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Micro-Raman Investigation of Selective-area Growth of Cubic GaN on [110]-Stripe Patterned GaAs (001) Substrate by MOVPE

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In this work, the cubic GaN with AlGa_n interlayers was selectively grown on the [110]-stripe patterned GaAs (001) substrate by metal organic vapor phase epitaxy (MOVPE). Since the cubic phase of GaN is meta-stable and hexagonal phase always exist, the structural phase and features of the film were investigated by micro-Raman spectroscopy and scanning electron microscopy (SEM), respectively. From the cross-sectional SEM images, the morphology of the film was nearly-trapezoidal shape with the flat surfaces. The (118) facet of top surface and (111)B facet of side surface were responsible for the vertical growth and lateral overgrowth, respectively. As for the results from Raman spectra observed by various excitation wavelengths: 633nm, 532nm, and 473nm, the longitudinal-optical frequency (LO) of cubic GaN, as well as the E₂(high) of hexagonal GaN were detected in both vertical growth and lateral overgrowth. The integrated Raman intensities of LO including E₂(high) were considered and then the LO/E₂(high) ratio were calculated in order to qualitatively compare the amount of cubic to hexagonal phase of GaN. With the same tendency in vertical growth and lateral overgrowth, the ratio of LO/E₂(high) presented the progressively decrease with the laser wavelength decrease. This may be indicated that, as far from the substrate, the cubic phase tended to have less quality or be transformed to hexagonal phase. Besides, at lateral overgrowth, the phonon frequencies of LO peaks shifted to the lower wavenumber which may be due to the tensile stress occurred during the growth.

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