

Efficiency Droop Improvement in InGaN/GaN LED Using Chirped Barrier

Powar Sadanand^{1*}, Sumitra Singh^{2,5}, Pramila Mahala³ and Suchandan Pal^{4,5}.

¹Department of Physics, National Institute of Technology (NIT), Warangal, 506002, India

²Flexible and Non-Silicon Electronics Group, CSIR-Central Electronics Engineering Research Institute, Pilani, 333031, India

³Department of Electrical and Electronics Engineering, Birla Institute of Technology and Science (BITS), Pilani, 333031, India

⁴Opto-electronic and MOEMS Group, CSIR-Central Electronics Engineering Research Institute, Pilani, 333031, India

⁵Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, Uttar Pradesh-201002, India

* corresponding author: spowar@student.nitw.ac.in, powarsadanand28@gmail.com

Abstract

In this paper, we have simulated multi quantum well blue light-emitting diodes in which barrier regions are alternately considered as p-doped and no-doped (intrinsic) and is compared to alternately n-doped and no-doped (intrinsic) regions in the barrier. This was done in order to avoid the diffusion of Mg into the quantum well during crystal growth. Here, we have demonstrated by simulation that the p-type step-doping in the quantum barriers is effective in reducing the polarization-induced fields and lowering the energy barrier for hole transport compared to n-type step-doping in the quantum barriers which has already been investigated. The p-type step doping also attributed for increase in the hole injection and improvement of carrier distribution across multiple quantum wells. According to the simulation results, when the stepwise-doping profile is used alternately in the barrier regions, the output power and internal quantum efficiency markedly improve due to suppression of quantum confined stark effect and the increased hole injection efficiency and decreased electron leakage.