MOVPE growth of InGaN MQWs by modulating the flow of metaloorganic precursors

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Today indium gallium nitride (InGaN) alloys are widely used in commercially available blue, green and white light-emitting diodes (LEDs) [1]. The band gap of InGaN can be adjusted to make emission and absorption from the entire visible spectrum by changing the ratio of indium to gallium atoms in the layer. Despite remarkable advances in LED technologies, there still remain lots of issues for further improvements yet to be achieved for the maximum realization of solid-state lighting [2]. The attempts to manufacture LEDs emitting light at longer wavelengths encounter problems due to increased defect density, high influence of internal electric field and carrier localization.

In this work InGaN MQWs were grown on GaN template on c-plane sapphire by low-pressure conventional and pulsed MOVPE using Aixtron 3x2" closed-coupled showerhead reactor. The pulsed MOVPE process of InGaN MQWs growth was conducted by modulating the flow of the In and Ga precursors into the chamber, while maintaining the flow of ammonia constant [3]. In the pulsed growth mode, the reactant atom surface mobility becomes enhanced which suppresses metal segregation, appropriate selection of pulse time duration of metals precursors supply allows increasing V/III ratio, which helps to suppress the creation of nitrogen vacancies. On the other hand the pulsed growth mode cannot completely prevent spinodal decomposition process, but thin layers could be expected to be grown without distinct thickness fluctuations.

InGaN MQWs structures for 450÷460 nm and 500÷510 nm wavelength were grown. InGaN alloy composition, layers thickness and crystal grating tensions in heterostructures were estimated from X-ray diffraction (XRD) measurements. Samples surface was investigated by atomic force microscopy (AFM). Optical properties of different grown MQWs were investigated by photoluminescence (PL) at different temperatures. The influence of In and Ga precursors flow modulation (amount of precursor pulses from 4 up to 16 per quantum well, pulse duration from 30s up to 5s, pauses between pulses from 3s up to 10s) at different growth temperatures to MQWs structural and optical parameters will be discussed in the presentation.

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