Improved 250 nm UV PL Spectra from BAlGaN/AlN MQW Grown on 6H-SiC Substrate by MOVPE Using TEB

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Introduction

The BAlGaN quaternary system is one of the candidate materials for application to semiconductor lasers operating in deep UV spectral region. These system will enable the lattice matching to 6H-SiC and AlN substrates. In this paper, the growth and optical characterization in a 250 nm UV region of BAlGaN/AlN multi quantum wells (MQW) structures will be discussed.

Experiments

The BAlGaN/AlN MQW structures were grown on an AlN layer on (0001) 6H-SiC substrates by Low-pressure metal-organic vapor phase epitaxy (LP-MOVPE). Triethylboron (TEB) was used as a boron precursor. The BAlGaN and AlN layers were adopted as well and barrier layers, respectively. The thickness of the well and barrier layers were 20 Å and 100Å, respectively. The number of the pairs was 10. The growth temperature and pressure were 1170°C and 50 mbar, respectively. Fig. 1. shows summarized schematic layer structure. The molar ratio of TEB in the vapor phase (TEB/III) is fixed 0.015 for BAlGaN epitaxy, where III (TEB+TMAl+TMGa) means the total number of moles of the group III sources. It was assumed that the solid composition of BAlGaN was nearly equal to the molar ratio in vapor phase in low boron composition. A 193 nm line from an ArF excimer laser was used as the excitation light source for the photoluminescence (PL) measurement.

Results and Discussion

The low temperature (15K) photoluminescence (PL) spectra from the BAlGaN/AlN MQW structure were shown in Fig. 2. The wavelength of PL spectra smaller than 250 nm was observed from BAlGaN/AlN MQW grown on 6H-SiC substrate for the first time. Shortest PL wavelength from the BAlGaN/AlN MQW was 235 nm in this time. The FWHM of PL peak near the 250 nm were summarized in Fig. 3 as a function of calculated residual strain for BAlGaN/AlN MQW. FWHM of PL was narrowed, as decrease the residual strain from 2.0% to 1%. And PL intensity was increased by decreasing the residual strain less than about 1.0%. This results indicate that the FWHM and intensity of PL peak of BAlGaN/AlN MQW structure strongly depends on residual strain. The control of the strain is effective in improving the optical quality of the BAlGaN layers.

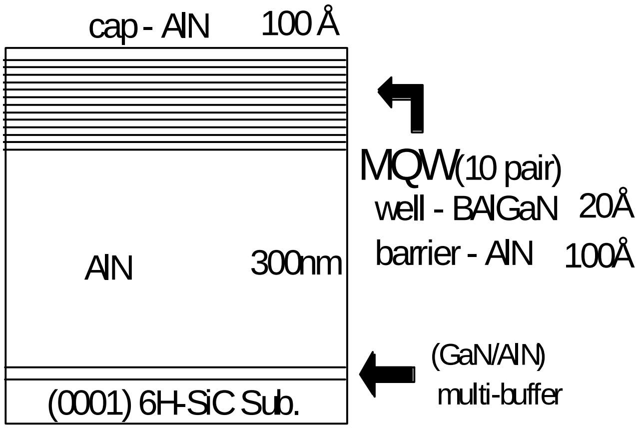

Fig. 1. Schematic layer structure.

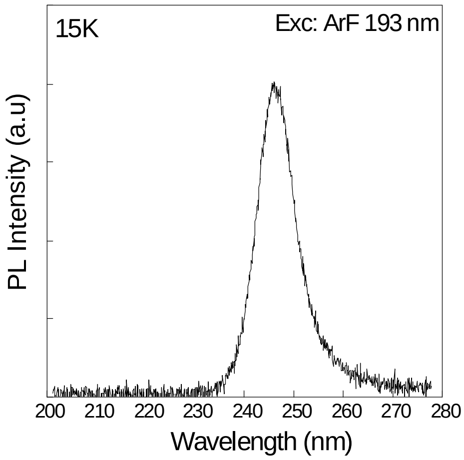

Fig. 2. The PL spectra of BAlGaN/AlN MQW structure.

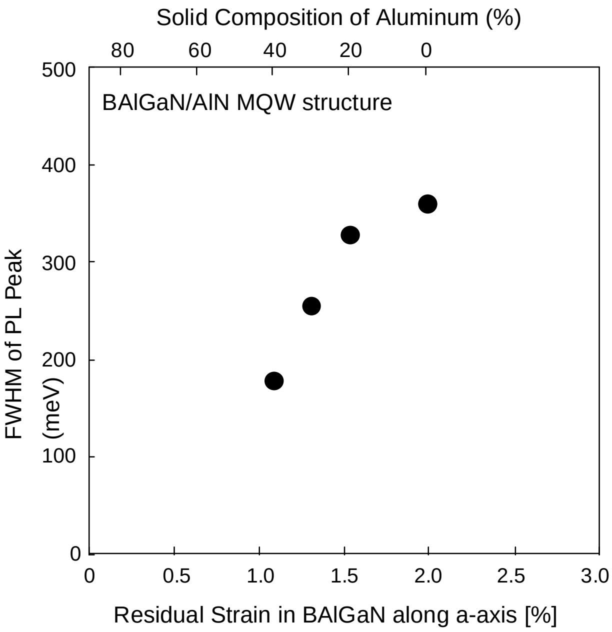

Fig. 3. The FWHMs of PL peak as a function of Residual strain along a-axis.