FREE-SPACE MICROWAVE MEASUREMENT OF DOPING CONCENTRATION FOR SILICON WAFER

ALYAA SYAZA BINTI AZINI

FACELY OF LEGTRICAL ENGINEERING UNIVERSITE TEXNOLOGI MARA

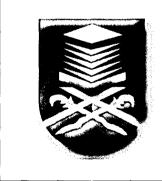
MALAYSIA

FREE-SPACE MICROWAVE MEASUREMENT OF DOPING CONCENTRATION FOR SILICON WAFER

Thesis presented in partial fulfillment for the award of the

Bachelor of Electrical Engineering (Hons)

UNIVERSITI TEKNOLOGI MARA



ALYAA SYAZA BINTI AZINI FACULTY OF ELECTRICAL ENGINEERING UNIVERSITI TEKNOLOGI MARA 40450 SHAH ALAM, SELANGOR, MALAYSIA MAY 2011

ACKNOWLEDMENT

Alhamdulillah, thanks to Allah S.W.T for His blessings, guidance, knowledge and the ability given to me. Without it, I would not have been able to come this far.

I wish to express my sincere appreciation to my project supervisor, Madam Noor Hasimah Baba and my co-supervisor, Madam Maizatul Zolkapli for their encouragement, guidance, critics and friendship throughout this two semester period. Without them this project might not been successful.

Not to forget, great appreciation goes to the rest of MTC's staff, Madam Fatimah 'Audah Md. Zaki and Mr. Mohd Kamarulzamin Bin Salleh of TMRND whom had given me valuable information, suggestions and guidance throughout my final year project.

Special thanks to Mr. Mohd Rosydi Zakaria from Universiti Malaysia Perlis, (uniMAP) for his assistance in finishing this project successfully.

My greatest thanks to my family, especially both my parents who has gave a lot of love, courage and inspiration throughout my journey of education.

ABSTRACT

Microwave non-destructive testing (MNDT) using free space microwave measurement (FSMM) system is used to characterize silicon semiconductor wafers from reflection and transmission coefficients. The FSMM system consists of transmit and receive spot-focusing horn lens antenna, mode transitions, coaxial cables and a vector network analyzer (VNA). The resistivity and conductivity of silicon wafers can be obtained from the complex permittivity. In this project, results for p-type high resistivity silicon wafer before and after doping was measured.

The FSMM setup was modeled using CST Microwave Studio simulation and the simulation results were then compared with the measurement. Simulation results of doping concentration using tsuprem conducted by Mr. Mohd Rosydi Zakaria from Universiti Malaysia Perlis, (uniMAP) were used in this project to make comparison with FSMM technique.

In this project, it was found that the dielectric constant, loss factor and conductivity of doped wafer were higher than the undoped wafer. In addition, it was observed that the resistivity decreased with increased frequencies

TABLE OF CONTENTS

TITLE	ť
APPROVAL	ii
DECLARATION	iii
ACKNOWLEDGMENT	iv
ABSTRACT	v
TABLE OF CONTENTS	vi
LIST OF FIGURES	ix
LIST OF TABLES	xi
LIST OF SYMBOLS	xii
LIST OF ABBREVIATION	xiii

CHAPTER	CONTENTS	PAGE
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Problem Statement	3
	1.3 Objectives	3
	1.4 Scope of Project	3
2	FUNDAMENTALS OF MICROWAVES AND	4
	SEMICONDUCTOR MATERIALS	
	2.1 Theory of Microwaves	4
	2.2 Introduction of MNDT	4
	2.3 Microwave Non-Destructive Testing	5
	2.4 Advantages and Disadvantages of MNDT	7
	2.5 Application of MNDT	8
	2.6 Electromagnetic Properties of Materials	8
	2.6.1 Complex Permittivity	9
	2.6.2 Real Dielectric Constant	9
	2.6.3 Loss factor	10
	2.7 Scattering Parameters (S-parameters)	10