■ INTRODUCTION
Diamond is one of the most promising materials for future power electronic devices due to its wide band gap (5.5 eV), high breakdown fields (> 10 MV/cm), high thermal conductivity (20 W/cmK), and high bulk carrier mobility (3800 cm²/Vs for holes and 4500 cm²/Vs for electrons) [H. Umezawa et al., Diamond Relat. Mater 18 (2009) 1196].

Crystallographic defects are common in diamond. They may be the results of lattice irregularities or extrinsic substutional or interstitial impurities, introduced during or after the diamond growth. Tracking these defects is indispensible, due to their effects on the performance of diamond for power electronic devices’ application.

■ EXPERIMENTAL SETUP
1. EPILAYER GROWTH
P-type homoepitaxial diamond film was grown by microwave plasma chemical CVD on a high-pressure high-temperature (HPHT) type-Ib(001) substrate (miscut angle: 2.5°).

2. DEFECTS TRACKING
Here, we investigate the crystal quality and defects in CVD grown diamond film using X-ray diffraction topography (XRT), using synchrotron radiation, at Photon Factory, High Energy Accelerator Research Organization (KEK). In addition, these defects were also characterized by cathodoluminescence (CL).

Fig. 1 Contrast of XRT image

■ RESULTS & ANALYSIS
Luminescence from dislocation lines may be either violet-blue emission “Band-A” at CL wavelength of 430 nm, or green-yellow emission “H3 system” at CL wavelength of 503 nm [A.R. Lang, J. Cryst. Growth 42 (1977) 625]. Not all dislocations are luminescent, and there is no correlation between the dislocation type and the parameters of the emission [P.L. Hanley et al., Phil. Trans. Roy. Soc. A 284 (1977) 329]. Some defects were observed only at specific XRT diffraction plane. Different XRT diffraction planes can observe, beside types of defects (screw, edge, or mix), their orientations.

Fig. 2 XRT image of [0 4 4] and [4 0 4] diffraction planes versus CL mapping of p-type epilayer diamond.

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