Electrical and Optical Properties of InGaN/GaN Quantum Well Light-Emitting Diodes with N-GaN Layer

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The effect of Si-doped n-GaN layers on the electrical and optical properties of InGaN/GaN multiple quantum well (MQW) light-emitting diode (LED) structures were investigated. The current-voltage (*I-V*) characteristics measured at room temperature of InGaN/GaN MQW LEDs as a function of [Si] showed the lowest operating voltage (4.3 V) at 15 nmol/min of SiH_4 flow rate ([Si]) at 20 mA injection current and the reverse voltage decreased with increasing [Si]. The *I-V* characteristics with various heavily-doped spreading layers for uniform current injection into the active layer showed the operating voltage was relatively similar independent of [Si]. However, the output power substantially decreased down to 7.5×10^{18} cm^{-3} of carrier concentration. Also, at the Si-doped InGaN spreading layer, degradation in the reverse voltage and the output power depends strongly on the defects related to stacking faults, which act as nonradiative recombination center into the QW regions. We were able to obtain improved *I-V* properties and a higher output power using the Si-doped GaN spreading layer instead of Si-doped InGaN one.