



	Experiment title: Grazing Incidence Reflection from the Side Walls of Surface Gratings	Experiment number: SI-210
Beamline: BM 05	Date of Experiment: from: 04-Oct-96 to: 06-Oct-96	Date of Report: 21-Feb-97
Shifts:	Local contact(s): Alexei Souvorov	<i>Received at ESRF :</i> 27 FEB. 1997

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Report:

The submitted proposal was originally focused on X-ray reflectivity measurements from surface grating side walls using small angle of incidence. Unfortunately the required resolution in orthogonal direction could not be realized at the scheduled beam line. Therefore we turned to high resolution XRD measurements in order to analyse the lateral structure of a free standing [110] surface grating prepared by a combination of holographic exposure and wet chemical etching onto GaAs [001]. The grating structure leads to a periodic diffraction pattern which can be observed in transverse scans. The average shape function and the respective lattice strain of gratings becomes available recording q_x - q_z -mappings close to a fundamental Bragg reflection of the substrate. At the presented experiment such maps were accumulated close to the (004) and (115) reflection (fig. 1 and 2) using a wavelength of $\lambda = 0.7114 \text{ \AA}$. For both mappings a Si(111) single reflection monochromator was attached in front of the sample. The symmetric (004)-mapping was recorded with a Si(111) analyzer crystal behind the sample. Analyzer and detector were equipped on a third goniometer. This provided high resolution but it was restricted on a very small angular range, because each angular step of the detector was connected with a translation of the corresponding goniometer. For asymmetric diffraction the analyzer crystal and the detector as well as the sample were mounted on the same goniometer to record a more extensive mapping.

Fig. 1 and 2 show the typical intensity distribution of an approximately rectangular shaped surface grating. The periodicity along q_x ($\Delta q_x = 0.019 \text{ nm}^{-1}$) corresponds to a lateral periodicity of $D = 325 \pm 6 \text{ nm}$. The respective periodicity along q_z ($\Delta q_z = 0.12 \text{ nm}^{-1}$) measures the etch depth of the surface structure ($t = 54 \pm 2 \text{ nm}$). Both values coincidence with the expected ones. The two components of strain ($\epsilon_{\perp}, \epsilon_{\parallel}$) will be analysed from the asymmetry of the intensity distribution at both q_x - q_z -mappings.

The contour lines represent from up to down 10000, 1000, 320, 160, 80, 40, 10 and 5 counts per second

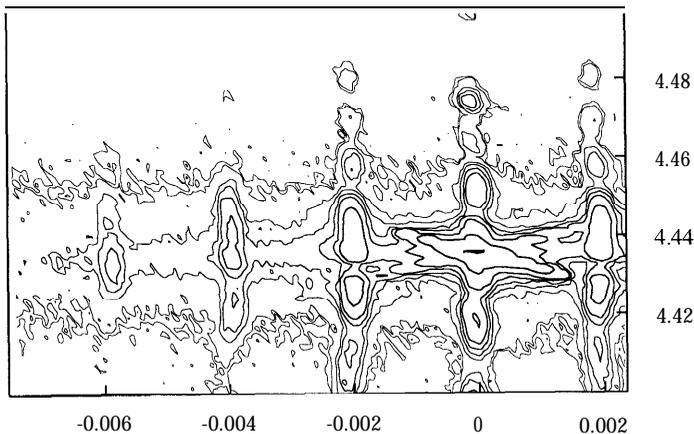


Figure 1. q_x - q_z -mapping of the symmetric (004) Bragg reflection

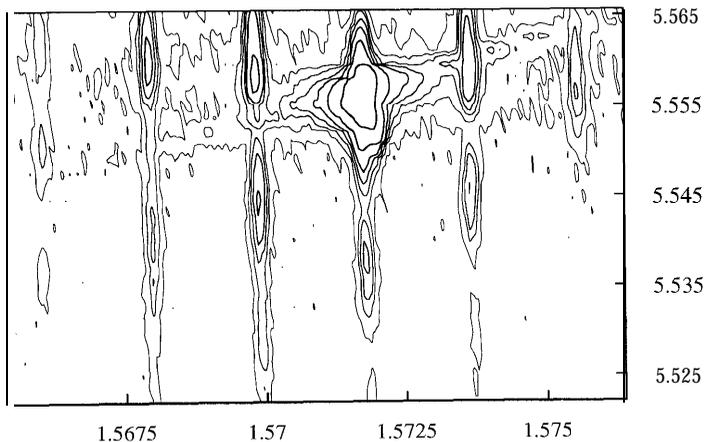


Figure 2. q_x - q_z -mapping of the asymmetric (115) Bragg-g reflection