Si 表面炭化基板上への GaN 成長の TMAI 先行供給条件依存性

Dependence of TMAl preflow condition on GaN growth on surface carbonized Si substrates 東大院工 ⁰朱 逸夫, 百瀬 健, 霜垣 幸浩, 出浦 桃子 Univ. of Tokyo, °Yifu Zhu, Takeshi Momose, Yukihiro Shimogaki, and Momoko Deura E-mail: shu@dpe.mm.t.u-tokyo.ac.jp

Introduction We have proposed to utilize a 3C-SiC thin film formed by Si surface carbonization for heteroepitaxy of III-nitrides on Si substrates, which is a simple method only to supply a C source during heating the Si substrate [1]. In the case of GaN growth on the SiC/Si substrates obtained by Si surface carbonization, the wettability of GaN may be poor in analogy with the case of SiC substrates and SiC epitaxial layers. To improve the wettability of GaN on SiC, the Al source preflow just before the growth is available [2]. In this work, we investigated the dependence of the trimethylaluminum (TMAI) preflow condition on GaN characteristics grown on carbonized Si substrates.

Experimental setup Si(111) substrates were carbonized by CO-Ar gas mixture under 1 atm at 1200 °C for 1 h in a horizonal graphite hot-wall reactor. CO supply ratio (P_{CO}/P_{CO+Ar}) was 1.2% and 20%, which resulted in ~100-nm-thick rough and ~10-nm-thick smooth SiC layer, respectively. The SiC/Si substrates and 4H-SiC(0001) substrate were pretreated at the same time just before the introduction into the MOVPE reactor. GaN with the thickness equivalent to 1 µm was grown on the SiC and SiC/Si substrates in a growth batch at 1100 °C and 200 mbar with H₂ carrier gas. Only H₂ was supplied during heating, trimethylgallium (TMGa) and NH₃ were supplied at the same time after the TMAl preflow with changing the preflow time and partial pressure.

<u>Results and discussion</u> Figure 1 shows the Nomarski optical microscope (OM) images of sample surfaces after the GaN growth. Trends of the surface coverage and flatness of GaN were almost the same grown on carbonized Si substrates and 4H-SiC substrates. However, the perfect coverage was difficult on the carbonized Si substrates. The surface coverage of GaN increased as the TMAl preflow time increased from 60 s to 960 s under the partial pressure of 0.0006 mbar because the surface coverage of Al precursors was increased. However, GaN polycrystals were generated at the preflow time of 2400 s because the excessive supply time resulted in the agglomeration of Al precursors on the SiC surface. Therefore, a proper preflow time or supplied amount of TMAl exists. The surface coverage of GaN improved when the partial pressure of TMAl was increased, which indicates that a higher TMAl flux with a shorter surface migration length leads to better surface coverage of Al precursors. Here, flatter and more continuous GaN film was obtained on the flat SiC/Si substrate carbonized with CO20%. Therefore, the surface flatness largely affects the surface coverage of Al precursors and steps are difficult to be covered on the rough surface.

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Fig. 1 OM images of GaN grown with different TMAl preflow time and partial pressure on carbonized Si or 4H-SiC (0001) substrates.