

High-Quality Pure Cubic GaN on Patterned GaAs (001) Substrates with [110]-Oriented Stripes by MOVPE

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It is known that the cubic GaN (c-GaN) structure using epitaxial lateral overgrowth (ELO) could be controlled by mask fill factor (ratio of the open width to the pattern period), mask direction, and growth temperature. Particularly, ELO GaN on the [110] oriented stripe-patterned GaAs (001) exhibits hexagonal phase structure. On the other hand, in this work, we have proposed the use of the [110] oriented mask stripe-patterned SiN_x/GaAs (001) with an optimized mask fill factor of 0.8 as a substrate for the metalorganic vapor phase epitaxy (MOVPE) growth of ELO c-GaN to realize a layer with high cubic-phase purity. Our results demonstrate that ELO c-GaN with high cubic-phase purity was successfully performed on the window stripes opening along the [110] direction at growth temperature 900 °C. Consequently, a trapezoidal shape with (001) top surface and (111)B sidewall facets, which is a characteristic of cubic structure, was clearly observed the c-GaN stripes. XRD measurements showed that the full-width at half-maximum of c-GaN (002) rocking curve was determined as the narrowest as 14.9 arcmin, indicating to a high crystalline quality of ELO c-GaN. The integrated volume amount of hexagonal phase inclusion, which was examined by XRD reciprocal space mapping, was decreased from 30.5% to 16.8% with increasing thicknesses from 1.4 μm to 12.0 μm, respectively. On the basis of our results, the hexagonal phase generation can be suppressed by controlling the growth feature, which is sensitive to mask fill factor and growth temperature.

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