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Rocking curve imaging for crystal lattice misorientation mapping

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Synchrotron radiation diffraction rocking curve imaging (RCI) is an X-ray diffraction technique which combines full-field X-ray digital topography and Bragg-diffraction rocking curve recording. Large parallel monochromatic beam irradiates a crystalline sample (wafer or a planar crystal) with a misorientation distribution characterized by local tilt angles. Series of digital topographs are measured by a two-dimensional detector at different sample orientations from which peak characteristics of millions of local Bragg peaks from each series are extracted. The field of view and lateral resolution is given by the camera size, its pixel size and the Bragg angle, while the angular resolution is given by the rocking curve width being much smaller than the misorientation angles of the studied crystal. The inherent focusing-defocusing pattern of diffracted rays due to finite sample-detector distance requires a reconstruction method in order to back-project the peak positions from detector planes towards tilt components on the sample surface. Simultaneous high spatial resolution (ones up to tens of micrometers) provided by the two-dimensional detector and high angular resolution (0.001°) allows to quantify crystalline structure perfectness over large sample area which scales with the area of the detector. Therefore the rocking curve imaging is an imaging method with faster recording but more demanding analysis compared to usual laboratory scanning area diffractometry with typical spatial resolution downto 0.1 mm which requests measurement of the rocking curve at each surface point.

Several reconstruction methods depending on angular misorientation values and type of defects (such as misoriented crystallites, slowly-varying misorientated wafer regions and their combinations) will be discussed. Measurement and analysis of lattice misorientations in semiconductor wafers with values up to several degrees will be presented.

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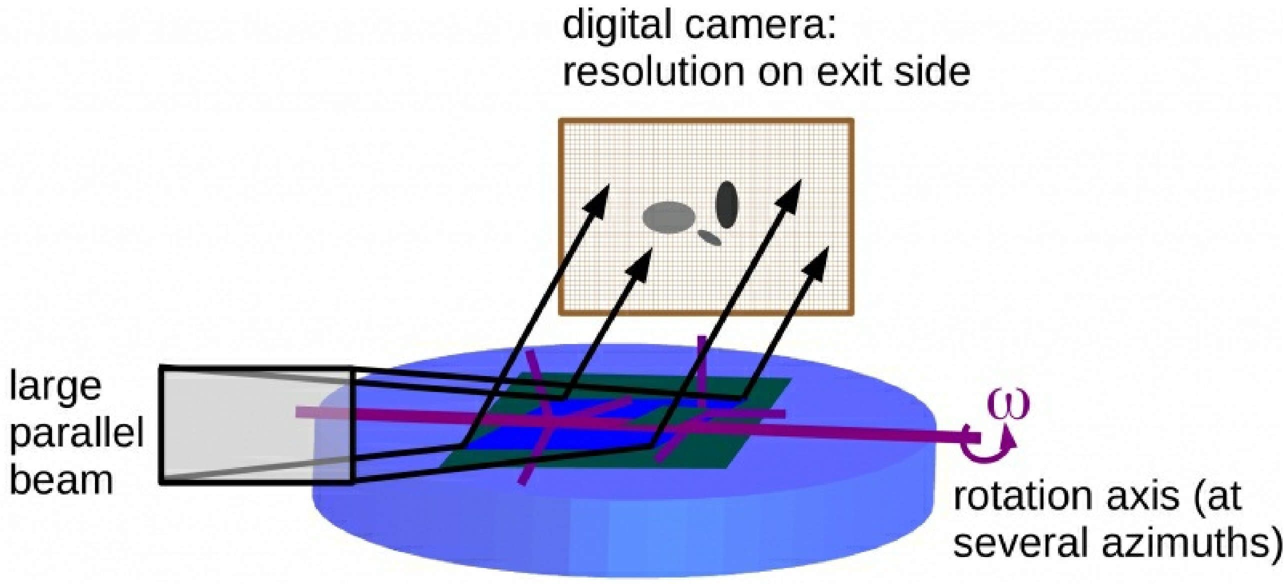

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