



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم



HANAA ALY



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شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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جامعة عين شمس

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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Electronics Engineering and Electrical Communications

Modelling and Simulation of Tunnel Field Effect Transistor (TFET)

A Thesis submitted in partial fulfilment of the requirements of the
degree of

Master of Science in Electrical Engineering
(Electronics Engineering and Electrical Communications)

by

Yasmin Yahia Ebrahim Morgan

Bachelor of Science in Electrical Engineering
(Electronics Engineering and Electrical Communications)

Faculty of Engineering, Modern Academy for Engineering and
Technology, 2008

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Cairo - (2021)



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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

Scaling down conventional MOSFETs has a vital challenge in electronic circuit design. The scaling of MOSFET depends not only on the device dimension and gate oxide thickness but also on the applied voltage. Unfortunately, down scaling has a negative effect on increasing the power consumption and other issues.

Several studies demonstrated to solve the MOSFETs problems but most of them are rendered impractical. Following the International Technology Roadmap for Semiconductors (ITRS), there is a vital need to reduce the device size. So, this led to Steep Slope devices like TFET devices to come into play as a problem-solving device.

TFET is promising device with low power consumption, low subthreshold swing, low applied voltage and low OFF current due to its band-to-band tunnelling mechanism. However, it has a low ON current and suffers from ambipolar effects. Several studies have been developed to increase the ON current and to reduce the ambipolar effect. These studies are based on either changing the structure of the device or changing the materials used in manufacturing, spacers, or gate dielectric.

In this work, Si-based DG (double gate) TFET devices are extensively studied by analytical calculations and simulations. Analytical calculations use MATLAB environment on the Si-DG TFET. It uses semi-analytical model considering depletion regions at both source/channel and drain/channel junctions. It also uses the SILVACO TCAD simulator in modelling. Here it is used to model a Tapered shape TFET, to study its impact on the ambipolar effect and ON current and ON/OFF current ratio.

Key words: DG-TFET, BTBT, ON Current, SS, ambipolar

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Table of Contents

Contents	i
List of Figures.....	iii
List of Tables	vii
List of Abbreviations	viii
List of Symbols	x
Chapter One: Literature Review	
1.1 Introduction	19
1.2 MOSFET Limitations.....	20
1.3 TFET Structure and Operation.....	22
1.3.1 TFET Structure	22
1.3.2 TFET theory of operation	23
1.4 TFET Characteristic Parameters	24
1.4.1 Sub threshold Swing (SS).....	24
1.4.2 Short Channel Effects	25
1.4.3 Transconductance.....	26
1.4.4 Leakage current:.....	26
1.5 TFET's advantages:.....	27
1.6 TFETs Limitations:	27
1.6.1 Ambipolar effect	28
1.6.2 Miller Capacitance	28
1.6.3 ON-Current.....	29
1.7 TFET with new materials:.....	30
Chapter Two: Device Simulation	
2.1 Silvaco simulator:.....	39
2.1.1 ATLAS Inputs and Outputs:	40
2.1.2 Modes of operation.....	41

2.1.3	The Atlas Command order:	41
2.2	Si-DG TFET Simulation:	42
2.3	Potential and Electric Field in DG-TFET:	48
2.4	The ON-OFF Current in DG-TFET:	50
Chapter Three: Design of Tapered-Shape TFET Structure		
3.1	Tapered-shape TFET design:	56
3.2	Simulation methodology and device structure parameters: 57	
3.3	Results and discussions:	59
Chapter Four: Analytical Modelling of TFET		
4.1	Analytical Model Derivation:.....	66
4.1.1	Drain Current Modeling:.....	72
4.1.2	Capacitance Modeling:.....	74
4.2	Model Evaluation and Simulation Results:.....	75
4.2.1	Potential and Electric Field:	76
4.2.2	Minimum tunneling width:	78
4.2.3	Drain current:	79
4.2.4	Capacitance:	81
4.2.5	Cutoff frequency:	82
4.2.6	Validity of depletion approximation:	83
Chapter Five: Conclusions and Future Works		
	Conclusions:.....	85
	Future Work:	86
	References	87

