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Comparative Study of Single and Double Barrier GaAs Based Resonant Tunneling Diodes Considering NEGF

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***Abstract*—Growth of pepped up determining demand of final consumers always forces devices and circuits to increase power and speed., only resonant tunneling diode can solve this problem and can be able to take a vital role in many nanoscale applications. This research paper demonstrates the simulations of the Resonant Tunneling Diode (RTD) by using Hartree Model for the single barrier (1B) and the double barrier (2B) Resonant Tunneling Diodes by the using of NEMO5 considering NEGF. In addition, switching applications also require Large Peak to Valley Voltage Ratio (PVVR) to reduce energy loss. In this article, it is been clearly explained that compared to the Thomas Fermi Model, Hartree Model improves the Peak to Voltage Valley Ratio (PVVR) by 21.21%. The results that are found with the Double Barrier RTD showed much better performance than the Single Barrier RTD. Furthermore, the I-V characteristic verified the notable improvement for Hartree model.**

***Index Terms*—Resonant Tunneling Diodes, Hartree model NEGF, Lorentzian approximation NEMO5, PDR1, PDR2, NDR, Quantum Sheet Charge Density, Resonance Energy.**

I. Introduction

Difficulties for continual Complementary Metal Oxide Semi-Conductors have brought about explorations to substitute constructions for the capable, high speed operated and less powered upcoming logic devices. Resonant Tunneling Diode is an example of the evident gadget, which impressed an intense profit for possessing THz capabilities, negative differential resistance region and low voltage operation. The principle of quantum mechanical tunneling of electrons is operated by RTD into states of quantized well via a potential barrier in the transmission features that results in resonance. Transportation of simulation models are needed to describe RTD characteristics because the quantum mechanical nature of the tunneling process. This research paper used software where non-equilibrium green function formalism was present with use of approached effective mass and used to study Gallium Arsenide/Gallium Aluminum Arsenide RTD features. Scattering in the emitter region has been treated to ease computational burden in an approximate manner.

To represent a RTD, three equivalent proposals are worked out which include non-equilibrium Green function scheme, Schrodinger equation method and Winger equation [1]. Electrons are supposed on condition of composition where information are obtained by the chemical potential of the entrance regions. With the support of the open boundary conditions, all the states are found. At the hartree level, the interaction of electrostatic force is taken into account. In a less particular way with thomas fermi approximation, the coherent property is promoted.[1].

A very strongly creative and calculative model is provided by the no-equilibrium Green Function formalism for the use of quantum transport in high tech [2] [3-9]. To add the inflexible scattering and powerful effects of correlation at an atomics level, it excels the Landauer proposition for choleric, non-interacting electronics.

Double barrier RTD structures recently can be analyzed by Transfer Matrix Method (TMM)[10]. The numerous applications of RTD can be applied in both digital and analog circuits[11].

A huge diversity of uses in communication and electronic fields are demonstrated by the diodes of nano-scale size, for example, inert optics, and different sensor applications[13]. For reaching the highest frequency of 2.2THz in contast with the traditional Complementary Metal Oxide Semiconductors (CMOS) and Transistors which have 215 GHz. Nano

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