SIRKELI, Vadim, YILMAZOGLU, Oktay et al. Effect of p-NiO and n-ZnSe interlayers on the efficiency of p-GaN/n-ZnO light-emitting diode structures. In: Semiconductor Science and Technology. 2015, Vol.30, Nr.6, pp. 1-20. ISSN 0268-1242.

We report on a numerical study of the characteristics of p-GaN/n-ZnO light-emitting diodes (LEDs) with p-NiO and n-ZnSe interlayers, and on LED design optimization which includes bandgap engineering, thickness and doping of constituent layers. The current-voltage dependences of investigated LEDs show a threshold voltage of 3.1 V, 5.4 V and 5.6 V for LED devices without and with the presence of p-NiO and n-ZnSe interlayers, respectively. It is found that p-NiO, n-ZnSe and n-ZnO interlayers act as an electron blocking layer, active media layer, and electron transport layer, respectively. It is established that the insertion of both p-NiO and n-ZnSe interlayers leads to the enhancement of charge carrier-confinement in the active region and to the significant increase of internal quantum efficiency (IQE) of the LED device up to 82%, which is comparable with IQE values in order to obtain better AlGaN- and InGaN-based LEDs. It is found that the efficiency of LED devices at 100 A $cm^{-2}$ is equal to 0.024, 0.09 and 16.4% of external quantum efficiency (EQE), $1.3 \times 10^{-4}$, $1.6 \times 10^{-4}$, and 6.4 lm $W^{-1}$ of PE, and $1.3 \times 10^{-4}$, $2.9 \times 10^{-4}$, and 12 cd $A^{-1}$ of CE for p-GaN/n-ZnO, p-GaN/p-NiO/n-ZnO, and p-GaN/p-NiO/n-ZnSe/n-ZnO LED devices, respectively.