A STUDY OF DEVICE PERFORMANCE ON THE EFFECTS OF INTEGRATING PHOTODIODE ONTO CMOS TECHNOLOGY

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ABSTRACT

The execution of this project is to investigate the effects on device performances of integrating photodiode onto a 0.5μm and 0.35μm CMOS technology. The desired device performances that are desired to be observed are threshold voltage, saturation current and breakdown voltage. The methodology was carried out using a device modeling; SILVACO TCAD tools where the substrate layers and graphical results are observable. Factor that holds the reins of optimizing the threshold voltage is investigated. The device performances and electrical properties are observed and analyzed. As the investigation was undertaken, it can be bring to a close that the integration of photodiode onto a CMOS technology results in a decline manner for the threshold voltage and saturation current. Nevertheless, this negative effect may be resolved by optimizing the threshold voltage. On the contrary, the existence of photodiode results in a constructive manner for the breakdown voltage of NMOS technology.

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CHAPTER 1

INTRODUCTION

This research was executed as an attempt to observe the effect on device performance of integrating photodiode onto a CMOS technology. Photodiode is one of the detectors to sense light or movement that are commonly used beside laser and infra-red. The concept of performing this research emerge for the reason that in order to utilize a photodiode for switching purposes, the photodiode must be wired with a transistor to function. This is a norm whenever photodiode wishes to be used. The wiring of photodiode usually shall experience some current leakage as the current flow through the wires must endure the length and limitations of the wire. Not only that, space consumption becomes a fuss as a good PCB board should be small yet manage to comprise all the required components to function well. These two constraints are the most common bother on every occasion of using a photodiode.

For these reasons, the insertion of photodiode onto a CMOS intends to observe whether this integration may curb these constraints. With an audacity of hope, this research shall tackle only three device parameters which are the threshold voltage, saturation current and breakdown voltage. Each parameter has a point to voice out. Nonetheless, observing the threshold voltage is the main concern through out the study. This is so because threshold voltage decides the state of the transistor either it is on or off.

The study on this integration was carried out using SILVACO TCAD tools; a simulation tool that enables an observation of the CMOS substrates and layers. As a step to observe the effects, two device characteristics were set as constants; the gate oxide thickness and the critical dimension. As for that, the factors that hold the reigns in altering the threshold voltage shall be observed. Optimization was performed at the very end to determine the required doping concentration as a step to un-shift the threshold voltage regardless the existence of photodiode.