ESRF	**Experiment title:** **Smart wafer deformation mapping by Rocking Curve Imaging method**	**Experiment number**: ME-1074
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Report:

The aim of this proposal was lattice deformation study in ultrathin silicon wafers by x-ray diffraction imaging method of rocking curve imaging (RCI). Such wafers, with thickness ranging from 20 to 100 micrometers, are intended for preparation of flexible electronic devices for “smart” electronics such as communication devices, memory and smart cards, and portable computing. The fabrication steps of thinning (grinding, lapping) induce (sub)surface deformations, which are further removed in subsequent technological steps (polishing, etching).

The utilized RCI is an x-ray topography method utilizing a digital area detector, and we have used it in order to quantitatively analyze samples for mapping distribution of (a) misorientation (tilt) and (b) deformation on the sample surface. The experiment has been run at beamline ID19 using monochromatic beam (energy 10.07 kV) and 004 Bragg reflection. The experimental arrangement was similar to our previous RCI experiments with horizontal scattering plane, see Fig. 1. Here, we have additionally used azimuthal rotation about sample surface normal so that rocking scan image series can be measured at 0, 90, 180 and 270º. This is required in order to subtract tilt components for misorientation and deformation, which are asymmetric and symmetric with respect to rotation by 180º, respectively. FReLoN camera resolution was 2048^2 pixels of 7.48 μm size, which allowed us to map 15^2 mm^2 of the wafer surface.

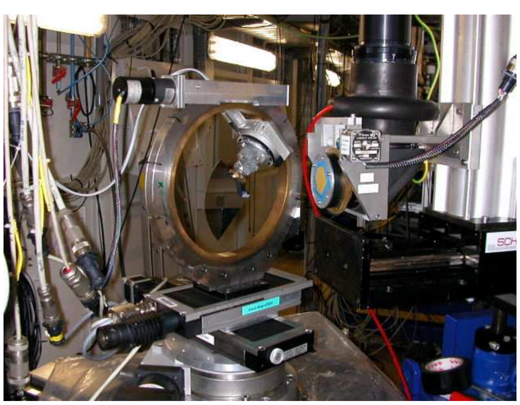

Fig 1. The experimental setup with azimuthal wafer rotation.

We have used our standard RCI data analysis software to extract the rocking curve image series information: maximum intensities, positions and fwhm of Bragg peaks. Further tricky point for the visualization is a mutual pixel-to-pixel correlation of these images from different sample orientations for proper misorientation analysis.

Below we show results for a 50 µm thick ultrathin wafer glued on a thick supporting silicon wafer carrier. The local misorientation of the wafer Bragg peak was mainly caused by the gluing procedure, Fig. 2.

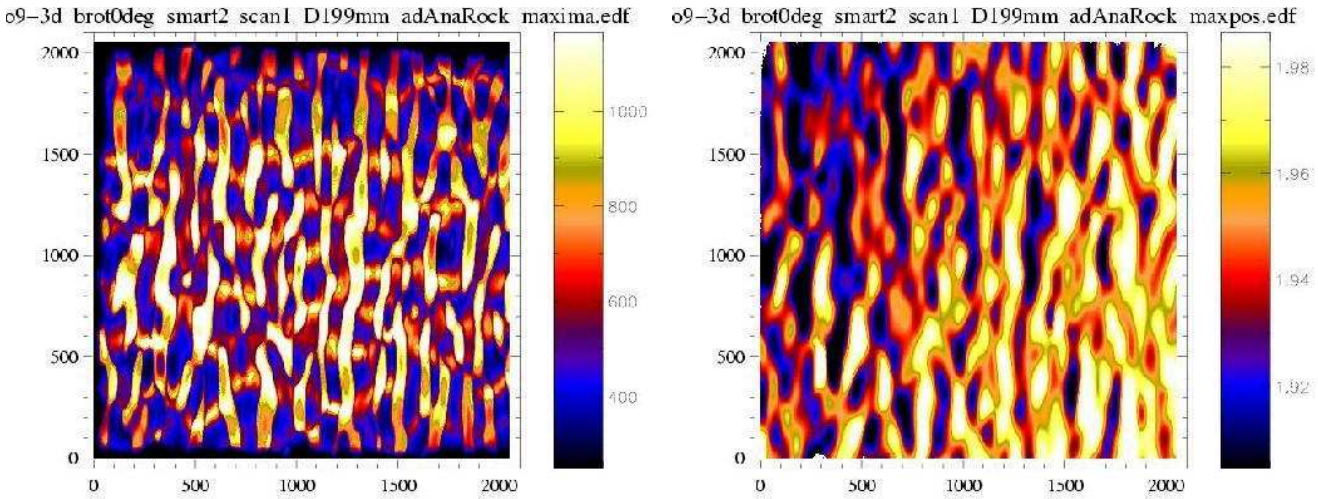

Fig 2. Maximum intensity (left) and local Bragg peak position (right) over the wafer surface for wafer to detector distance of 199 mm.

Image analysis lead to the misorientation, see Fig. 3. Preliminary analysis of strain distributions shows the strain being smaller than $5 \cdot 10^{-4}$. The method was found to be rather sensitive to precise alignment of images, and the analysis will have to be optimized for this effect.

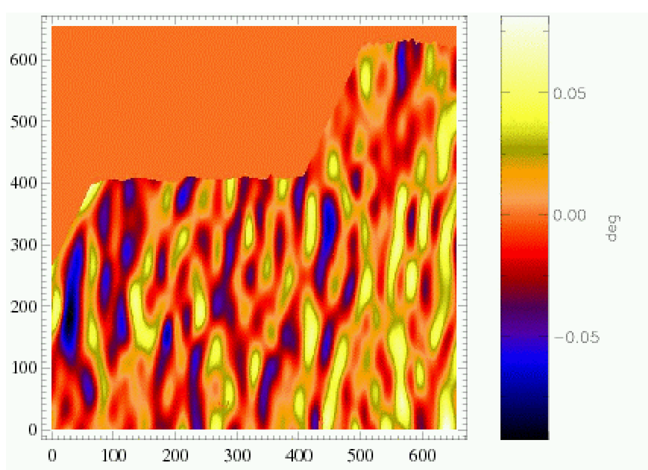

Fig 3. Local lattice misorientation along a specific direction on the wafer surface. The missing part is shadowed by the wafer holder.

In summary, the preliminary image analysis makes it possible to analyse deformation (local lattice misorientation and strain distribution) induced in thin silicon wafers glued on a thick substrate carrier. Further data analysis will allow us to optimize the procedure and compare the data and results from measurements recorded in different scattering geometries.