Lattice-plane orientation mapping of 2-inch homo-epitaxial GaN (0001) thin films by grazing incident x-ray diffraction topography

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Characterization of the lattice-plane orientation of a whole wafer is fundamentally important for improving crystal quality. We propose a method for evaluation of the lattice-plane orientation using grazing incident synchrotron X-ray diffraction topography. The sample was a p-GaN/undoped-GaN/2-inch GaN (0001) wafer. The GaN ($11\bar{2}4$) diffraction peak and its rocking curve at every point in the wafer were recorded using a two-dimensional area detector in a short amount of time using monochromatic X-rays. In addition, we describe how to reconstruct a [0001] vector with q_x, q_y, and q_z components based on a Cartesian coordinate system of the physical surface of the sample using a matrix obtained from two equivalent ($11\bar{2}4$) diffraction topographic images. We were able to obtain the q_x, q_y, and q_z components of every point of the 2-inch wafer from the images recorded at azimuthal angles of 0 and 120°. The vector analysis indicated that the lattice planes of GaN ($11\bar{2}4$) were cylindrical rather than spherical. This proposed method could be used to evaluate the orientation mapping of crystal planes that are almost parallel to the sample surface.