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Comparative Study of a-plane InGaN/GaN Multiple Quantum Wells with Various Emission Wavelengths

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GaN and related ternary compounds have been widely used for fabrication of light emitting diodes (LEDs) and laser diodes (LDs). Especially, low-dimensional active layers such as quantum wells, quantum wires, and quantum dots have been investigated as an effective structure for improving the emission efficiency. Although GaN-based optoelectronic devices with the c-axis orientated structures have achieved maturity sufficient for reproducible industrial production, the effects of axis-dependent strong piezoelectric polarization limit the performance of quantum well active regions. These polarization-induced internal fields reduce the efficiency of carrier recombination rate. And the effect of red-shift in band edge emission makes it difficult to control the source of green and blue light emitter. To solve these problems, several studies about nonpolar axis oriented heterostructures have been intensively investigated.

In this study, the nonpolar a-plane InGaN/GaN multiple quantum wells (MQWs) have been grown by metal organic chemical vapor deposition (MOCVD) on r-plane sapphire substrates. By varying the composition of indium in InGaN MQWs, the emission wavelengths by ultraviolet laser excitation were designed to be from 370 to 500 nm at room temperature. To study comparative characteristics of nonpolar InGaN/GaN MQWs with various emission wavelengths, the results of temperature -dependent photoluminescence, time-resolved photoluminescence, and cathodoluminescence will be discussed.