UNIVERSITI TEKNOLOGI MARA
CAWANGAN PULAU PINANG

SURFACE PASSIVATION AND THERMALLY TREATED POROUS SILICON FOR SCHOTTKY PHOTODETECTOR APPLICATION

NURUL ASHIQIN BINTI MOHD NAZIR

BACHELOR OF ENGINEERING (HONS)
ELECTRICAL AND ELECTRONIC ENGINEERING

February 2025

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Nurul Ashiqin Binti Mohd Nazir
Student I.D. No.	:	202153
Programme	:	Bachelor Of Engineering (Hons.) Electrical and Electronic Engineering (CEEE200)
Faculty	:	Electrical Engineering Studies
Thesis	:	Surface Passivation and Thermally Treated Porous Silicon for Schottky Photodetector Application
Signature of Student	:	....
Date	:	February 2025

ABSTRACT

This study addresses the natural limitations of porous silicon (Psi), including instability, oxidation, degradation, and fragility, which limit its use in advanced optoelectronic devices such as Schottky photodetectors. These issues have been caused by Psi's extremely sensitive surface and structural defects, which result in poor reliability and performance. This study aims to enhance the stability and optoelectronic characteristics of Psi by surface passivation with SiO_2 and thermal treatment with 450°C methods. SILVACO TCAD simulations were used to produce and characterize Psi in various kinds of conditions, including untreated, passivated, and thermally treated structures. The key parameters examined are dark current (I_D), photocurrent (I_P), Schottky barrier height (SBH), current gain, and spectral response. The results indicated that treated passivated Psi structure (PSSO4) excelled over all other structures. It obtained an SBH of 0.9503 eV, a significantly reduced dark current of 2.59×10^{-10} A at 5 V, and a peak spectral response at 500 nm, which relates to an energy gap of 2.48 eV. These enhancements are due to the combined effect of passivation and thermal treatment, which successfully reduced surface defects, stabilised the porous structure, and improved charge carrier movement. The study shows that surface passivation and thermal treatment are useful ways to reduce Psi's limitations, making it a suitable candidate for next-generation optoelectronic applications. These findings help encourage the development of dependable, high-performance Psi-based devices for optoelectronic innovations through improving stability and optoelectronic performance.

Keywords—porous silicon, passivation, thermal treatment, optoelectronic, SILVACO TCAD

ACKNOWLEDGEMENT

First and foremost, I would like to express my gratitude to Allah. With Allah's permission, I was able to prepare the final years project proposal within the specified time. Basically, this research cannot be done without the guidance, encouragement, and assistance of many individuals.

I would like to thank the most important person in this research, which is my supervisor, Assoc. Prof. Ir. Dr. Alhan Farhanah Binti Abd Rahim, who have been very patient in providing guidance in all aspects. Without her help, this research could not be completed successfully. I also want to thank my classmates for giving me moral support and encouragement when I was not motivated to complete this research.

Furthermore, not forgetting the most important person in my life, which is my parents. I really appreciate their sacrifice. Without their prayers and encouragement, I would not be where I am today. Thank you for being my source of strength in completing this research. My deepest appreciation goes to them. In addition, I also want to express my appreciation to the individuals who are involved directly or indirectly in this project. Finally, I would like to thank myself for putting a lot of effort into successfully completing the given task.

.

TABLE OF CONTENTS