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FABRICATION OF P-TYPE POROUS SILICON FOR IMPROVED RAMAN EFFICIENCY IN LOW CONCENTRATION SERS DETECTION

JAMILAH BINTI MAT TAPAH

BACHELOR OF ENGINEERING (HONS) ELECTRICAL AND ELECTRONIC ENGINEERING

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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	:	Jamilah Binti Mat Tapah
Student I.D. No.	:	202115
Programme	:	Bachelor of Engineering (Hons.) Electrical and Electronic Engineering (CEEE200)
Faculty	:	Electrical Engineering Studies
Thesis	:	Fabrication of p-type Porous Silicon for Improved Raman Efficiency in Low Concentration SERS Detection
Signature of Student	:	………………………………………………..
Date	:	February 2025

ABSTRACT

Surface-enhanced Raman scattering (SERS) is a powerful tool for detecting low concentrations of analytes, but the high cost and instability of traditional metallic substrates limit its applications. To overcome these challenges, this study focuses on the fabrication of p-type porous silicon (PSi) as a cost-effective and reliable SERS substrate. A photo-electrochemical etching process was employed to create PSi, with etching times varied to optimize pore structures. Silver nanoparticles (AgNp's) of 5nm and 75nm sizes were deposited on the PSi surface to enhance Raman signal amplification through plasmonic effects. Structural characterization using Field Emission Scanning Electron Microscopy (FESEM) revealed that a 25 minutes etching time produced uniform and deep pores, maximizing surface area and hotspot distribution. Electrical properties were assessed using current-voltage (I-V) measurements, confirming improved conductivity with AgNp integration. Raman efficiency was evaluated using Rhodamine 6G (R6G) as a model analyte, where the 75nm AgNp's provided stronger signal enhancement compared to the 5nm particles. The optimized substrates demonstrated high sensitivity and reliability in detecting low concentrations of R6G. By combining precise fabrication methods with thorough structural, electrical, and optical characterization, this study presents a robust, affordable approach to advancing SERS technology. The findings highlight the potential of p-type PSi substrates for a wide range of applications, including non-invasive diagnostics, environmental monitoring, and chemical sensing, offering significant improvements in sensitivity, stability, and reproducibility over traditional methods.

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