

## Defect-related yellowish emission of undoped ZnO/p-GaN:Mg heterojunction light emitting diode

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**Abstract :** ZnO with a large band gap (~3.37 eV) and exciton binding energy (~60 meV), is suitable for optoelectronic applications such as ultraviolet (UV) light emitting diodes (LEDs) and detectors. However, the ZnO-based p-n homojunction is not readily available because it is difficult to fabricate reproducible p-type ZnO with high hall concentration and mobility. In order to solve this problem, there have been numerous attempts to develop p-n heterojunction LEDs with ZnO as the n-type layer. 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. In particular, a number of ZnO films show UV band-edge emission with visible deep-level emission, which is originated from point defects such as oxygen vacancy, oxygen interstitial, zinc interstitial [1]. Thus, defect-related peak positions can be controlled by variation of growth or annealing conditions.

In this work, the undoped ZnO film was grown on the p-GaN:Mg film using RF magnetron sputtering method. The undoped ZnO/p-GaN:Mg heterojunctions were annealed in a horizontal tube furnace. The annealing process was performed at 800 °C during 30 to 90 min in air ambient to observe the variation of the defect states in the ZnO film. Photoluminescence measurements were performed in order to confirm the deep-level position of the ZnO film. As a result, the deep-level emission showed orange-red color in the as-deposited film, while the defect-related peak positions of annealed films were shifted to greenish side as increasing annealing time. Furthermore, the electrical resistivity of the ZnO film was decreased after annealing process. The I-V characteristic of the LEDs showed nonlinear and rectifying behavior. The room-temperature electroluminescence (EL) was observed under forward bias. The EL showed a weak white and strong yellowish emission colors (~575 nm) in the undoped ZnO/p-GaN:Mg heterojunctions before and after annealing process, respectively.

**Key Words :** ZnO, Electroluminescence, Deep-level, Sputtering

[1] C. H. Ahn, Y. Y. Kim, D. C. Kim, S. K. Mohanta, and H. K. Cho, *J. Appl. Phys.* 105, 013502 (2009)