List of Figures

Figure 1.1 The transistor size scaling trend according to ITRS [48]	19
Figure 1.2 The scaling feature and gate length according to 2013 Semiconductor Roadmap [47].	20
Figure 1.3 Si-DG TFET.	23
Figure 1.4 The TEFT operation shows the ON- OFF state and the BTBT mechanism.	24
Figure 1.5 The average swing Vs. the point swing.....	25
Figure 1.6 The Transfer characteristics of Si-TFET.....	27
Figure 1.7 Miller Capacitance in inverter schematic diagram....	29
Figure 1.8 The capacitance voltage characteristics C_{gg} , C_{gs} and C_{gd} in Si-TFET and Si MOSFET [4].	29
Figure 1.9 (a) Si-Ge graded heterojunction structure, (b) the I_D - V_{G_s} transfer characteristics of Si-Ge [8].	32
Figure 1.10 InAs and GeSb with (a) uniform body thickness and Non-uniform body thickness, (b) the I_D - V_{G_s} transfer characteristics [7].	33
Figure 1.11 (a) The use of Ge-Si in three-dimensional TFET (GAA), (b) the I_D - V_{G_s} transfer characteristics of GAA TFET [16].	34

Figure 1.12 (a) DG TFET with different dielectric materials, (b) DG nMOSFET with different dielectric materials [2].	35
Figure 1.13 (a) the use of dielectric material as spacer, (b) I_D - V_{GS} transfer characteristics [17].	36
Figure 1.14 Switching and RF characteristics performance (a) intrinsic delay time, (b) cut off frequency [17].	37
Figure 2.1 Atlas inputs and outputs.	40
Figure 2.2 Si-DG TFET regions and Electrodes.....	42
Figure 2.3 Si-DG TFET Meshing	43
Figure 2.4 Meshing Boundaries.	44
Figure 2.5 The Doping profile of Si-DG TFET.....	45
Figure 2.6 The I_D - V_{GS} Transfer characteristics of Si-DG TFET.	48
Figure 2.7 The The Si-TFET (a) Energy band diagram (b) Electric Field at certain V_{GS}	49
Figure 2.8 The Potential of Si-TFET.	50
Figure 2.9 The TFET ON-current and the Ambipolar effect.....	51
Figure 2.10 TFET transfer characteristics using high K (HfO_2).	51

Figure 2.11 The effect of Different Doping in Source, Channel and Drain Regions on the TFET characteristics.	52
Figure 2.12 Asymmetric gate oxide with different Work function [20].	53
Figure 2.13 The changing in OFF current through the use of H_{NAR} [20].	53
Figure 2.14 Asymmetric gate dielectric and body thickness [21].	54
Figure 3.1 The device structure using Devedit tool.	56
Figure 3.2 The Meshing Profile in the device structure.	57
Figure 3.3 Basic TFET tapered-channel structure (dimensions are in μm).	58
Figure 3.4 A comparison of IV characteristics of Conventional and Tapered TFET for (a) $T_d = 6 \text{ nm}$ and (b) $T_d = 8 \text{ nm}$	60
Figure 3.5 Impact of L_{chu} on the (a) $I_{\text{ON}}/I_{\text{OFF}}$ ratio, and (b) ambipolar current, I_{amb} , for $T_d = 6 \text{ nm}$ and $T_d = 8 \text{ nm}$	61
Figure 3.6 A comparison of $T_d = 6 \text{ nm}$ and $T_d = 8 \text{ nm}$ for (a) subthreshold swing (b) threshold voltage.	62
Figure 3.7 Electric field when $V_{\text{DS}} = 1 \text{ V}$ and $V_{\text{GS}} = -1 \text{ V}$ for conventional and tapered-channel TFET structures.	63
Figure 4.1 Device structure showing different regions.	67
Figure 4.2 Surface potential for a variation of the gate voltage from 0 to 1 V at $V_D = 1 \text{ V}$	76