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Bhanu B. Upadhyay, Kuldeep Takhar, Jaya Jha, Swaroop Ganguly, Dipankar Saha

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Bhanu B. Upadhyay, Kuldeep Takhar, Jaya Jha, Swaroop Ganguly, and
Dipankar Saha

*Department of Electrical Engineering, Indian Institute of Technology Bombay, Powai,
Mumbai - 400076, India.
Email: dipankarsaha@iitb.ac.in*

Abstract

We demonstrate that N₂ and O₂ plasma treatment followed by rapid thermal annealing leads to surface stoichiometry modification in a AlGaIn/GaN high electron mobility transistor. Both the source/drain access and gate regions respond positively improving the transistor characteristics albeit to different extents. Characterizations indicate that the surface show the characteristics of that of a higher band-gap material like Al_xO_y and Ga_xO_y along with N-vacancy in the sub-surface region. The N-vacancy leads to an increased two-dimensional electron gas density. The formation of oxides lead to a reduced gate leakage current and surface passivation. The DC characteristics show increased transconductance, saturation drain current, ON/OFF current ratio, sub-threshold swing and lower ON resistance by a factor of 2.9, 2.0, 10^{3.3}, 2.3, and 2.1, respectively. The RF characteristics show an increase in unity current gain frequency by a factor of 1.7 for a 500 nm channel length device.

Keywords: RF, HEMT, Plasma treatment, AlGaIn/GaN

1. Introduction

GaN based high electron mobility transistors (HEMTs) are being actively pursued for various high frequency and power applications [1, 2, 3, 4]. Various methods have been employed to improve the device performance including

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