V-pit Defects in InGaN/GaN Studied by X-ray Diffraction

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The V-pit defects play a very important role in the strain relaxation of InGaN/GaN; however, there are numerous unclear issues concerning their formation and their impact on the x-ray diffraction (XRD) patterns. Improving the theories of V-pit formation can make the epitaxial growth process more predictable, whereas the knowledge of how the V-pits affect the outputs of XRD experiments is vital for the interpretation of any XRD data collected from InGaN/GaN samples.

The presented work brings detailed analyses of the V-pits influence on the high-resolution XRD curves and reciprocal space maps (RSM) based on finite element method (FEM) simulations of the deformation field around the V-pits and the kinematic theory of x-ray scattering.
The study deals with three sets of InGaN/GaN samples prepared by the metal-organic vapor phase epitaxy (MOVPE), used for laboratory XRD experiments and for recording micrographs of their surfaces, which also become a source of quantitative information about the samples.

In particular, it is revealed how the V-pits impact the strain relaxation in InGaN/GaN samples and how the relaxation appears on XRD curves and RSMs. Another aim of the research is to determine the influence of In concentration and threading dislocations density on the V-pit formation. Finally, the threading dislocation type (screw vs. edge) responsible for the V-pit creation is identified.