Super-lattice p-region for improved performance of deep UV LEDs

Ramit Kumar Mondal[1,2*], **Vijay Chatterjee**[1], **and Suchandan Pal**[1,2]

[1] *Optoelectronics and MOEMS Group, CSIR- CEERI, Pilani, Rajasthan-333031, India*

[2] *Academy of Scientific and Innovative Research (AcSIR), CSIR-CEERI Campus, Pilani, Rajasthan-333031, India*

* Corresponding author: rkmondal@ceeri.res.in

A novel AlGaN based deep ultraviolet light emitting diode (DUV LED) structure with peak emission wavelength of 273 nm has been proposed. The superiority of the proposed structures (trinary and quaternary super-lattice structures on top of EBL) over the conventional structure has been established by comparing the optoelectronics properties of both of the structures using APSYS software tool (from Crosslight Software Inc., Canada) [1]. The conventional structure (Structure A) and the modified DUV LED structure (Structures B and C) considered for the simulations are schematically described in Fig. 1. The Structure B and Structure C both are identical to Structure A, except the intermediate p region. In Structure A a 20nm p-$Al_{0.62}Ga_{0.38}N$ is working as the intermediate p region, whereas this region is replaced by superlattice structure of 5 period p-$Al_{0.62}Ga_{0.38}$ (2 nm)/ p-$Al_{0.50}Ga_{0.50}$ (2 nm) for Structure B and 5 period p-$Al_{0.67}In_{0.03}Ga_{0.30}N$ (2 nm)/ p- $Al_{0.55}In_{0.03}Ga_{0.42}N$ (2 nm) for structure C respectively. Other parameters considered for simulations can be found elsewhere[2]. The operating temperature is set as 300 K. The analysis (Table 1) clearly shows that our proposed structures are capable of producing improved performance in terms of IQE, droop and output power because of better carrier confinement leading to higher radiative recombination efficiency. Further detailed results would also be presented.

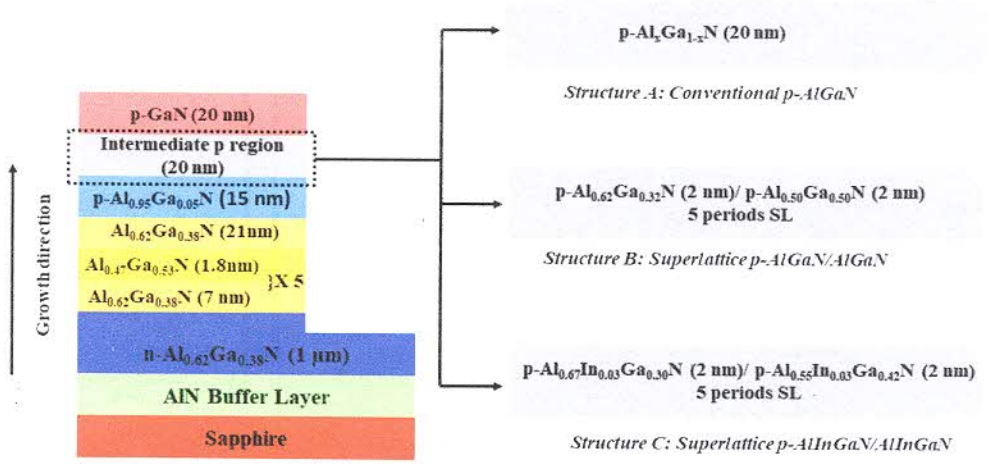

Fig. 1. Schematic of both of the DUV LED structures

Table 1. Comparison between various output characteristics of conventional and modified structures

Structure	Maximum IQE (%)	IQE Droop (@200 A/cm²) (%)	Output power (@200 A/cm²) (mW)
Structure A	**37.03**	**91.89**	**30.01**
Structure B	**54.51**	**80.81**	**95.41**
Structure C	**87.92**	**42.37**	**462.14**

Reference:

[1] www.crosslight.com, Crosslight Device Simulation Software, (2019).

[2] Vurgaftman, J.R. Meyer, L.R. Ram-Mohan, J. Appl. Phys. 89 (2001) 5815–5875.

Authors thank the office of PSA to Govt. of India, New Delhi for sponsoring the activity. RKM thanks CSIR for his SRF-ship.