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Study of Carbon Concentration in GaN Grown by Metalorganic Chemical Vapor Deposition

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Abstract
We investigated the C concentration in GaN as a function of the V/III ratio and growth rate for a p-n junction diode structure on a bulk GaN substrate by metalorganic chemical vapor deposition (MOCVD). The C concentration was independent of the growth rate for growth at atmospheric pressure. Moreover, the C concentration in GaN was 3.3×10^{15} cm^{-3} at a V/III ratio of 5000 with a growth rate of 2.3 μm/h and 4×10^{15} cm^{-3} at a V/III ratio of 3700 with a growth rate of 4.7 μm/h. Both of the major and minor carrier concentrations in the drift layers of a p-n junction structure were optimized at the reasonable growth rate in terms of the short growth time. The C impurity concentration was well controlled at a concentration on the order of 10^{15} cm^{-3}.

Keyword: A1. Impurities; A3. Metalorganic chemical vapor deposition; B1. Nitrides; B2. Semiconducting III-Vmaterials.

1. Introduction

A low power consumption for a power supply system is important for conserving energy to achieve a reduction in CO_2 emissions. GaN electron devices are very attractive owing to the physical properties of GaN, notably its large electron saturation velocity and high breakdown voltage. To date, horizontal AlGaN/GaN electron device architectures on Si substrates have been extensively studied owing to the low cost of large-diameter Si substrates. However, the study of vertical GaN power devices has recently attracted attention for high-power devices because the price of GaN substrates is decreasing [1-3]. For this application, a slightly Si-doped GaN layer that is tens of micrometers thick is required to achieve a high breakdown voltage; furthermore, the carrier concentration must be suppressed to 10^{16} cm^{-3} in order