

**OPTICAL AND STRUCTURAL PROPERTIES OF  
ZINC OXIDE THIN FILM ANNEALED AT  
DIFFERENT TEMPERATURE**

**RABIATUL ADAWIAH BINTI AHMAD RASHAIDI**

**Final Year Project Report Submitted in  
Partial Fulfillment of the Requirements for the  
Degree of Bachelor of Science (Hons.) Physics  
in the Faculty of Applied Sciences  
Universiti Teknologi MARA**

**OCTOBER 2008**

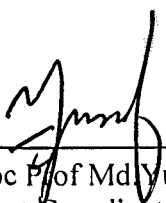
This Final Year Project Report entitled “**Optical and Structural Properties of Zinc Oxide Thin Film Annealed at Different Temperature**” was submitted by Rabiatul Adawiah binti Ahmad Rashaidi, in partial fulfillment of the requirements for the Degree of Bachelor of Science (Hons.) Physics, in Faculty of Applied Sciences and was approved by

---

Assoc Prof Dr Saifollah Abdullah  
Supervisor  
Ph.D Physics  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
40450 Shah Alam  
Selangor


---

Assoc Prof Dr Mohamad Rusop  
Co-Supervisor  
Ph.D Physics  
Faculty of Electrical Engineering  
Universiti Teknologi MARA  
40450 Shah Alam  
Selangor



---

Assoc Prof Md Yusof Theeran  
Project Coordinator  
Ph.D Physics  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
40450 Shah Alam  
Selangor



---

Dr Zu Azhan Yahya  
Head of Programme  
B.Sc (Hons.) Physics  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
40450 Shah Alam  
Selangor

## TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	ix
ABSTRACT	x
ABSTRAK	xi
<b>CHAPTER 1: INTRODUCTION</b>	
1.1 Brief Overview of Zinc Oxide Thin Film	1
1.2 Problem Statement	4
1.3 Objectives	4
1.4 Significance of Study	5
<b>CHAPTER 2: LITERATURE REVIEW</b>	
2.1 Fundamental Properties of Zinc Oxide	6
2.1.1 Crystal Structure	6
2.2.2 Energy Band Gap	7
2.1.3 Defects in ZnO	8
2.2 Previous Research on Optical and Structural Properties	8
2.2.1 Photoluminescence	8
2.2.2 Scanning Electron Microscope	13
2.3 Deposition Techniques	15

## ABSTRACT

Zinc oxide (ZnO) thin films deposited on silicon and glass substrate were prepared using chemical vapor deposition (CVD) method utilizing zinc acetate dehydrate as the zinc sources. The deposited film then annealed at 300°C to 500°C for 1 hour. The optical and structural properties of ZnO thin films were characterized using photoluminescence (PL) and Scanning Electron Microscopy (SEM) respectively. SEM images show that the ZnO thin film on silicon substrate formed unique morphology of flower-like and ball-shaped structures at annealing temperature 300°C and 400°C. Increasing annealing temperature to 450°C for ZnO deposited on glass substrate had increased the grain size of particle which implies the improvement of crystalline grain of thin film. PL results observed that the defect of oxygen vacancy decreased after annealing process for films deposited on silicon substrate. The blue peak emission at 437 nm appears only on the glass substrate. Based on the highest PL intensity value, the optimum annealing temperature for silicon and glass substrate is 350°C and 450°C respectively.

## CHAPTER 1

### INTRODUCTION

#### 1.1 Brief Overview on Zinc Oxide Thin Film

Zinc oxide, ZnO is a chemical compound with the formula ZnO which is soluble in acids and alkalis but insoluble in water. It occurs as white hexagonal crystals or a white powder commonly known as zinc white ([http://en.wikipedia.org/wiki/Zinc\\_oxide](http://en.wikipedia.org/wiki/Zinc_oxide)). ZnO is a direct band-gap semiconductor having an energy gap of 3.37 eV at room temperature. However, its band gap energy can be extended to 4.0 eV by adding Mg and narrowed to 2.8 eV by alloying with CdO. Its high exciton binding energy, 60 meV is used in UV semiconductor laser material in order to compete with only 25 meV for GaN (Wang et al, 2005). ZnO has strong resistance makes it useful for varistors. Its large piezoelectric constant applicable in transducers and its luminescence is used in phosphor. ZnO surfaces are sensitive to the presence of adsorbates, allowing applications as sensors. ZnO also exhibits large optical nonlinearities that can be exploited in optical devices, and its high thermal conductivity makes it suitable as a substrate for growth of other materials, including GaN (Chris, 2001).

In recent years, ZnO has been introduced to the ZnO based thin films. Thin films are thin material layer with a fraction of nanometer to several micrometers in thickness in the range of 600 nm to 3  $\mu\text{m}$  (Wang et al, 2005, Wei et al, 2006 and Liang et al,