高感度エミッション顕微鏡による HVPE (001) β型酸化ガリウム SBD のリーク電流の起源の同定ープローブによる欠陥

Probe-Induced Defect−Origin of Reverse Leakage Current in HVPE (001) β-Ga_2O_3 SBDs Identified by High Sensitive Emission Microscope

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1. Introduction

β-Ga_2O_3 has a bandgap of 4.43–4.8 eV, which is wider than that of SiC and GaN; hence, it can be used to develop high-efficient high-power electronic devices. However, it has been observed that the SBDs fabricated on a single wafer, some show a higher reverse current and a lower breakdown voltage than their neighbors. We have confirmed that polycrystalline defects and stacking faults are killer defects.[1-2] Therefore, in this study we further investigate the killer defects that are responsible for the reverse leakage current in HVPE (001) β-Ga_2O_3 SBDs via ultrahigh-sensitivity emission microscopy.

2. Fabrication

An n-type β-Ga_2O_3 epitaxial layer grown by HVPE on a 2” EFG-grown (001) single-crystal wafer substrate. The net donor doping density, N_D-N_A, is 1.4×10^{16} cm^{-3}. The epitaxial thickness is ca. 10 μm. Vertical-type SBDs were fabricated. For the ohmic contact, Ti/Au was evaporated on the entire back face, whereas for the Schottky barrier (SB) contacts, Ni/Au was evaporated on the surface. By emission microscopy, light emission was observed from the backside of the SBDs during reverse bias condition.

3. Results and discussion

Emission microscope image of the SBD with a diameter of 800 μm at the condition of a high reverse leakage current (density) of −1.45 μA (−0.29 mA·cm^{-2}) at −140 V, (Fig. 1) shows two emission patterns, #1 and #2, at position where the probe was attached. An X-ray topography image with the **g** = 605 of the SBD (Fig. 2) reveals that defects were induced at #1 and #2 due to stress that applied to the SB contact.

In conclusion, we have found that the probe-induced defect is a leakage current path of HVPE (001) β-Ga_2O_3 SBDs by emission microscopy and synchrotron X-ray topography.

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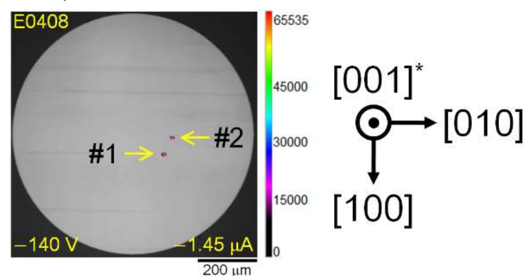

Fig. 1. Emission microscope image of the SBD.

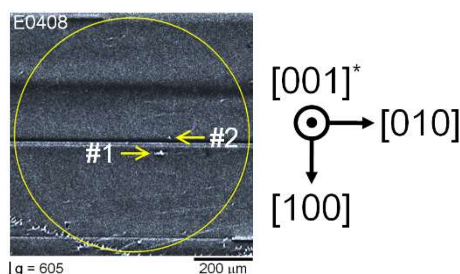

Fig. 2. X-ray topography image of the SBD with **g** = 605.

References

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