uncover fundamental mechanisms of the local piezoelectric phenomena. Piezoelectric coupling may arise locally due to symmetry breaking in small dimensions and at the interfaces. In this presentation, I will briefly overview the new features in PFM and ESM as of today and present our recent results on nanoelectromechanical imaging in several novel materials to be used in multifunctional devices. The materials range will include centrosymmetric perovskites (such as SrTiO3 and manganites with charge order states), hydroxyapatite thin films, and deformed graphene. The results are interpreted in light of the possible symmetry breaking induced by the highly inhomogeneous electric field and mechanical stress.