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Insertion of Carbon Interlayer Into GaN Epitaxial Layer

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This paper reports doping of carbon atoms in GaN layer, which based on dimethylhydrazine (DMHy) and growth temperature. It is well known that dislocations can act as non-radiative recombination center in light emitting diode (LED). Recently, many researchers have tried to reduce the dislocation density by using various techniques such as lateral epitaxial overgrowth (LEO) [1] and patterned sapphire substrate (PSS) [2], and etc. However, LEO and PSS techniques require additional complicated steps to make masks or patterns on the substrate. Some reports also showed insertion of carbon doped layer may have good effect on crystal quality of GaN layer [3]. Here we report the growth of GaN epitaxial layer by inserting carbon doped GaN layer into GaN epitaxial layer. GaN:C layer growth was performed in metal-organic chemical vapor deposition (MOCVD) reactor, and DMHy was used as a carbon doping source. We elucidated the role of DMHy in various GaN:C growth temperature. When growth temperature of GaN decreases, the concentration of carbon increases. Hence, we also checked the carbon concentration with DMHy depending on growth temperature. Carbon concentration of conventional GaN is 1.15×10^{16} . Carbon concentration can be achieved up to 4.68×10^{18} . GaN epilayer quality measured by XRD rocking curve get better with GaN:C layer insertion. FWHM of (002) was decreased from 245 arcsec to 234 arcsec and FWHM of (102) decreased from 338 arcsec to 302 arcsec. By comparing the quality of GaN:C layer inserted GaN with conventional GaN, we confirmed that GaN:C interlayer can block dislocations.

Keywords: GaN, carbon, doping

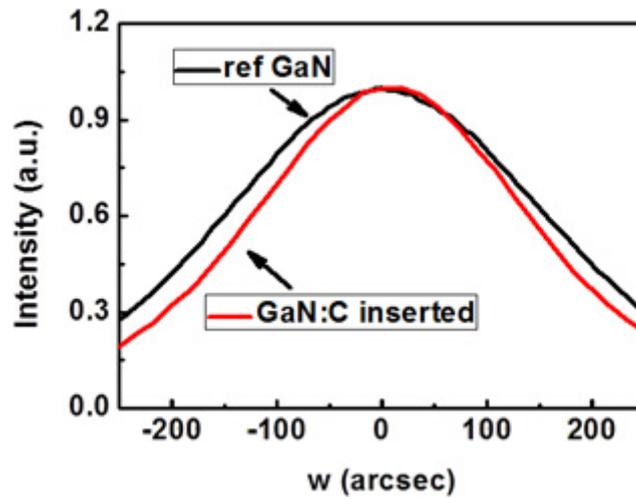


Table 1. XRD rocking curve of reference GaN (black-245 arcsec) and GaN with carbon doped layer (red-234 arcsec) in (002) plane. Data shows that effect of GaN:C layer made good effect.

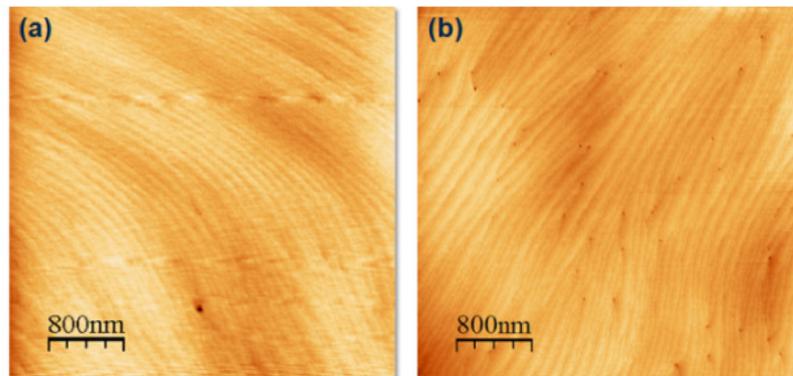


Fig. 1. AFM images of GaN with GaN:C, without GaN:C interlayer. Carbon doped layer have flat surface. Carbon does not act as catalyst of 3D growth.