

“Ferroelectric-relaxors” can be distinguished from “classic ferroelectrics” by a diffuse ferroelectric-paraelectric phase transition where ϵ' reaches a broad high peak value with a strong frequency dispersion (the temperature at the maximum T_m increases with frequency). Additionally, the spontaneous polarization P_s is not suddenly lost at T_m , but decays more gradually to zero (at T_{Burns}) with increasing temperature. On cooling from high temperatures, $\text{PbZn}_{1/3}\text{Nb}_{2/3}\text{O}_3$ relaxors (PZN) transform from a paraelectric state to a state with ferroelectric nanodomain fluctuations in a paraelectric matrix and, to a disordered low-temperature polar phase. The existence of polar Nano-Regions in these materials, which can be associated with local lattice distortions with respect to the average structure can be linked to the presence of diffuse scattering in diffraction experiments. From a vibrational viewpoint, a ferroelectric polarization is found to exist based on the recovery of the soft optic mode without a rhomboedral distortion. From a technological viewpoint, PZN exhibits giant electromechanical coupling with a relatively modest applied electric field along the [001] direction. Many studies are related to the competition between short-range and long-range order in these materials, which is supposed to be responsible for the giant piezoelectric response. In this contribution, we present the first local “in-situ” investigation as a function of $\vec{E}\vec{E}$ to really understand what occurs at the atomic scale.

X-Ray Absorption Spectroscopy was performed at the 3 absorption-edges of interest in PZN (i.e., Pb(L_{III}), Zn(K), Nb(K)) and collected in the fluorescence mode as a function of the electric field up to 10 kV/cm along the [001] direction on BM29 at the ESRF. Careful analyses of our EXAFS data linked with an entire dielectric/piezoelectric characterization have clearly enabled us to determine the polarisation process, i.e. between the unpoled and poled states; above a critical value of $\vec{E}\vec{E}$ (the coercitive field here is about 3 kV/cm), one can observe the persistence of the polarization even when the $\vec{E}\vec{E}$ is removed. Additionally, our data permitted us to follow the local distortion of the Zn and Nb atoms in their oxygen octahedra cage, giving rise to the piezoelectric effect, to field reaching 10 kV/cm!!!

Keywords: ferroelectric-relaxor; X-ray absorption spectroscopy; electric field

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Domain Structure in $\text{PbZr}_{1-x}\text{Ti}_x\text{O}_3$. Roland Schierholz^a, Hartmut Fuess^b. ^a*Institute for Materials Science, Technische Universität Darmstadt, Germany.*

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The *Cm* phase of $\text{PbZr}_{1-x}\text{Ti}_x\text{O}_3$ (PZT) for compositions at the morphotropic phase boundary (MPB) has been proposed based on X-ray diffraction results [1]. Also nanodomains were observed in this compositional region [2]. We observed monoclinic symmetry within single domains of $\text{PbZr}_{0.54}\text{Ti}_{0.46}\text{O}_3$, by Convergent-Electron Beam Diffraction (CBED) [3].

The monoclinic phase allows 24 polarization directions. In

PZT the low temperature monoclinic phase is a subgroup of a tetragonal phase at higher temperatures. Due to group-subgroup relations four domains with $\langle uuv \rangle$ polarization can form within one tetragonal domain. In former 90° micro domain walls domains with $\langle uuv \rangle$ and $\langle uvu \rangle$ polarizations meet. This leads to restrictions in lattice parameters in the (110) plane for polarizations that cannot be transformed by a single twin operation.

On the rhombohedral site of the MPB within one rhombohedral micro domain at most three different domains can be formed. In experiments a finer nanodomain contrast is observed with orientations of the nanodomain walls, that differ from those on the tetragonal site. These nanodomain walls can be explained as domain walls of the *Cm* phase as a subgroup of *R3m* instead of *P4mm*.

An *in situ* study revealed a change from a tetragonal/monoclinic shape of the 110_{pc} reflection in X-ray diffraction to a more rhombohedral appearance with cycling [4]. For a sample cycled *ex situ* wide monoclinic domains and rhombohedral appearing domain configurations exist. Those rhombohedral domains show an inner contrast that is consistent with nanodomains. So we discuss the possibilities for a rearrangement of monoclinic nanodomains formed on the *P4mm* to *Cm* transition under an electrical field.

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Electron Diffuse Scattering in epitaxially grown SrTiO₃ thin film, Jérôme Pacaud^a, Frédéric Pailloux^a. ^a*Laboratoire PhyMat Université de Poitiers, France.* E-mail: jerome.pacaud@univ-poitiers.fr

The main requirement for many devices is the growth of a high purity and high structural quality thin film. The perovskite structure is extremely sensitive to the deposition condition and particularly to the temperature and the partial pressure of oxygen. Changes in deposition conditions may lead to a large deviation of the dielectric properties of thin films from those of bulk materials. The chemistry of defects is often proposed as an explanation of this deviation.

Another important parameter for thin perovskite films is the geometrical constraint imposed by the substrate. Most of the time, perovskite exhibit excellent epitaxy on each other and the films are tied to the substrate so the in-plane parameters are not free to reach their bulk equilibrium values. For materials as sensitive to phase transition as perovskite this effect and the associated relaxation processes can be extremely important for the fine tuning of the physical properties of the film.

For perfect crystal, diffuse scattering is mostly inelastic due to phonons, plasmons and other processes. Thermal