Characterization of GaN crystals with the X-ray topography

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1. Introduction

The nitride semiconductor, gallium nitride (GaN) materials, attracts attention as the next-generation power device which can realize a low loss and high efficiency in saving energy worked on worldwide. However, GaN is hard to get a large bulk crystal, and all the electronic and photonic device need epitaxial growth technics. Dislocations generate into the growth interface, as it is grown in the epitaxial process. Now we studied the section of GaN by HVPE method on amonothermal GaN . And we paid attention to the interface and the epitaxial grown layers.

2. Experimental objective

In this study, we took photos of the crystal face in μm order by the X-ray topography using CCD camera. We obtained values of degree of leaning ($\Delta\theta$) of the crystal face and spacing ($\Delta d/d$) by calculation [1] and made separated images of $\Delta\theta$ and $\Delta d/d$. Experiments of X-ray topography were carried out at beamline 14B and 20B in the Photon Factory.

3. Results and Discussion

Fig. 1 and Fig. 2 show separated images of $\Delta\theta$ and $\Delta d/d$. (a) shows photos by topography method, (b) shows images of $\Delta\theta$, and (c) shows images of $\Delta d/d$.

For images of $\Delta\theta$ and $\Delta d/d$, we observed variations not to be clearly appeared in the original photos as shown in (a). For variations at interface, $\Delta\theta$ is about $-5\sim10$ [arcsec] and $\Delta d/d$ is $-5\sim10 \times 10^{-6}$. For variations at the epitaxial grown layers, $\Delta\theta$ is about $-10\sim10$ [arcsec] and $\Delta d/d$ is $-8\sim4 \times 10^{-6}$. Because $\Delta d/d$ changed by 10^{-6} order, changes of value are hardly any difference. As variations of $\Delta\theta$ and $\Delta d/d$ at both the interface and the epitaxial grown layers change at the same position, it is thought that two images have close relation each other.

Reference

[1]S. Kikuta, K. Kohra, and Y. Sugita, Jpn. J. appl. Phys., 5,1047,1966.
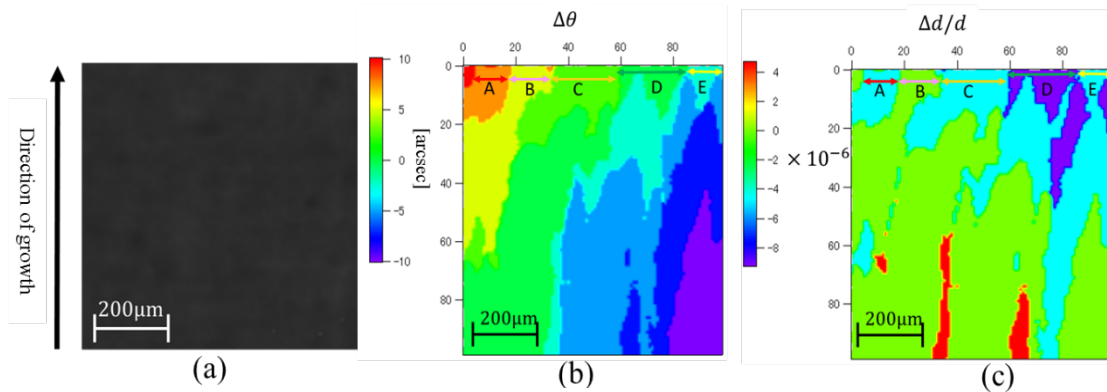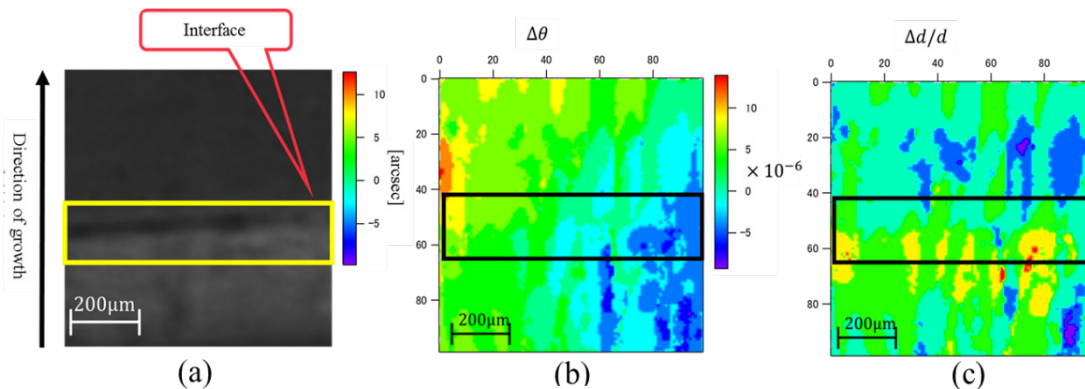
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Fig.1 Analysis at the epitaxial grown layers.

Fig. 2 Analysis at the interface.