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Following Strain-Induced Mosaicity Changes of Ferroelectric Thin Films by Ultrafast Reciprocal Space Mapping With a Convergent Beam

We investigate coherent phonon propagation in a thin film of ferroelectric Pb(Zr0.2Ti0.8)O3 (PZT) by ultrafast X-ray diffraction (UXRD) experiments, which are analyzed as time-resolved reciprocal space mapping (RSM) in order to observe the in- and out-of-plane structural dynamics simultaneously.[1] The mosaic structure of the PZT leads to a coupling of the excited out-of-plane expansion to in-plane lattice dynamics on a picosecond timescale, which is not observed for out-of-plane compression. In our opinion the ultrafast reciprocal space mapping (URSM) technique is a next key part to fully understand the coupling between physical and structural dynamics in PZT and other domain forming materials.
Furthermore, we present a detailed characterization of the utilized diffractometer setup. We show that the resolution function of the diffractometer is determined by the convergence and energy bandwidth of the incoming X-rays. For quasi-perfect crystalline samples with insignificant in-plane Bragg peak broadening we can correct the measured reciprocal space maps for the known resolution function of the diffractometer in order to achieve high resolution rocking curves with improved data quality. For this case, the resolution of the diffractometer is not limited by the convergence of the incoming X-ray beam but is solely determined by its energy bandwidth.

[1] Following Strain-Induced Mosaicity Changes of Ferroelectric Thin Films by Ultrafast Reciprocal Space Mapping, D. Schick, A. Bojahr, M. Herzog, P. Gaal, I. Vrejoiu and M. Bargheer, Phys. Rev. Lett., 110, 095502 (2013)

Primary author: SCHICK, Daniel (Helmholtz-Zentrum berlin für Materialien und Energie)

Co-authors: Mr BOJAHR, André (University of Potsdam); Mr HERZOG, Marc (Fritz-Haber-Institut der Max--Planck-Gesellschaft); Mr BARGHEER, Matias (Universität Potsdam/HZB); GAAL, Peter (Helmholtz-Zentrum berlin für Materialien und Energie); Mr SHAYDUK, Roman (Helmholtz-zentrum Berlin für Materialien und Energie)

Presenter: SCHICK, Daniel (Helmholtz-Zentrum berlin für Materialien und Energie)

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