World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:18, No:10, 2024

Double Gaussian Distribution of Nonhomogeneous Barrier Height in Metal/n-type GaN Schottky Contacts

Authors : M. Mamor

Abstract : GaN-based compounds have attracted much interest in the fabrication of high-power, high speed and high-frequency electronic devices. Other examples of GaN-based applications are blue and ultraviolet (UV) light-emitting diodes (LEDs). All these devices require high-quality ohmic and Schottky contacts. Gaining an understanding of the electrical characteristics of metal/GaN contacts is of fundamental and technological importance for developing GaN-based devices. In this work, the barrier characteristics of Pt and Pd Schottky contacts on n-type GaN were studied using temperature-dependent forward current-voltage (I-V) measurements over a wide temperature range 80–400 K. Our results show that the barrier height and ideality factor, extracted from the forward I-V characteristics based on thermionic emission (TE) model, exhibit an abnormal dependence with temperature; i.e., by increasing temperature, the barrier height increases whereas the ideality factor decreases. This abnormal behavior has been explained based on the TE model by considering the presence of double Gaussian distribution (GD) of nonhomogeneous barrier height at the metal/GaN interface. However, in the high-temperature range (160-400 K), the extracted value for the effective Richardson constant A* based on the barrier inhomogeneity (BHi) model is found in fair agreement with the theoretically predicted value of about 26.9 A.cm-2 K-2 for n-type GaN. This result indicates that in this temperature range, the conduction current transport is dominated by the thermionic emission mode. On the other hand, in the lower temperature range (80-160 K), the corresponding effective Richardson constant value according to the BHi model is lower than the theoretical value, suggesting the presence of other current transport, such as tunneling-assisted mode at lower temperatures.

Keywords : Schottky diodes, inhomogeneous barrier height, GaN semiconductors, Schottky barrier heights
Conference Title : ICCSE 2024 : International Conference on Compound Semiconductor Electronics
Conference Location : Tokyo, Japan
Conference Dates : October 03-04, 2024