Cathodoluminescence study of defects in InGaN/GaN quantum wells grown on semipolar plane

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GaN/InGaN Quantum well (QW) structures grown on the sapphire substrate is the one of the main structure of blue light emitting diodes (LED). InGaN/GaN quantum wells (QWs) grown on a c-plane sapphire has strong spontaneous and piezoelectric polarization field, which induces a spatial separation of electrons and holes in the quantum wells hinder a recombination of carriers, known as a quantum-confined stark effect (QCSE). Since the QCSE is one of the factors to deteriorate the emission efficiency of light-emitting diode, InGaN/GaN was grown on m-plane sapphire substrates to reduce the QCSE, taking advantage of the semi-polar nature of the plane. InGaN/GaN quantum wells formed on the semi-polar substrate, however, resulted in complex microstructures like basal plane stacking faults (BSFs), prismatic stacking faults (PSFs), partial dislocations (PDs), and threading dislocations (TDs). Understandings the luminescence characteristics from defects in semi-polar InGaN/GaN QWs are critical steps to improve the efficiency of semi-polar LED. Because of the high defect density in the m-plane GaN, It is difficult to identify the individual defects. We report combined analytical results of microstructure and cathodoluminescence results on (11-22) semi-polar InGaN/GaN QWs by using home-built cathodoluminescence stage for transmission electron microscopy. The semi-polar GaN epilayers were grown on the hemispherical patterned sapphire substrates (HPSS) and planar m-plane sapphire substrates by metal organic chemical vapor deposition. The CL mappings overlaid microstructure clearly reveal uneven distribution of luminescence and the wavelength shift in the vicinity of Basal-plane Stacking Faults (BSF) and dislocations. Types of stacking faults, which were difficult to isolate, were visualized from the luminescence wavelength window. QWs following surface topological planes showed the short wavelength shift.