

Double Negative Differential Resistance Features in GaN-Based Bipolar Resonance Tunneling Diodes

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Abstract : Here, we report the study of the performance of AlN/GaN bipolar resonance tunneling diodes (BRTDs) using numerical simulations. The I-V characteristics of BRTDs show double negative differential resistance regions, which exhibit similar peak current density and peak-to-valley current ratio (PVCR). Investigations show that the PVCR can approach 4.6 for the first and 5.75 for the second negative resistance region. The appearance of the two negative differential resistance regions is realized by changing the collector material of conventional GaN RTD to P-doped GaN. As the bias increases, holes in the P-region and electrons in the N-region undergo resonant tunneling, respectively, resulting in two negative resistance regions. The appearance of two negative resistance regions benefits from the high AlN barrier and the precise regulation of the potential well thickness. This result shows the promise of GaN BRTDs in the development of multi-valued logic circuits.

Keywords : GaN bipolar resonant tunneling diode, double negative differential resistance regions, peak to valley current ratio, multi-valued logic

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