



Experiment title: Synchrotron Topography and High-Resolution Diffraction Study of Periodically Domain-Inverted and Proton-Exchanged Nonlinear Optical Crystals

Experiment number:
HC-540

Beamline:
BL16/ID19

Date of experiment:
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Date of report:

Shifts:
12

Local contact(s): Dr. J. Baruchel

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Report:

Periodic domain inversion in a poled KTiOPO_4 crystal using an electric-field poling technique and a waveguide structure in Cs-doped RbTiOAsO_4 have been investigated by white-beam and monochromatic beam topography. Major results are

(1) Periodic contrast in relatively-perfect domain-inverted regions has been revealed in the white-beam and section topographs. The contrast observed is found to change considerably with choice of reflection. A preliminary analysis suggests that the periodic contrast is the result of interbranch scattering caused by the phase-shift between the the X-ray wavefields in neighbouring domains. Compared with the topographs of an untreated KTP crystal, the perfection of the poled KTP sample has been degraded. In particular, The number of dislocations has increased, giving rise to the bundles of dislocation in poorer regions. This

is thought to result mainly from the domain-inversion processing. Dynamic effects, which occur during the domain-inversion processing, such as the drastic movements of ions driven by high voltage pulses and the converse piezoelectric effect produced, could lead to severe strain in poled regions of confined width, typically of order $10\ \mu\text{m}$ in the samples investigated thus far. Also the fact that periodic domain-inversion walls for optical devices are forced into a specific orientation could lead to an extra strain, not seen for naturally-occurring domains at the resulting walls.

(2) Monochromatic beam and white-beam topography has clearly shown the channel waveguide structure of period $26\ \mu\text{m}$ in the Cs-doped RTA sample. The images of the waveguide structure mainly come from the strain produced in the exchanged layer. The strain along the c-axis in the exchanged-layer is less than 0.04%, and is negligible in the xy plane. The low strain status in the layer can be interpreted in terms of the specific structural characteristics of RTA and its ability to accommodate larger ions on the M(2) atomic site.

We are currently preparing to publish two papers in scientific journals by combining these results with those obtained using the diffractometer at our home laboratory.