THE SIMULATION OF THE STRAINED Si ON RELAXED $Si_{0.7}Ge_{0.3}$ N-MOS

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MOHD NURUL FAIZAL BIN JUSOH
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR, MALAYSIA.

DECLARATION

It is hereby declared that all materials in this project report are the result of my own work and all the materials that are not the result of my own work, have been clearly acknowledged in this project report.

ABSTRACT

This project report describes about the design of the strained Si on relaxed $Si_{0.7}Ge_{0.3}$ N-MOS semiconductor and to compare the electrical characteristics with the conventional Si N-MOS using a device simulator SILVACO. In the first part, the simulation of basic fabrication processes to create the material of conventional Si NMOS devices are be developed. In the second part, the material of the $Si_{0.7}Ge_{0.3}$ N-MOS will be developed and interfaced with Si. In this part, simulations of the electrical characteristics are done and compared it with the process in the first part. From the electrical characteristics, the results will prove that the $Si_{0.7}Ge_{0.3}$ N-MOS gives better performance compared to the conventional Si N-MOS.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

The metal-oxide-semiconductor field effect transistor (MOSFETS) became a practical reality in the 1970. The MOSFETS compared to BJT can be made very small (that is, it occupies a very small area on an IC chip). Since digital circuits can be designed using only MOSFETS, with essentially no resistors or diodes required, high-density VLSI circuits, including microprocessors and memories can be fabricated.

In the MOSFETS, the current is controlled by an electric field applied perpendicular to both the semiconductor surface and to the direction of current. The phenomenon used to modulate the conductance of semiconductor, or control the current in a semiconductor by applying an electric field perpendicular to the surface is called field effect [2].

SiGe is an alloy of two materials from group IV which are silicon and germanium. There have been suggestions to use complementary heterostructure field-effect transistor based on GaAs/AlGaAs in order to make use of the high electron mobility in this material system. However, the problem of the low mobility which plagues Si not solved. In addition the technology relied on making schottky gates, which result in several orders of magnitude higher gate leakage current than in oxide-gated devices. Unlike the other group III-IV element such as GaAs, SiGe is compatible with silicon process.

Nowadays, the Si MOSFETS is designed to down scaling to get high performance such as, to get high speed operations, low power consumptions and others. But many problems occur from this design. The problems are leakage current and oxidation. But if we develop SiGe MOSFETS, we do not need to scale down to obtain the same performance as in the down scaled Si MOSFETS.