Analytical Drain Current Modeling and Simulation of Triple Material Gate-All-Around Heterojunction TFETs Considering Depletion Regions

© *C. Usha, P. Vimala*

Department of Electronics and Communication, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India

E-mail: usha.chintu.dec14@gmail.com

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This paper deals with electrostatic behavior of triple-material gate-all-around hetero-junction tunneling field-effect transistors (TMGAA-HJTFET) device. The model is advantageous in apprehending a comparative study with the single-material gate-all-around hetero-junction tunneling field-effect transistors (SMGAA-HJTFET) in terms of surface potential, electric field, drain current, transconductance, and threshold voltage. The surface-potential distribution in partition regions along the channel is solved by using two-dimensional Poisson's equation. By using the drift and diffusion current, drain current is derived, and I_{On}/I_{Off} ratio of 10^{11} is gained from analytical modeling and TCAD simulation. Transconductance and threshold voltage are derived from the tunneling current. The proposed model results are validated by the ATLAS TCAD simulation tool.

Keywords: drain current, surface potential, electric field, TFETs, TCAD simulation.

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