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High-quality Ga-rich AlGaN grown on trapezoidal patterned GaN template using super-short period AlN/GaN superlattices for rapid coalescence

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Abstract

High quality crack-free Ga-rich $Al_{26.1}Ga_{73.9}N$ film was grown on trapezoidal patterned GaN template (TPGT) by low-pressure metalorganic chemical vapor deposition. The super-short period AlN/GaN superlattices structure was used to grow AlGaN material instead of the direct growth method. We obtained large lateral to vertical growth rate ratio larger than 4.79. The growth rate of GaN layer was proved to be the decisive factor of the lateral to vertical growth rate ratio. Moreover, for AlGaN growth, we found that that the TPGT is more beneficial to suppression of crack and relaxation of biaxial tensile strain than planar GaN template. The obtained results demonstrate that, comparing with AlGaN grown on planar GaN template, the threading dislocation density in AlGaN grown on TPGT was reduced from 2×10^{9} cm^{-2} to 2×10^{8} cm^{-2}.

Keywords: A1. Defect, A3. Selective epitaxy, A3. Metalorganic chemical vapor deposition, A3. Superlattices, B2. Semiconducting III-V materials.

I. Introduction

The deep-ultraviolet (DUV) range (radiation with wave-length from 200 nm to 350 nm) is one of the few relatively unexplored ranges of electromagnetic spectrum. New emerging DUV detectors, light-emitting diodes (LEDs) or laser devices (LDs) with different wavelengths are finding wildly application potential in sterilization, water and air purification, curing, medicine, biochemistry, and light sources for high-density optical recording [1-4]. AlGaN alloy are attracting considerable attention as ideal materials for realization of DUV LEDs or LDs, because