Interface Dynamics in Ferroelectrics Investigated By X-ray Imaging of *In-situ* Electric-field Poling Experiments

ESRF Report

P. A. Thomas, D. Walker, Q. Jiang: Department of Physics, University of Warwick, Coventry, CV4 7AL, UK
J. Baruchel, P. Pernot-Rejmánková: ESRF, Grenoble, France

White-beam X-ray section topography *in-situ* with an applied electric field was used to study the electrostrictive distortions in $RbTiOAsO_4$ (RTA) single crystals. An expansion in the thickness of the topographs was observed, which suggested the presence of a depletion region in the near-surface under large electric fields. This implied that RTA should be treated as a semiconductor ferroelectric. Based on the topographic images collected, a model of RTA as a ferroelectric semiconductor was developed.

A paper was published in Journal of Physics D: Applied Physics entitled "X-ray imaging investigation of periodically electroded rubidium titanyl arsenate, $RbTiOAsO_4$, under an applied electric field" (D. Walker, P. A. Thomas, Q. Jiang, P. Pernot-Rejmánková, J. Baruchel and T. Ayguavives, J. Appl. D: Appl. Phys, **38**, A55-A60 (2005)). The abstract of the paper reads as follows:

The behaviour of an [001] slice of initially single-domain rubidium titanyl arsenate ($RbTiOAsO_4$, RTA) crystal, when prepared with a periodic Ag electrode of period 38μm as for periodic poling in nonlinear optics, is investigated for applied voltages of up to ±1.5kV. The method of investigation is by synchrotron x-ray section topography with electric fields applied in-situ while under white-beam X-ray illumination at the ID19 topography beamline of the ESRF, Grenoble. An increasing expansion of the width of section topographs is observed with increasing voltage resulting from a corresponding bending of the lattice planes in the near-surface region, with angles ranging between 4-200μrads. This behaviour is explained by formation of a Schottky barrier, which results from a semiconductor-metal contact interaction between RTA and the Ag film, in the near surface region beneath the high voltage electrode. This restricts the depth of the electric field to a near-surface depletion layer. The actual bending of the planes is by the electrostrictive strain that acts only in the depletion layer where the field is non-zero.