High-resolution X-ray scattering methods for the structural characterization of epitaxial nitride structures
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GaN and its alloys are key materials for the emerging market of white high-brightness light emitting diodes (LEDs). Although in mass production around the globe, layer quality, wafer uniformity and reproducibility of the epitaxial growth process remain difficult to control.

Tolerances on the alloy composition, the thickness and the interface quality are tight. Thus a characterization method is required that is accurate, precise, suitable for wafer mapping and fast. No single technique can fulfill all of the above requirements – and a combination of analytical tools is applied for full characterization.

High-resolution X-ray diffraction (XRD) plays an important role. It has been extensively used to characterize GaN based structures during the research and development phase but, until recently, it was considered too difficult and time consuming for use in a production environment. However, the improved performance of current laboratory XRD equipment plus advances in analytical software allow fast and reliable determination of the most important parameters of single layers as well as multiple quantum well structures based on nitrides. XRD process control tools are currently used in a number of GaN fab lines. This paper will discuss the status of available XRD solutions for the characterization of nitride LED structures. The information content of XRD techniques will be illustrated and ongoing developments will be discussed.