

Spontaneous Polarisation in PZN-PT Relaxor Ferroelectrics Surveyed Using High Resolution Neutron Powder Diffraction

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The relaxor ferroelectric materials $\text{PbZn}_{1/3}\text{Nb}_{2/3}\text{O}_3-x\text{PbTiO}_3$ (PZN-PT) at $x < 9\%$ display piezoelectric strains up to 1.7% along [001] of the rhombohedral multi-domain crystals in which the spontaneous polarisation is along [111]. This amounts to ten times the strain available from conventional piezoelectric materials. This Giant Piezoelectric Effect is associated with symmetry changes under applied electric field which have been widely interpreted as electric field induced phase transitions. We have demonstrated using group-theoretical analysis that the observed symmetry reduction is exactly of the kind expected for an electric field applied along [001] of a rhombohedral crystal and does not imply a phase transition [1]. Symmetry changes alone can not explain the piezoelectric response of these materials. Rather, ion shifts are responsible for the induced polarisation that cause the piezoelectric effect. Therefore, we have undertaken a baseline high resolution neutron powder diffraction study of the ion positions (spontaneous polarisation) within PZN-PT materials as a function of temperature and composition in preparation for *in-situ* electric field determinations of the induced polarisation (e.g. [2]). Here we will report on these spontaneous polarisation determinations and their implications for understanding the Giant Piezoelectric Effect and the structure of relaxor ferroelectrics in general.

(1) E.H. Kisi, R.O. Piltz, J.S. Forrester and C.J. Howard J. Phys.: Condens. Matter (2003) 15 3631-3640.

(2) J.S. Forrester, E.H. Kisi, K.S. Knight and C.J. Howard, J. Phys.:Condens. Matter (2006) 18, L233-L240.