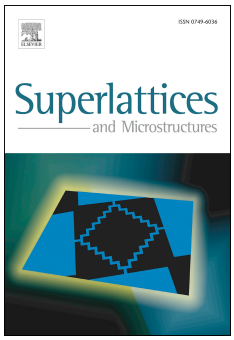
Accepted Manuscript



Droop-Multimode Trade-off in GaN-InGaN LEDs: Effect of Polarization-Matched AlInGaN Blocking Layers

Vikas Pendem, Sonachand Adhikari, Manish Mathew, Sumitra Singh, Suchandan Pal

PII: S0749-6036(15)30199-3

DOI: 10.1016/j.spmi.2015.09.025

Reference: YSPMI 3989

To appear in: *Superlattices and Microstructures*

Received Date: 24 June 2015

Revised Date: 16 September 2015

Accepted Date: 19 September 2015

Please cite this article as: V. Pendem, S. Adhikari, M. Mathew, S. Singh S. Pal Droop-Multimode Trade-off in GaN-InGaN LEDs: Effect of Polarization-Matched AlInGaN Blocking Layers, *Superlattices and Microstructures* (2015), doi: 10.1016/j.spmi.2015.09.025.

Droop-Multimode Trade-off in GaN-InGaN LEDs: Effect of Polarization-Matched AlInGaN Blocking Layers

Vikas Pendem, [a, b, c] Sonachand Adhikari, [a, b] Manish Mathew, [a] Sumitra Singh [a, b] and Suchandan Pal [a, b]

[a] *CSIR-Network of Institutes for Solar Energy, Opto-electronic Devices Group, CSIR-Central Electronics Engineering Research Institute, 333 031, Pilani, Rajasthan, India*

[b] *Academy of Scientific and Innovative Research (AcSIR), CSIR Campus, Taramani, 600 113, Chennai, Tamilnadu, India*

[c] Corresponding author E-mail: vikas6@outlook.com; Ph.: +91-1596-252286; Fax: +91-1596-242294

Abstract–Polarization-matched graded AlInGaN electron blocking layer (EBL) and hole blocking layer (HBL) are proposed to reduce efficiency droop in GaN-InGaN light-emitting diodes (LEDs). Five different structures have been simulated to study the effect of different blocking layers and a significant reduction in the efficiency droop has been noticed, from 52% in conventional structure to 2% in polarization-matched graded AlInGaN EBL and HBL structure at a current density of 1000 A cm^{-2}. This has been achieved at the cost of multimode emission from such polarization-matched blocking layers which sets a trade-off between efficiency droop and multimode emission. The AlInGaN layer can therefore be characterized by droop cut-off condition (DCC) and multimode cut-off condition (MCC). For the best structure proposed in this paper, simulations indicate a DCC having Al and In composition of 0.10 and 0.15 respectively; and an MCC having Al and In composition of 0.08 and 0.23 respectively.

Highlights–

- Efficiency droop is reduced by polarization-matched graded AlInGaN EBL and HBL.
- Droop reduced from 52% to 2% measured at a current density of 1000 A cm^{-2}.
- A high-intensity secondary emission is observed due to AlInGaN blocking layers.
- A trade-off exists between efficiency droop and multimode emission.

Keywords–droop cut-off condition (DCC), efficiency droop, internal quantum efficiency (IQE), light-emitting diode (LED), multimode cut-off condition (MCC), polarization-matched AlInGaN.