ESRF	**Experiment title:** Evaluation of local stresses induced by periodic trench isolation structures via High Resolution X-Ray Diffraction	**Experiment number**: 32-02-640
Beamline: BM 32	**Date of experiment**: from: 01 may 2006 to: 04 may 2006	**Date of report**: 05 oct. 2006
Shifts: 9	**Local contact(s)**: Jean Sebastien Micha	*Received at ESRF:*

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Report:

Aim of experiment :

Stains in crystalline materials introduce small shifts in the diffracted intensity in the reciprocal space. The aim of the experiment is to study the local strain field in Si(001) in a oxide filled trench array. To manage such analysis, high resolution reciprocal space mappings are needed. Previous experiments in laboratory with Cu sealed tube show a poor dynamic and sensitivity.

Measurements have been performed on two samples. Both have a period of 200nm with 250nm deep trenches. One has 100nm wide trenches; the other has 130nm wide trenches.

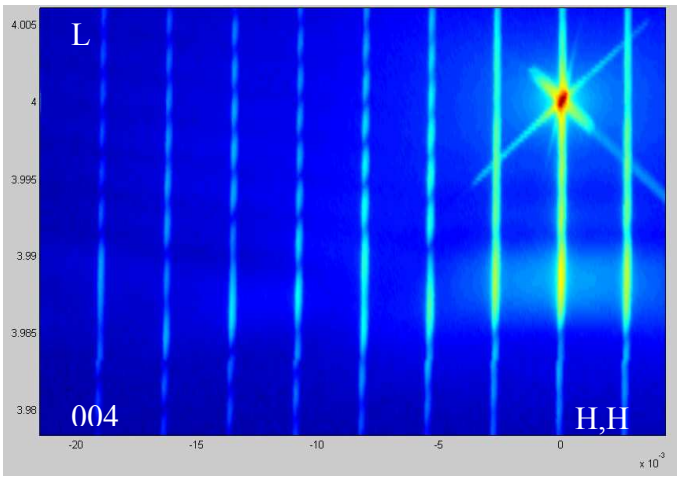
Experiment setup :

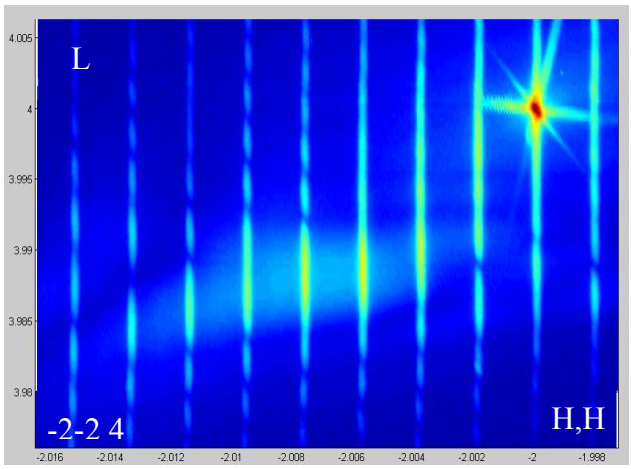
Chosen energy for this experiment was 8 keV. This energy is needed to be able to measure the asymmetric diffraction (-2 -2 4). The beam was ~ 500µm wide. A double bounce Si(111) analyser has been used to perform the high resolution reciprocal space mappings.

Results :

For each sample, two reciprocal space mapping was measured along qx and qz axes. One using symmetric (004) diffraction plans and one using asymmetric (-2 -2 4) diffraction plans.

Sample with 100nm-wide trenches :

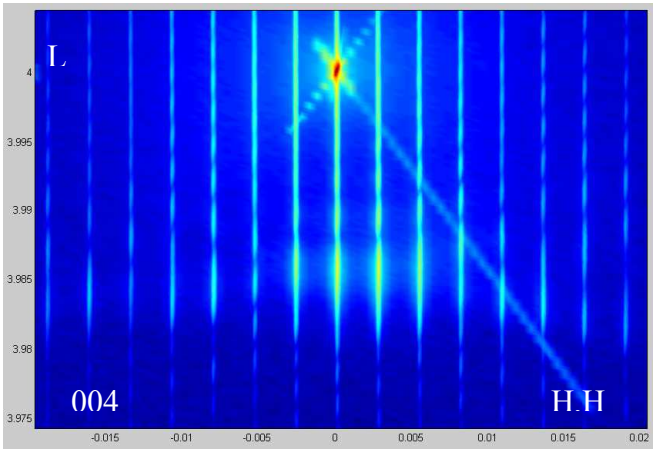


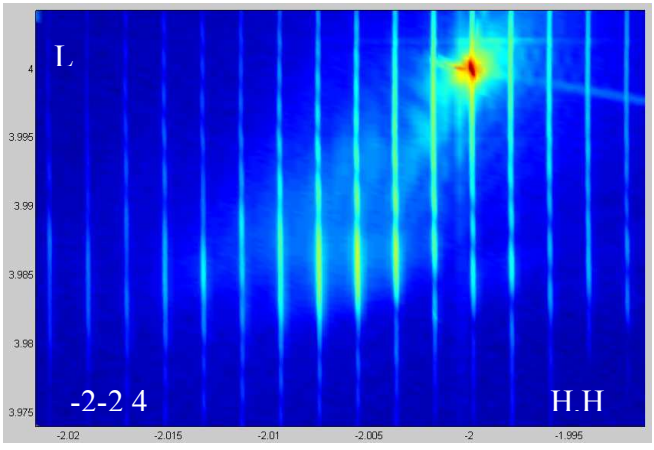


It has been shown on previous samples with larger period (0,58µm) that the secondary diffraction peak appearing for smaller value of L and H (for -2 -2 4 map) is due to an homogeneously Si strained area between the trenches. The strain is negative across the trenches and positive perpendicular to the surface.
In this case the homogenous strain across the trenches is $-3.1*10^{-3}$ and $2.9*10^{-3}$ vertically.

The brilliance of ESRF beam allowed us to do large reciprocal space mappings with many satellites. It is the envelope and intensity of those satellites that hold the local strain information. With the good sensitivity, we will be able to compare with precision high order satellites with simulated ones to validate the strain field on the entire sample.

Sample with 130nm-wide trenches :





For this sample the homogenous strain would $-2.8*10^{-3}$ horizontally and $3.5*10^{-3}$ vertically. But on the 004 reciprocal space mapping, there is an asymmetry in the diffraction between positive values of H,H and negative ones. Therefore, a direct measurement of the strain is not possible anymore. Further analyses are in progress to understand this asymmetry: geometry of the lines, anisotropy of process...