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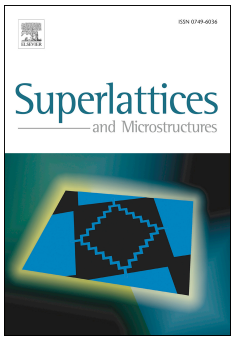

Influence of ammonia flow rate for improving properties of polycrystalline GaN

A. Ariff, M.A. Ahmad, Z. Hassan, N. Zainal

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Influence of ammonia flow rate for improving properties of polycrystalline GaN

A. Ariff, M. A. Ahmad, Z. Hassan, N. Zainal*

Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia, 11800 USM, Malaysia

Corresponding author: norzaini@usm.my

Abstract

Post-annealing treatment in ammonia ambient is widely accepted for GaN material, but less works have been done to investigate the influence of the ammonia (NH_3) flow rate for reducing the N-deficiency as well as improving the quality of the material. In this work, we investigated the influence of NH_3 flow rate at 1, 2, 3, and 4 slm in improving properties of a ~1 μm thick polycrystalline GaN layer. Our simulation work suggested that the uniformity of temperature and pressure gradient of the NH_3 gas did not lead to the reduction of N-deficiency of the polycrystalline GaN layer. Instead, it was found that the mitigation of the N-deficiency was strongly influenced by the fluid velocity of the NH_3 gas, which had passed over the layer. Either at lower or higher fluid velocity, the chance for the active N atoms to incorporate into the GaN lattice structure was low. Therefore, the N-deficiency on the polycrystalline GaN layer could not be minimized under these conditions. As measured by EDX, the N atoms incorporation was the most effective when the NH_3 flow rate at 3 slm, suggesting the flow rate significantly improved the N-deficiency of the polycrystalline GaN layer. Furthermore, it favored the formation of larger hexagonal faceted grains, with the smallest FWHM of XRD peaks from the GaN diffractions in $(10\bar{1}0)$, (0002) and $(10\bar{1}1)$ orientations, while allowing the polycrystalline GaN layer to show sharp and intense emissions peak of NBE in a PL spectrum.

Keywords: Polycrystalline GaN; ammonia annealing; ammonia flow rate; N-deficiency