Enhancement and Modeling of Drain Current in Negative Capacitance Double Gate TFET

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Research Article

Keywords: Negative capacitance, Tunnel Field Effect, Transistors, Drain current modeling, Double Gate structure, Heterojunction, Tangent line approximation

Posted Date: March 11th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-271741/v1>

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Abstract

The drain current improvement in a Negative Capacitance Double Gate Tunnel Field Effect Transistor (NC-DG TFET) with the help of Heterojunction (HJ) at the source-channel region is proposed and modeled in this paper. The gate oxide of the proposed TFET is a stacked configuration of high-k over low-k to improve the gate control without any lattice mismatches. Tangent Line Approximation (TLA) method is used here to model the drain current accurately. The model is validated by incorporating two dimensional simulation of DG-HJ TFET with one dimensional Landau-Khalatnikov (LK) equation. The model matches excellently with the device simulation results. The impact of stacked gate oxide topology is also studied in this paper by comparing the characteristics with unstacked gate oxide. Voltage amplification factor (A_v), which is an important parameter in NC devices is also analyzed.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and [accessed as a PDF](#).

Figures

Figure 1

Band diagram of NC homojunction and heterojunction DG TFET

Figure 2

Cross sectional view of NC-DG-HJ TFET

Figure 3

Tunneling generation rate along the channel depicting TLA method [8]

Figure 4

Transfer characteristics in linear scale for hetero- junction TFET, homojunction NC-DG TFET, heterojunction NC-DG-TFET and heterojunction NC-DG TFET with dielectric stacking(proposed) at $V_{DS}=1\text{V}$

Figure 5

Transfer characteristics in logarithmic scale for heterojunction TFET, homojunction NC-DG TFET, heterojunction NC-DG-TFET and heterojunction NC-DG TFET with dielectric stacking (proposed) at $V_{DS}=1V$

Figure 6

Surface potential distribution for NC-DG-HJ TFET for $V_{DS}=1V$ and varying V_G

Figure 7

Electric eld distribution of Proposed NC TFET for VDS=VG=1V

Figure 8

Comparison of simulation results of transfer characteristics in linear scale for Proposed NC TFET and NC TFET without gate stacking with respective models based on TLA and Shortest Tunneling Length method at $V_{DS}=1\text{V}$

Figure 9

Comparison of simulation results of transfer characteristics in logarithmic scale for Proposed NC TFET and NC TFET without gate stacking with respective models based on TLA and Shortest Tunneling Length method at $V_{DS}=1V$

Figure 10

Comparison of simulation results of output characteristics of Proposed NC TFET and NC TFET without gate stacking with respective models based on TLA and Shortest Tunneling Length method at $V_G=1.2V$

Figure 11

Plot of V_{FE} versus V_G for $V_{DS}=1V$

Figure 12

Effect of FE thickness on A_v for the proposed NC- DG-HJ TFET