Abstract: ZnO has been extensively studied for optoelectronic applications such as blue and ultraviolet (UV) light emitters and detectors, because it has a wide band gap (3.37 eV) and a large exciton binding energy of ~60 meV over GaN (~2.67 eV). However, the fabrication of the light emitting devices using ZnO homojunctions is suffered from the lack of reproducibility of the p-type ZnO with high hall concentration and mobility. Thus, the ZnO-based p-n heterojunction light emitting diode (LED) using p-Si and p-GaN would be expected to exhibit stable device performance compared to the homojunction LED. The n-ZnO/p-GaN heterostructure is a good candidate for ZnO-based heterojunction LEDs because of their similar physical properties and the reproducible availability of p-type GaN. Especially, the reduced lattice mismatch (~1.8%) and similar crystal structure result in the advantage of acquiring high performance LED devices with low defect density. However, the electroluminescence (EL) of the device using n-ZnO/p-GaN heterojunctions shows the blue and greenish emissions, which are attributed to the emission from the p-GaN and deep-level defects.

In this work, the n-ZnO:Ga/p-GaN:Mg heterojunction light emitting diodes (LEDs) were fabricated at different growth temperatures and carrier concentrations in the n-type region. The effects of the growth temperature and carrier concentration on the electrical and emission properties were investigated. The I-V and the EL results showed that the device performance of the heterostructure LEDs, such as turn-on voltage and true ultraviolet emission, developed through the insertion of a thin intrinsic layer between n-ZnO:Ga and p-GaN:Mg. This observation was attributed to a lowering of the energy barriers for the supply of electrons and holes into intrinsic ZnO, and recombination in the intrinsic ZnO with the absence of deep level emission.

Key Words: LDE, UV, Sputtering, ZnO, GaN