Application Note B-XRD2026

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B-XRD2026 - Analysis of epitaxial films on in-plane anisotropic substrates by wide-range RSM

Introduction

In-plane anisotropic substrates such as m-plane sapphire, Si 110, patterned wafers are used as substrates to grow epitaxial films with specific crystallographic orientations. For these samples, it is important to evaluate crystal orientation and crystallinity of the epitaxial film with respect to the orientation of the substrate. Wide-range reciprocal space mapping (RSM), which provides diffraction intensity distribution in a wide range of reciprocal space, helps to understand the entire image of the crystal orientation and crystallinity of epitaxial films.

Measurements and results

Wide-range RSM of a GaN film deposited on an m-plane sapphire substrate was performed with two sample settings. Comparison with the simulation suggests that m-planes (1100) of both GaN and sapphire were parallel to the sample surface, and the orientation relationship in the in-plane direction was **[0001] (1100) GaN // [1120] (1110) sapphire**.

The shapes of the diffraction spots of GaN differed depending on the incident X-ray direction, and streaks were observed between GaN 110ℓ diffraction spots in the RSM along the GaN c-axis (Figure 1 right). In detailed RSMs around GaN 1100, the width of the GaN diffraction spot along the GaN c-axis (Figure 2 right) was significantly larger than that along the orthogonal a-axis (Figure 2 left). This indicates that this GaN layer grew in-plane anisotropically on the sapphire substrate, as the tilt distribution was wide and the crystallite size was small in the c-axis direction.

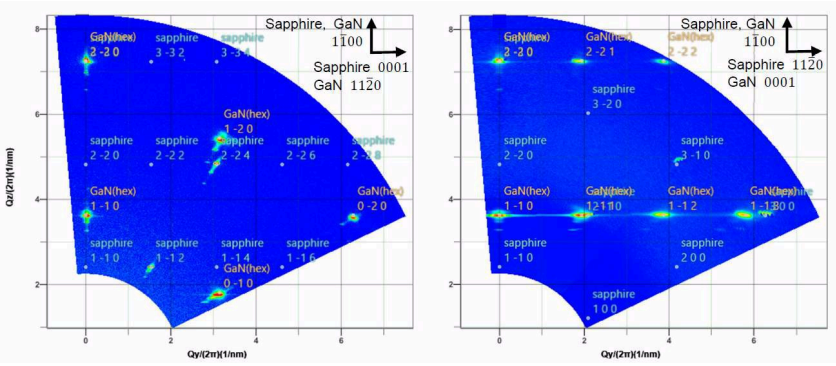

Figure 1: Wide-range RSM of GaN / m-sapphire substrate. Left: the horizontal axis is sapphire 0001, right: the horizontal axis is sapphire 1120

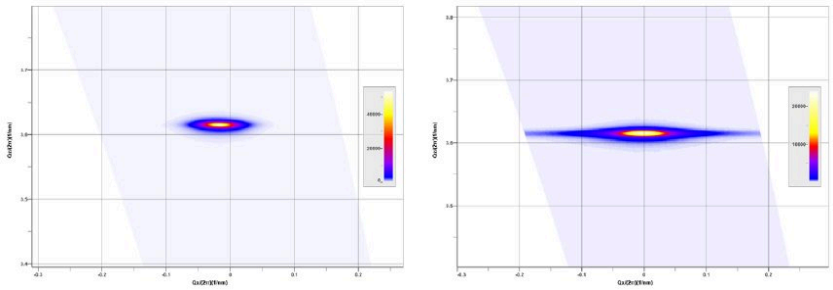

Figure 2: RSMs near GaN 1100. Left: the horizontal axis is GaN 1120 Right: the horizontal axis is GaN 0001

Reference

S.Kobayashi: XTOP 2018 (The 14th Biennial Conference on High-Resolution X-ray Diffraction and Imaging)

Related products

HyPix-3000

Compact photon counting x-ray detector

SmartLab

Advanced state-of-the-art high-resolution XRD system powered by Guidance expert system software

SmartLab SE

Highly versatile multipurpose X-ray diffractometer with built-in intelligent guidance

SmartLab Studio II

Windows-based software suite for Rigaku's X-ray diffractometers