The Characterization of Mg Implanted GaN Material

Chang-Da Tsai, Yow-Jon Lin, and Ching-Ting Lee*
Institute of Optical Sciences, National Central University, Chung-Li, 32054, Taiwan, R.O.C.
*Tel: 886-3-4263914 Fax: 886-3-4252897 Email: t260003@cc.ncu.edu.tw

Abstract

The recent advances in the III-nitride have led to demonstration of high-brightness LEDs, blue LDs, and high-frequency transistors. However, the devices have relatively high p-type ohmic contact resistance due to the difficulty of achieving heavily doping in p-type GaN film by epitaxial growth. In this study, we reported the characteristics of Mg shallow implanted to p-tyoe GaN films. The undoped GaN layer ~1.3 μm thick followed Mg-doped GaN layer ~1.3 μm thick were grown at 1050℃ by metalorganic chemical vapor deposition (MOCVD) using trimethylgallium and ammonia. The hole concentration of the thermal annealing wafer was measured by the Hall effect to be $1\times10^{17}cm^{-3}$. Mg^{+} was implanted to a dose of $5\times10^{15}cm^{-2}$, 30 KeV, resulting in a maxium Mg concentration of $\sim1\times10^{21}$ cm^{-3} at a depth of ~27nm. The implanted sample was activation annealing at 1000℃ for 20 min under N_2 flowing ambience.

We examined the crystal quality by X-ray diffraction. The FWHM of diffraction spectra are 0.53, 0.87 and 0.79 degree for non-implanted, Mg-implanted before activated annealing and Mg-implanted after activated annealing samples, respectively. The broader diffraction spectra in Mg-implanted sample was due to the ion implanted damage. Fig. 2 showed the Raman spectra of Mg implanted samples compared to that of non-implanted samples. The spectrum of non-implanted samples was similar to that of the Mg-implanted samples after activation anneal, as shown in Fig. 2. The result suggested that the ion implanted damage was recover by post-thermal anneal. The spectrum of the Mg-implanted sample before activation anneal appeared forbidden mode in addition to allowed E_2 mode at near 570 cm^{-1}.

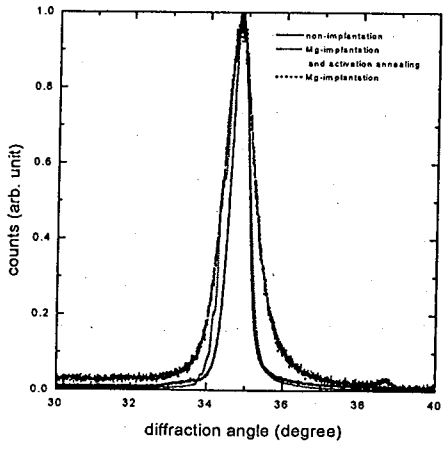

Fig. 1

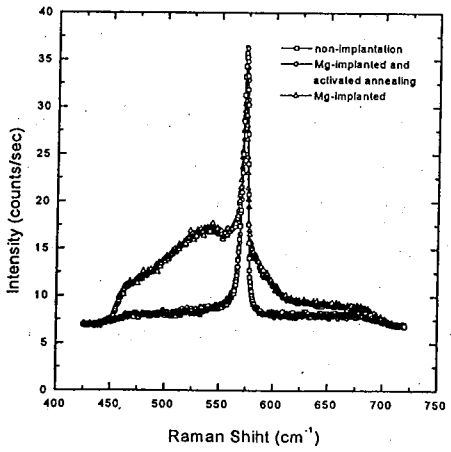

Fig. 2