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p형 GaN에서 반사도가 우수한 MgAl 오믹적극에 관한 연구

이상한, 손준호, 정관호, 송양희, 이종람

포항공과대학교

In vertical light emitting diodes (VLEDs), emitted light from active regions of the devices is reflected-up from reflective ohmic contacts on p-type GaN. Ag is very suitable for reflective ohmic contacts due to its high reflectance (>95%). However, annealing in oxygen ambient causes Ag to be oxidized and/or agglomerated, leading to degradation in both reflectance and adhesion to GaN and overlaid metals. Therefore, preventing Ag from oxidation and/or agglomeration is a key aspect in obtaining high quality Ag-based ohmic contacts suitable for application to high-power LEDs .

For measurements of specific contact resistivity, active regions were defined by ICP of Cl_2/BCl_3 gas, followed by dipping samples into a boiling aqua regia solution to remove surface oxides. Prior to metal deposition, all samples were dipped in HCl:de-ionized water (1:1) solution. MgAl/Ag/Ru metals were deposited by electron beam evaporation. The samples were annealed at temperatures ranging from 300 to 500 ^{o}C in air ambient. Current-voltage characteristics and light reflectance of the contacts were measured. and an Ag mirror was used as the reflectance standard. Interfacial reactions between contact metals and GaN were analyzed through depth profiles of secondary ion mass spectroscopy and synchrotron radiation photoemission spectroscopy.

A specific contact resistivity of 8.59×10^{-6} Ωcm^2 and light reflectance of 84 % at 460 nm wavelength were obtained after annealing MgAl/Ag/Ru contact at 450 ^{o}C in air ambient. The MgAl/Ag/Ru contact showed excellent thermal stability with annealing time at 450 ^{o}C. While MgAl interlayer has a small work function, the outdiffusion of Ga atoms after annealing resulted in the formation of the Ag-Ga solid solution, leading to a good ohmic contact resistivity. A Ru overlayer suppresses the agglomeration and the oxidation of Ag film during oxidation annealing, resulting in a low contact resistivity, a good thermal stability, and a high reflectance. We suggest that the MgAl/Ag/Ru contact should be a promising reflective contact for high-power GaN-based LEDs with vertical-structure configuration.