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Numerical simulations of the electrical transport characteristics of a Pt/n-GaN Schottky diode

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Abstract: In this paper, using a numerical simulator, we investigated the current-voltage characteristics of a Pt/n-GaN thin Schottky diode on the basis of the thermionic emission (TE) theory in the 300 to 500 K temperature range. During the simulations, the effect of different defect states within the n-GaN bulk with different densities and spatial locations is considered. The results show that the diode ideality factor and the threshold voltage decrease with increasing temperature, while at the same time, the zero-bias Schottky barrier height (?b0) extracted from the forward current density-voltage (J-V) characteristics increases. The observed behaviors of the ideality factor and zero-bias barrier height are analyzed on the basis of spatial barrier height inhomogeneities at the Pt/GaN interface by assuming a Gaussian distribution (GD). The plot of apparent barrier height (?b,App) as a function of q/2kT gives a straight line, where the mean zero-bias barrier height ( ) and the standard deviation (?0) are 1.48 eV and 0.047 V, respectively. The plot of the modified activation energy against q/kT gives an almost the same value of and an effective Richardson constant A* of 28.22 Acm-2K-2, which is very close to the theoretical value for n-type GaN/Pt contacts. As expected, the presence of defect states with different trap energy levels has a noticeable impact on the device electrical characteristics.

Keywords : Gallium nitride, Schottky barrier, diode, Temperature