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Abstract

We demonstrate that N_2 and O_2 plasma treatment followed by rapid thermal annealing leads to surface stoichiometry modification in a AlGaN/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, AlGaN/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