17p-A27-2

Influence of intentional impurities (O, C) on the epitaxial GaN layers properties

Tokyo University of Science [1], Air Liquide Laboratories [2], ○Yaxin Wang [1], Takashi Teramoto [2]

Kazuhiro Ohkawa [1]

E-mail: yaxin.wang@rs.tus.ac.jp

Abstrat: Quality of epitaxial GaN layers is closely related to the purity of gaseous sources because of their impurities potentially acting as a donor or acceptor. In this work, we chose common oxygen-containing impurities such as CO_2, CO, and intentionally doped them in GaN layers during MOVPE growth. XRD, SIMS, Hall measurement, and low-temperature PL were used to analyze the structure, composition and photoelectric properties of doped GaN layers. The carrier density increased clearly with CO_2 than CO impurity concentrations, but the crystal quality was kept well below 3.8×10^{18} cm^{-3} (CO_2: 6 ppm) of the carrier density as shown in Fig 1 (a), (b). The increase of carrier density might come from oxygen donor doping, which could be verified by SIMS results as shown in the depth profiles of oxygen concentration and carbon concentration of typical samples $1^{\#}$～$5^{\#}$ in Fig 2 (a) and (b). The average oxygen densities were calculated to compare with the carrier densities. As shown in the inset of Fig 2 (a), consistent trend was observed between the oxygen concentration and the hall carrier density. PL spectra were measured at 15K, D^0X and FX emission peaks as shown in Fig 3, and the emission intensity increased with carrier density up to 3.8×10^{18} cm^{-3}, and went down. In summary, the properties of epitaxial GaN layer are more sensitive to CO_2 than CO, therefore higher carrier density was observed in doped GaN layer with CO_2. In addition, impurities like CO_2 and CO can mainly work as oxygen donor provider, and carbon incorporation efficiency from these molecules are lower than oxygen incorporation efficiency.

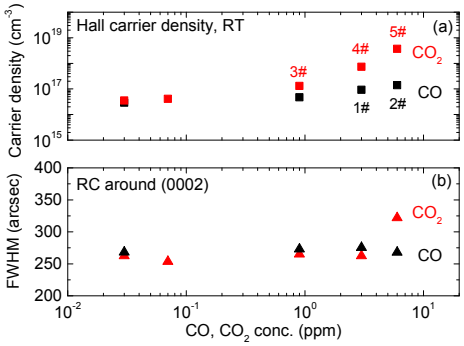
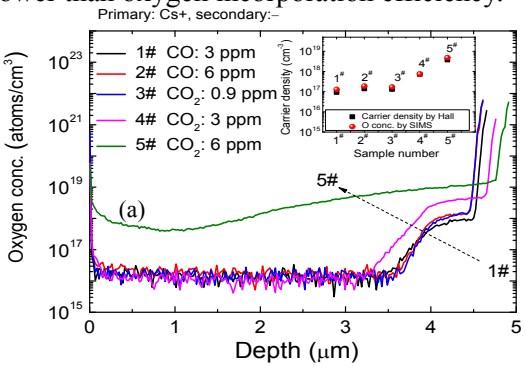


FIG 1



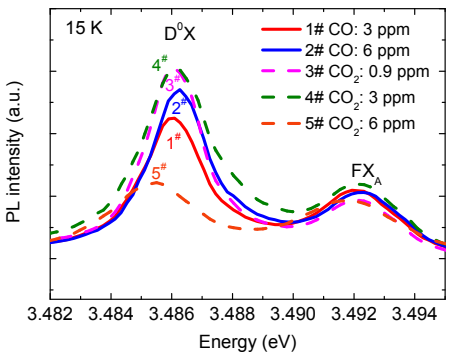


FIG 3

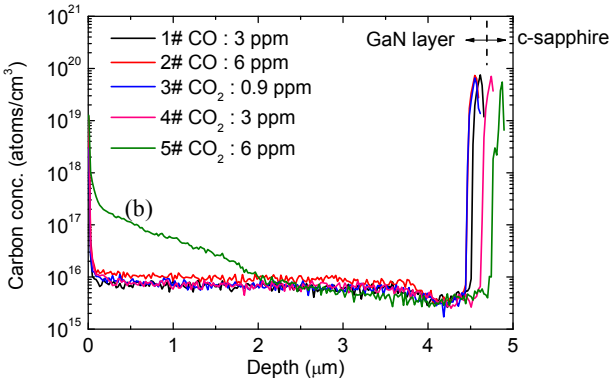


FIG 2