Materials Science

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Local variations in spacing and orientation of GaN crystal by X-ray Topography

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Introduction

Semiconductor, GaN or SiC is expected that it can save energy by half if we use it as an electronic power device. But due to a number of crystal defects, it is difficult to become reality now. About recent GaN or SiC crystal, the measurement of strain field in a broad area around a defect is important to improve crystalline quality. Recent GaN crystal needs measurement method of crystalline quality, local variations in orientation (Δθ) and spacing (Δd).

In this study, we measured Δθ and Δd separately in μm order by X-ray topography using CCD camera for GaN which has microstructures. Experiments of X-ray topography were carried out at beamline 14B in the Photon Factory.

Experimental principle [1]

1. As shown in Fig. 1(b), when a region which has some Δθ is compared with a region which has no Δθ (Fig. 1(a)), Bragg peak appears at a different angle of Δθ. If we rotate sample azimuth angle 180° in plane, Bragg peak appears at a different angle of –Δθ, which is opposite angle side compared with before 180° - rotation.
2. As shown in Fig. 1(c), when a region which has some Δd is compared with a region which has no Δd (Fig. 1(a)), Bragg peak appears at a different angle. However, even if we rotate the sample azimuth angle 180° in plane, Bragg peak appears at the same angle position as before 180° - rotation.

Results & Discussion

Fig. 2 and Fig. 3 show analyzed Δθ and Δd for the same area of c-plane GaN crystal, respectively. In Fig. 3, there are large Δd/d (10^{-4} order) regions, although most of the regions are 10^{-5} order. In this large Δd/d region, the sign of Δθ changes as shown in Fig. 2.

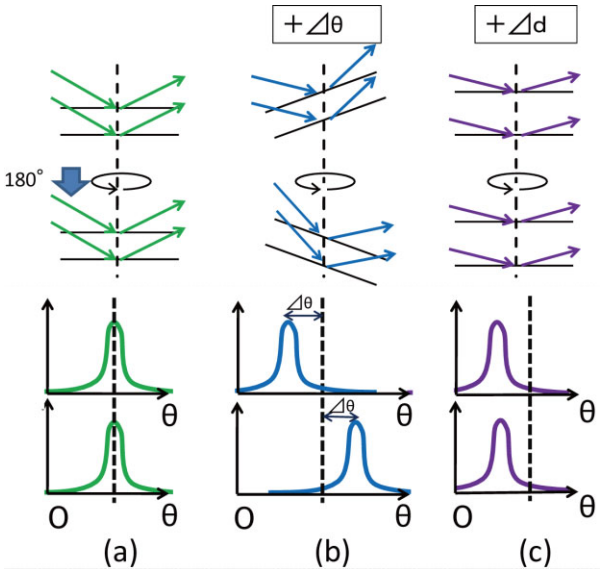

Fig. 1. Experimental principle of separation of Δθ and Δd.

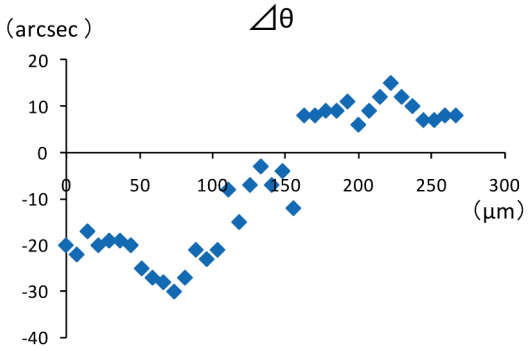

Fig. 2. Analyzed Δθ from experimental data.

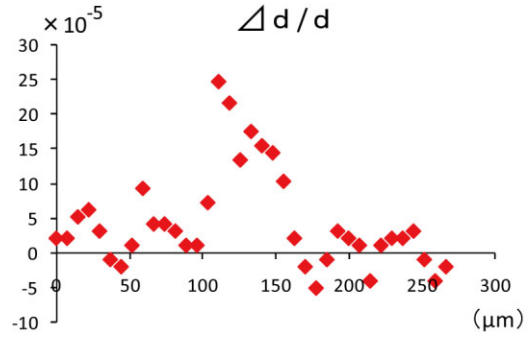

Fig. 3. Analyzed Δd/d from experimental data.

Reference

[1] S. Kikuta, K. Kohra, and Y. Sugita, Jpn. J. Appl. Phys., **5**, 1047, 1966.

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