s10.m32.p3 Spatial Micrometer-Resolution Three-Dimensional Local Lattice Misorientation Determination of GaAs Wafers by Synchrotron Radiation Rocking Curve Imaging.

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We present details about synchrotron radiation diffraction rocking curve imaging technique (RCI; called synchrotron radiation area diffractometry as well) for a reconstruction-based determination of the complete three-dimensional tensor of local lattice misorientations in wafers with down to micrometer spatial resolution.

GaAs compound monocrystals, for example grown by LEC method, can form columnar structures with highly perfect crystalline structure inside the crystallites. A growth inhomogeneity can lead to nucleation of specific misoriented macrodefects with lattice planes tilted with respect to the main substrate lattice which cause problems during subsequent epitaxy steps. In order to classify the defect structures and their influence on the epitaxial layer quality, quantitative measurements of the local lattice rotation matrix (tensor) including tilts and twist in-plane rotation angles of the defect structures are required with high spatial resolution. We experimentally employ the presented method to analyze a series of GaAs wafers with varying magnitude of misorientation angles, and correlate the reconstructions to optical images of etched wafers.

In the past years, we have developed the RCI as a tool for wafer crystalline perfectness characterization by combining digital topography and conventional wafer Bragg-diffraction rocking curves recording [1] and pushed its limits to a micrometer scale resolution as to study crystalline properties of GaN overgrown layers [2]. We have extended its experimental setup and image analysis routines to reveal the complete three-dimensional tensor of local lattice misorientation in wafers for macrodefects of large local rotation angles with respect to the undisturbed region [3], and to determine dislocation densities [4].

Here, we discuss details of the method in its advanced data analysis including the multipeak analysis of the rocking scan image series and a subsequent backprojection step from detector pixels to sample surface pixels needed to reconstruct the complete spatially resolved three-dimensional local lattice-orientation maps over the wafer surface.

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[2] See abstract by Lübbert, D., *et al.* in this volume.
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s10.m32.p4 XRD Complex For Controlling Orientation And Lattice Elastic Deformations In 12" Wafers.

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For the first time a method has been suggested on how to determine elastic deformations of lattice in wafers based on concurrent identification of angular positions for interference maximums of (nKK)-type planes, obtained simultaneously during diffraction thereon of two convergent x-ray beams of two characteristic radiation lines. Four or five position-sensitive detectors statistically register interference maximums with dissimilar and same indices. This permits to avoid high-precision alignments and do rating based on two x-ray wavelengths. Identification of positional relationship between these maximums (nKK), with regard to other elastic constants in the <nKK> directions, permits to determine elastic deformations of the lattice. For example, for planes (111), (311) and (511) of sapphire wafers (Al_2O_3) in case of basic plane (111) in V Kα Co Kα radiation, elastic deformations are determined in directions <110> in the basic plane. This method is coupled with the method of determining orientation of basic crystallographic plane relatively to orientation of wafer shear plane. Both methods are implemented in the XRD complex designed for finding defects in industrial sapphire wafers 12", featuring the in-line capacity.