

ENHANCING SUBMICRON CMOS DEVICE PERFORMANCE



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TABLE OF CONTENTS

	Page
TABLE OF CONTENTS	ii
LIST OF FIGURES	v
LIST OF TABLES	vii
SYMBOLS AND ABBREVIATIONS	viii
ABSTRACT	xi
CHAPTER 1 INTRODUCTION	
1.1 Background	1
1.2 Research Objectives	2
1.3 Structure of Thesis	3
CHAPTER 2 LITERATURE REVIEW	
2.1 Introduction to Complementary-Metal-Oxide Semiconductor (CMOS) Technology	5
2.1.1 Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) Fundamental	6
2.1.2 Complementary Metal-Oxide-Semiconductor (CMOS) Fundamental	7
2.2 Basic characteristic of MOS transistor (MOSFET)	8
2.2.1 Operation of MOSFET	8
2.2.2 Linear and Saturation Region	9
2.2.3 Current-Voltage Characteristic of MOSFET	11
2.2.4 Threshold Voltage V_T	15
2.3 MOSFET Scaling	16
2.3.1 Constant-Field Scaling (Full Scaling)	17
2.3.2 Constant-Voltage Scaling	18
2.3.3 Non-Scalable Device Parameters	20
2.4 MOSFET Scaling Limiting Factors	23

2.4.1 Short Channel Effect	23
2.4.2 Drain-Induce Barrier Lowering (DIBL)	26
2.4.3 Bulk Punch-trough	26
2.4.4 Hot Electron Effect	27
2.4.5 Gate Oxide Tunneling	28
2.5 Submicron CMOS Design	29
2.5.1 Double $\bar{\text{d}}$ -diffused Drain (DDD)	29
2.5.2 Lightly-doped Drain (LDD)	30
2.5.3 Control of Threshold Voltage, V_T	31
2.5.4 Capacitance Effects and Self Alignment	33
2.5.5 Silicides	33
2.5.6 Shallow Trench Isolation (STI)	34
2.6 CMOS process flow using STI isolation technique.	37
2.7 Stress induced by Shallow Trench Isolation (STI)	55
CHAPTER 3 0.13μm CMOS TRANSISTOR DESIGN	
3.1 Introduction	57
3.2 0.13 μm CMOS Scaling	57
3.3 0.13 μm nMOS Fabrication Process	58
3.4 0.13 μm pMOS Fabrication Process	62
CHAPTER 4 0.13μm CMOS TRANSISTOR SIMULATION	
4.1 Virtual Wafer Fabrication (VWF) Simulator	66
4.1.1 Introduction	66
4.1.2 ATHENA Simulator	67
4.1.3 ATHENA Models	67
4.1.4 ATLAS Simulator	68
4.1.5 DECKBUILD Simulator	68
4.1.6 TONYPLOT Simulator	69
4.2 VWF Simulation Code for 0.13 μm nMOS Transistor	69
4.3 VWF Simulation Code for 0.13 μm pMOS Transistor	93

CHAPTER 5 RESULTS AND DISCUSSION	
5.1 Introduction	95
5.2 0.13 μ m nMOS Transistor Simulation Results	95
5.3 0.13 μ m pMOS Transistor Simulation Results	105
5.4 Results Discussions	111
5.4.1 Threshold Voltage, V_T	112
5.4.2 Gate Oxide Thickness, t_{ox}	113
5.4.3 Polysilicon Gate Length, L	113
5.4.4 I-V Characteristic	114
5.4.5 0.13 μ m nMOS and 0.13 μ m pMOS Structure	114
5.4.6 Stress analysis on STI	115
CHAPTER 6 CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH WORK	
6.1 Conclusions	119
6.2 Suggestions for Further Research Work	120
REFERENCES	122
APPENDIX	126
APPENDIX A 0.13 μ m nMOS Transistor Simulation Recipe	
APPENDIX B 0.13 μ m pMOS Transistor Simulation Recipe	

ABSTRACT

Semiconductor revolution has been possible with the downsizing or scaling the size of semiconductor devices such as Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET). Scaling of MOSFET becomes very important in Ultra Large-Scale Integration (ULSI) for high integration and high speed operation. In this dissertation, a study has been done for development of 0.13 μm CMOS technology. The device design, fabrication process and characterization have been discussed. By using the scaling rules, a Complementary Metal Oxide Semiconductor (CMOS) transistor with channel size of 0.13 μm has been scaled down from a CMOS transistor with channel size of 0.18 μm that had been designed and fabricated before. In order to achieve the desire electrical characteristic of 0.13 μm CMOS transistor, several parameters have to be scaled such as channel gate length, gate oxide thickness, ion implantation for threshold voltage adjustment and other related specifications. Scaling limiting factors such as short channel effect and hot electron effect have been given much consideration by implementing lightly doped drain (LDD) structure and shallow junction of drain/source. Shallow Trench Isolation (STI) has been proposed for the isolation technique to eliminate the oxidation encroachment or bird's beak by Local Oxidation of Silicon (LOCOS). Silicide using cobalt silicide has been implemented to reduce the sheet resistance and the double metal gate for better performance. The stress analysis between the STI and LOCOS isolation technique has been done and LOCOS structure introduce more stress if compare to the STI structure.

Fabrication and simulation of the CMOS transistor is done by using Virtual Wafer Fabrication (VWF) Silvaco TCAD Tools. NMOS and PMOS were simulated individually to simplify the fabrication process and shorten the simulation time. From the simulation results, the threshold voltage for nMOS and pMOS are 0.359863V and -0.335567V respectively. As to define the functionality of 0.13 μ m CMOS transistor, the relation of $I_d - V_d$ and $I_d - V_g$ are presented.