ESRF	**Experiment title: XRS investigation of multiferroic TbMnO3 thin films**	**Experiment number**: 28 01 816
Beamline: BM28	**Date of experiment**: from: to:	**Date of report**: 06/05/08
Shifts: 18	**Local contact(s)**: D. Mannix	*Received at ESRF:*

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Report:

During this experiment at the XMaS beamline of the ESRF we investigated several thin films of epitaxial TbMnO3. In the first part of the experiment we used a grazing incidence diffraction geometry to investigate the in-plane lattice parameters of the film. These measurements provide information on the matching of the film and substrate lattice parameters and how the films become strained or relaxed. Because of the weak scattering from the films, these measurements need high flux synchrotron radiation.

Figure 1 shows a typical in plane HK mesh scan around the (110) substrate SrTiO3 Bragg peak. In this figure four peaks are aparent in the figure around the central (110) substrate peak. The four peaks arise from film crystallographic domains which are become tilted away from the (110) substrate direction. These scans thus provide information on the relaxation mechanism of the film. In order to accomadate the strain induced from the substrate, the film unit cell rotates slightly with respect to the substrate. These results provide a unique insight into the relaxation mechanism of the films. Similar investigations of very thick films reveal that the films are relaxed with lattice parameters very similar to the bulk material.

In the second part of the experiment, we investigated XRS at the forbidden (001) position at the Mn K-edge. At this Bragg condition, the XRS signal is related to the Jahn-Tellar oxygen distortion around the Mn ions. Unfortunately, we did not have time to investigate the polarisation dependence nor temperature dependence of this scattering and this will form part

of a future continuation proposal. We have also tried to investigate the magnetic structure of the films by investigating the known magnetic positions from bulk TbMnO3. However, these investigations failed to find any signs of magnetism in the films. Although these results are still not understood, the most likely reason is that the magnetic structure of the films is different from bulk TbMnO3.

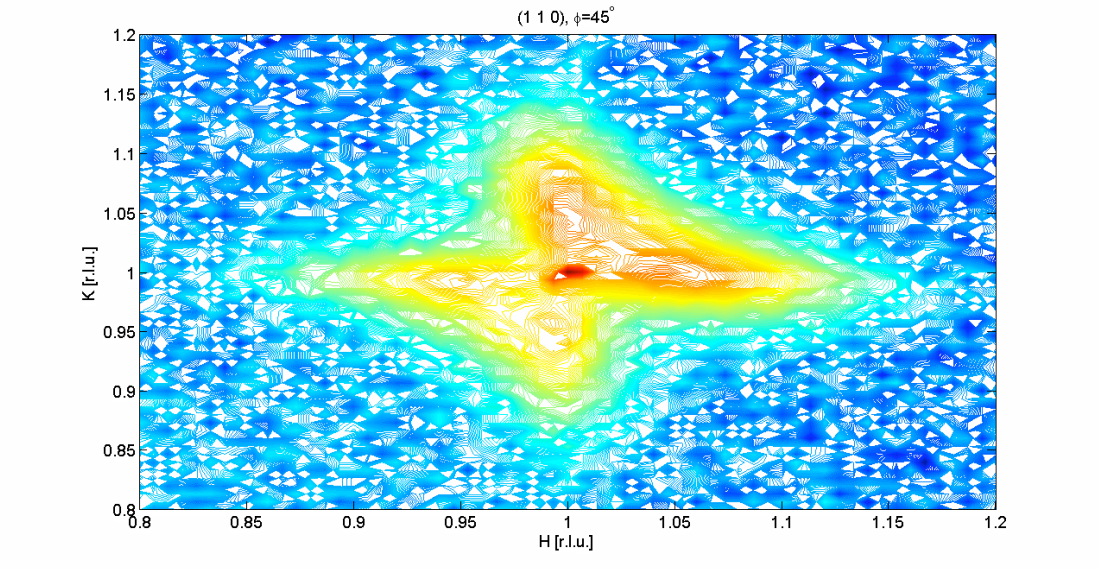

Figure 1. GIXD map around the in-plane (110) SrTiO3 substrate peak. Essentially, four film peaks are observed around the central (110) SrTiO3 peak. However, these film peaks do not lie along the (110) direction. This is because the film unit cell becomes slightly tilted away from this direction in order to releve the strain induced in the film from the substrate lattice mismatch.