ESRF	**Experiment title:** **INVESTIGATION OF CRYSTALLINE DEFECTS IN THE UPPER SILICON FILM OF "SMART-CUT" SO1 MATERIALS**	**Experiment number:** **HC-67**
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Report: The advantages of SO1 based devices include improved speed, low voltage use and low power consumption [1]. In order to be attractive for ULSI applications, high crystal quality of the upper thin silicon layer has to be reached. Several processes are now developed to manufacture such SOI structures, among which the "Smart cut" technology patented by LETI. It is based on wafer bonding, using implantation and thermal annealing effects to elaborate the upper Si film [2]. In order to be attractive for ULSI applications, high crystalline quality of the thin layer has to be reached. Three kinds of effects which decrease the perfection of that layer had to be investigated: (i) dislocations and their strain fields, (ii) voids or non bonded areas, and (iii) long range strain fields with spatial frequencies in the order of hundreds of micrometers.

Threading dislocations in the upper thin silicon layer could not be detected with synchrotron X-ray topography. This means they either do not exist or the other kinds of strain overlays the dislocation images. The potential visibility of dislocations in a wafer bonding structure could be demonstrated for the case of misfit dislocations. In rare cases they were visible (mainly in substrate reflections) in regions not interesting for potential applications - close to a sample border or to large "bubbles" (Fig. a). In both cases the epitaxial growth of an additional layer has probably an important influence on the formation of these dislocations. Figure a also demonstrates, that larger voids and non bonded areas may be detected without bigger problems.

It was the effect (iii) decreasing the perfection of the upper silicon layer, which had to be investigated in more detail - the long range strain fields that dominate the contrasts on the X-ray topographs. For that reason we continued to investigate the mechanism of this contrast and its origin. In principle the mechanism is understood now for the white beam and the double crystal topographs. Taking topographs in a double crystal arrangement for different working points on the rocking curve, we were able to reconstruct the effective misorientation of a layer (Fig. b). We analysed the main spatial frequency in the strong contrasts on X-ray topographs as a function of different process and sample parameters. In all cases it was nearly the same and in the order of hundreds of micrometers. The origin of this deformation is probably a waviness of the bonded surfaces [3].

References

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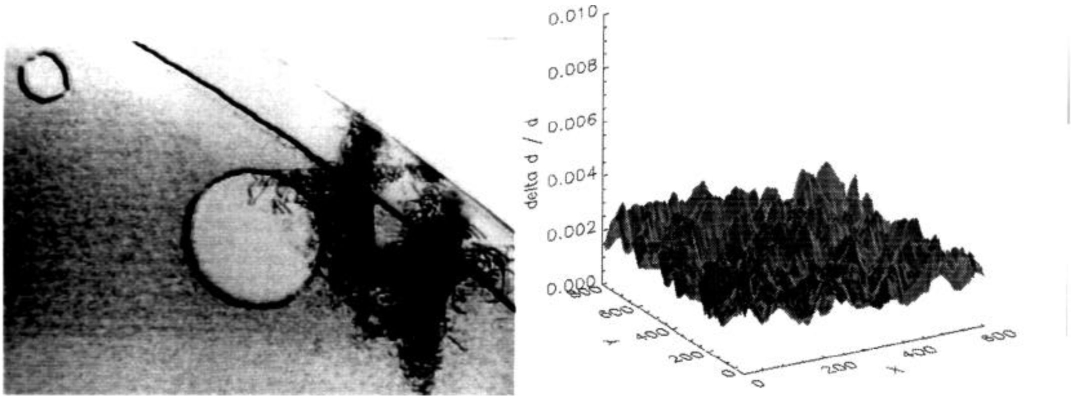

a) b)

a) white beam topograph of a part of a 8” wafer, 040 substrate reflection, layer thickness 4.7 pm, horizontal image widths 15 mm,

b) reconstruction of the effective misorientation in a layer, on the basis of a series of double crystal topographs, 022 layer reflections, $\lambda \approx 0.4$ Å