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Bright Field X-ray Topography with Sub-100-nm Spatial Resolution[1]

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X-ray topography is an extreme useful technique for visualizing crystalline defects. However, its application has been restricted to investigating strain fields above the micron scale due to the limited spatial resolution of the topographic imaging methods. Consequently, x-ray diffraction investigations requiring submicron spatial resolution are carried out exclusively using a scanning method such as synchrotron x-ray microdiffraction. We have developed a new x-ray topography method to visualize the lattice distortion with a spatial resolution below 100 nm. This new method is similar to "bright-field imaging" in transmission electron microscopy (TEM), in that a set of x-ray optics is used to image the x-rays transmitted through the crystalline specimen in order to obtain high-resolution diffraction contrast images. In the bright field topography, both diffraction contrast and absorption contrast (i.e., inhomogeneity in density) are imaged, making it extremely useful for correlating the lattice distortion with the microscopic defects in the specimen. Our presentation will focus on the instrumentation details and the quantitative data analysis methods for our new technique, and will discuss potential applications. This research has been carried out in collaboration with Dr. Yuncheng Zhonga and Hanfei Yan in X-ray Science Division of Argonne National Laboratory and Dr. Jae Mok. Yi and Jung Ho Je in X-ray Imaging Center of POSTECH, Korea.

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