ESRF	Experiment title: Evaluation of very small strains in $Si/SiO_2/Si$ layer systems by means of a special double crystal topographic technique	Experiment number: MI-66
Beamline: D5/BL10	Date of experiment: from: 29.10. to: 2.11.95 from: 6.12. to: 8.12.95	Date of report: 27.2.96
Shifts: 15	Local contact(s): J. Baruchel, J. Hartwig	*Received at ESRF:*

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Report:

We have used a double crystal setup with a curvable collimator system [1] and a sample holder with a angular resolution in the plane of incidence smaller than 0.01 second of arc. Both components are part of our laboratory setup for this special type of double crystal topography and were mounted in a rigid frame as close as possible to the beamline front end, For the collimator system an incidence angle of 1.5° was chosen. This proved advantageous in that the heat load was distributed over a large enough area and did provide a beam with dimensions of up to about 40x40 mm^2 and a rather low divergence.

With our current bending mechanism for the collimator a torsion cannot be avoided completely. Therefore we had to adjust the torsion of the collimator manually (i.e. without radiation) and repeatedly. We eventually succeded in that, however in the next synchrotrons beamline version of the curvable collimator we will install a drive for the torsion adjustment. We succeded in adjusting several curved $Si/SiO_2/Si$ samples (001-oriented; mean curvatures in the range of radii of some ten to about 100 meters) to the 448 reflection at 0.75 Å).

Typically more than half the 2x2 cm^2 sample showed topographic contrast but with varying working point at the local rocking curve due to the inhomogeneity of curvature. As checked with a 2D x-ray sensitive camera the reflection was shifting slightly after opening the shutter and became stable after about 5 seconds. Than the film or photoplate was moved in for

for about 30 to 200 seconds exposure. The drift was checked by means of the CCD-camera and compensated. We have taken tomographs of $Si/SiO_2/Si$- and SIMOX- samples (the latter investigation was done together with J. Härtwig, topography beamline). In regard of the $Si/SiO_2/Si$-samples (grown by selected area liquid phase epitaxy by the epitaxy group (E. Bauser) of the MPI für Festkörperforschung, Stuttgart [2]), there were two main results:

- With a higher angular resolution and without the contrast offset due to absorption in the layer the attractive force, observed in the laboratory [3] could be confirmed. In contrast to the laboratory measurements the lateral contrast (i.e. local stress) variation could be demonstrated. Currently strain models are investigated by means of finite element calculations are, which will be compared with the experimental contrasts.
- As hitherto unknown, the growth process, which starts from seeding windows in the oxide (Sin Fig. 1) and proceeds laterally (arrow), is obviously not completely continous. Growth striations (G) mark the progress of the growth front. These are not related with impurities but with stress exerted by the silicon layer onto the substrate.

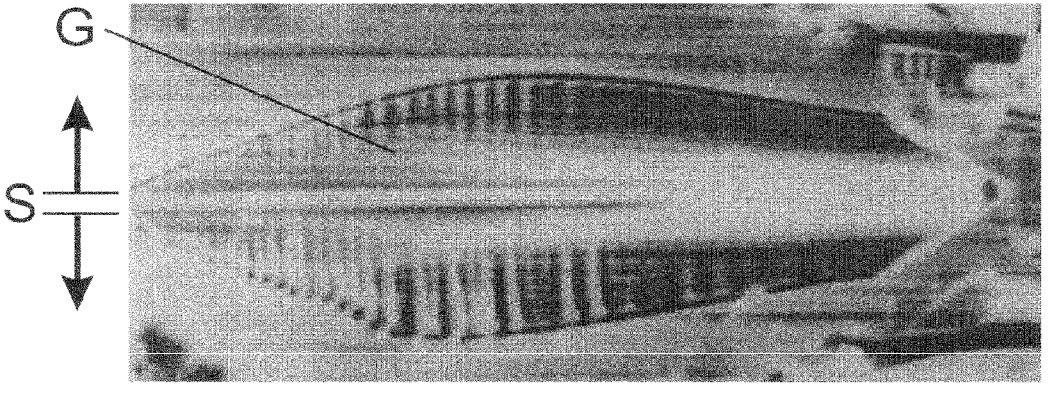

Fig. 1: Topograph of a silicon-island/SiO_2/Si (0.75 Å, 448-reflection)

After installation of above mentioned torsion control the setup will be made available to other users.

References:

[1] B. Jenichcn, R. Köhler, W. Möhling; J.Phys.E 21 (1988) 1062
[2] N. Nagel, F. Banhart, E. Czech, I. Silier, E. Bauser and F. Phillipp, Appl.Phys, A57 (1993) 249
[3] R. Köhler, B. Jenichen, H. Raidt, E. Bauser, and N. Nagel, J.Phys.D 28 (1995) A50