THE EFFECT OF P-TYPE DOPING OF POLYSILICON FOR PMOS APPLICATIONS

Thesis presented in partial fulfillment for the award of the

Bachelor of Electrical Engineering (Hons)

UNIVERSITI TEKNOLOGI MARA

NUR SHAZWANY BINTI ZAMANI
2006687466
Faculty of Electrical Engineering
UNIVERSITI TEKNOLOGI MARA
40450 Shah Alam, Malaysia

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ABSTRACT

This project presents the effect of p-type doping of polysilicon for BF_2^+, boron, gallium and indium at various doping concentration from 10^{11} to 10^{20} (atoms/cm^3) for PMOS device using SILVACO TCAD (*Technology Computer Aided Design*) software. It is seen that the effect of p-type doping at certain level of dose significantly effects the performance of the PMOS device. The threshold voltage of polysilicon obtain from I_D-V_{GS} curve was analyzed. The results show that BF_2^+ at dose 10^{14} to 10^{19} (atoms/cm^3) and gallium at dose 10^{13} to 10^{20} (atoms/cm^3), both are giving the better characteristics of the PMOS and give almost the same threshold voltage at 1.0V to 1.3V, but the most effective for both doping are concentration at dose 10^{14} (atoms/cm^3). The resistivity of the polysilicon is gradually decreased as a concentration of doping increase, while the conductivity is reciprocal of the resistivity. Furthermore, the smaller leakage current is wanted to achieve a better device, where the BF_2^+ and gallium doping has result less leakage current.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This project uses the SILVACO (Athena-Atlas) TCAD software as a primary fabrication process and device simulation tool. The first part of this project will discuss briefly about the polysilicon issues and history of PMOS device in the project background. The problem statement, objective, scope of project and thesis organization are also mentioned in this chapter.

1.2 PROJECT BACKGROUND

Deposited films (deposited layers) are widely used in the fabrication of modern VLSI circuits. These films provide conducting regions within the device, electrical insulation between metals, and protection from the environment. Deposited films must meet many requirements. The film thickness must be uniform and reproducible over each device and over all the wafers processed at one time. The structure and composition of the film must be controlled and reproducible. Finally, the method for depositing the film must be safe, reproducible, easily automated and inexpensive [3].

The most widely used materials for film deposition are polysilicon. Polysilicon in recent years has gained importance due to its wide spread applications in solar cell devices, thin film transistors, and gate electrodes. The development of polysilicon technology was driven by the use of polysilicon as a gate electrode or as an intermediate conductor in two-level structures for integrated circuits. However, once it was developed, polysilicon technology has found use in an increasing number of applications, and one of it is use for PMOS device. In PMOS device, for use as a conductor, the polysilicon gate or simply poly gate must be doped to render it conductive and this is done with either diffusion or ion implantation [2].