Journal of
Nanoelectronics and Optoelectronics
Vol. 7, 712–718, 2012

RESEARCH ARTICLE

UV-Blue and Green Electroluminescence from Cu-Doped ZnO Nanorod Emitters Hydrothermally Synthesized on *p*-GaN

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Aqueous solution synthesis of ZnO nanorods on *p*-GaN(0001) is a low-temperature (< 100 °C) and cost-efficient growth technique of high quality emitters for LED applications. We present morphological, optical and structural properties of zinc oxide nanorod arrays grown by a hydrothermal seed layer-free and rapid synthesis (15 min) on *p*-GaN(0001). We found that the epitaxial layer possesses a close packed hexagonal nanorod morphology and lateral facets are oriented in the same direction for the various nanorods. The effect of Cu-doping on the optical and electroluminescence properties of Cu–ZnO nanorod arrays on GaN substrate is discussed in details. The UV/Blue and green (near-white) emissions were found in both photoluminescence and electroluminescence spectra indicating the possibility to use the synthesized Cu–ZnO/*p*-GaN hetero-structures in white LED applications. The emissions started at relatively low forward voltage of 4.9 V and the intensity of the emission increased with increasing the biasing voltage. We propose for further exploration an efficient, seed layer-free and low temperature hydrothermal synthesis technique to fabricate Cu-doped ZnO/*p*-GaN heterojunction light-emitting devices-LEDs.

Keywords: Cu–ZnO Nanorods, ZnO, Hydrothermal, Epitaxy, Photoluminescence, UV-Light Emitting Diode, Green Emission, ZnO/*p*-GaN Heterojunction.

1. INTRODUCTION

In the last few years, light-emitting diodes (LED) based on heterojunctions ZnO nanorods/nanowires grown on *p*-GaN attracted increasing interest based on enhancement of light output intensity and their possible applications in lighting.[1–5] ZnO and GaN have the same wurtzite crystal structure, similar lattice parameters, a small in-plane lattice mismatch (∼ 1.9% for the *a* parameter), the same stacking sequence (2H),[6–7] a strong exciton binding energy of 60 meV for ZnO compared to 25 meV for GaN.[5, 8] Such properties favor the development of high quality LED based on ZnO/GaN-structure.[9] Nanostructures based on these semiconductors offer the added benefit of material quality leading to improved device efficiency.[10] However, it is known that heterojunctions of *n*-ZnO/*p*-GaN-based LED structures emits light in the near-UV range at both low and room temperatures.[5, 11–13] For practical applications it is important to develop white LEDs by using cost-effective technological approaches.

Previous reports demonstrated the bandgap tuning of ZnO films by addition of dopants.[12–19] However, several issues have to be clarified, such as the possibility of doping nanorods through a cost-effective and efficient process, and to tune its properties by incorporation of dopant in

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 1555-130X/2012/7/712/007 doi:10.1166/jno.2012.1413