

ELECTRICAL CHARACTERISTICS OF ALUMINIUM DOPED  
NANOSTRUCTURED  $\text{TiO}_2$  THIN FILM BY SOL-GEL METHOD SPIN  
COATING

KHAIRUL ANUAR BIN KASBI

FACULTY OF ELECTRICAL ENGINEERING  
UNIVERSITI TEKNOLOGI MARA  
MALAYSIA  
2010

## **ACKNOWLEDGEMENT**

I would like to take this opportunity to convey my heartfelt appreciation to each and everyone who were involved in this final year project and in producing the report, either directly or indirectly and have aided me through the difficult and crucial times. Though I had a tough time, with the help of caring, understanding and helpful people, I'm able to complete this project on time. This final year project has truly been an informative and remarkable experience for me.

First of all, I wish to express my sincere gratitude to my supervisor, Pn. Anees Binti Abdul Aziz for her priceless assistance and guidance to complete my final year project. I am very lucky and blessed to be under her supervision. Without her enthusiastic effort, advice and concern throughout this project, this project would not be as successful as it is. My thanks and appreciate also goes to my co-supervisor En. Musa Bin Mohamed Zahidi for his assistance and guidance to conduct the experiment in the laboratory.

Also not forgotten, thankful to Prof. Assoc. Dr. Mohamad Rusop for his attention and support for the realization of this project. I also acknowledged all the people that are helping to completed this project in the Solar Cell Labaratory esppecially En. Zainizan, Cik. Ayu and Pn. Nurul for their technical advices and as well as En.Suhaimi as the technician in the laboratory.

Last but not least, deepest appreciation and thanks to my beloved parents and friends for their encouragement and full moral support during the preparation of this project. To all those who helped me in one way or another, thank you.

## ABSTRACT

The study have been conducted on Electrical Characteristics of Aluminum Doped Nanostructured TiO<sub>2</sub> Thin Film. In this research, it have been prepared by a method known as Sol-gel method. Titanium dioxide (TiO<sub>2</sub>) thin films have been deposited on glass substrates using titanium Butoxide as a precursor. This research have been investigated on the different concentration of Aluminium doped Nanostructured Titanium Dioxide (TiO<sub>2</sub>) thin film from 1% to 5% by (molar percentage). The results in terms of electrical characteristics of the Aluminium doped Nanostructured TiO<sub>2</sub> thin film layer have been studied. When the concentration of doping Aluminium increased, the conductivity were increased and the resistivity were decreased. This is because Aluminium is one of the agent of conductivity. The spectral absorbance of undoped TiO<sub>2</sub> and Al doped TiO<sub>2</sub> thin films deposited on glass were measured in the wavelength range from 300 to 800 nm. The value of absorbance were increase rapidly within wavelength of 300 nm and 350 nm. The influences of different concentration of aluminium on the surface morphologies and electrical characteristics of the nanostructured TiO<sub>2</sub> were characterized by Scanning Electron Microscopy (SEM) and Current-Voltage (I-V) measurement. The optical properties of different concentration of aluminium of the nanostructured TiO<sub>2</sub> were characterized by UV-VIS Spectroscopy as well.

# TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	<b>DECLARATION</b>	i
	<b>ACKNOWLEDGEMENT</b>	ii
	<b>ABSTRACT</b>	iii
	<b>TABLE OF CONTENTS</b>	iv
	<b>LIST OF FIGURES</b>	vi
	<b>LIST OF TABLES</b>	vii
	<b>LIST OF SYMBOLS</b>	viii
<b>1</b>	<b>INTRODUCTION</b>	
	1.1 Introduction	1
	1.2 Objective	3
	1.3 Problem Statement	4
	1.4 Scope of Project	4
<b>2</b>	<b>LITERATURE REVIEW</b>	
	2.1 Introduction	5
	2.2 Thin Film	7
	2.3 Sol-Gel	8
	2.4 Spin-Coating	12
	2.5 Sputtering	13
	2.6 Ohmic Contact	15
	2.7 Magnetic Stir Bar	16
	2.8 Magnetic Stirrer	17
	2.9 Glass Substrate	18
	2.10 Nitrogen Gases	19

# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

Aluminium is a silvery white and ductile member of the boron group of chemical elements. It has the symbol Al and its atomic number is 13. It is not soluble in water under normal circumstances. Aluminium is the most abundant metal in the Earth's crust, and the third most abundant element therein after oxygen and silicon. It makes up about 8% by weight of the Earth's solid surface. Aluminium is too reactive chemically to occur in nature as a free metal.

Aluminium is a soft, durable, lightweight, malleable metal with appearance ranging from silvery to dull grey, depending on the surface roughness. Aluminium is nonmagnetic and nonsparking. It is also insoluble in alcohol, though it can be soluble in water in certain forms. Corrosion resistance can be excellent due to a thin surface layer of aluminium oxide that forms when the metal is exposed to air, effectively preventing further oxidation. The strongest aluminium alloys are less corrosion resistant due to galvanic reactions with alloyed copper. Aluminum doped Titanium Dioxide (TiO<sub>2</sub>) coatings exhibit high transparency and low resistivity and these materials are suitable for fabricating transparent electrodes in solar cells, gas sensors and ultrasonic oscillators.