Dislocation Generation Related to Microcracks in Si-Wafer: In-situ Study at High Temperature with White Beam X-Ray Topography

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Wafer handling in semiconductor manufacturing introduces microcracks at the wafer edge. Rapid thermal processing may generate dislocations and slip bands, some of which grow into cracks, shattering the wafer and disrupting manufacture. Microcracks and slip bands are visible through X-ray diffraction topography (X-ray Diffraction Imaging). The aim of the SIDAM project, supported by the European Commission, is to discover how to derive quantitative, predictive information from the X-ray images, and thus to enable a new metrology of wafer inspection.

For our experiments well defined defects were generated using a nanoindenter with Berkovitch tip. The applied forces for each set of indents are varied from 100 to 500 mN respectively. Around every indent a series of microcracks is produced dependent on the applied force. We discuss the X-ray diffraction imaging contrast around the indents and compare them with the stress field predicted from finite element stress calculations.

To observe the generation of defects *in-situ* at high temperatures from the indentation damage, a double ellipsoidal mirror heater was installed at the Topo-Tomo beamline of the synchrotron light source ANKA, Research Centre Karlsruhe, Germany. After heating up to about 790 °C large area transmission topographs were taken every 30 minutes which are compared to room temperature topographs before and after heating. At first straight dislocations of the type $\mathbf{b} = ½ [\bar{1}01]$ and $\mathbf{b} = ½ [110]$ originate from the microcracks related to the 500 mN load in the vertical direction. After 60 minutes an increase in the length and number of the dislocations is observed. Now dislocations develop additionally from 100 mN indents and also in the horizontal direction. The technical details of the high temperature topography as well as the results concerning the generation and propagation of dislocations in Si at high temperature will be presented.