

**PHOTODEGRADATION OF ORGANIC DYE BY ZINC OXIDE  
MICROSTRUCTURES DECORATED WITH SILVER  
NANOPARTICLES: EFFECT OF DIFFERENT ANNEALING  
TEMPERATURE**

**NOR ATIKAH BINTI EMBONG**

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

**JULY 2017**

## **ABSTRACT**

### **PHOTODEGRADATION OF ORGANIC DYE BY ZINC OXIDE MICROSTRUCTURES DECORATED WITH SILVER NANOPARTICLES: EFFECT OF DIFFERENT ANNEALING TEMPERATURE**

In this study, zinc oxide (ZnO) microstructures decorated with AgNPs were synthesized via sol gel method. The resulting ZnO catalyst was characterized by X-ray Diffraction (XRD), Field Effect Electron Microscopy (FESEM) and Electron Dispersive X-ray spectroscopy (EDS). XRD analysis show average crystallite size have an increasing pattern of crystallite size in the range of 79.44 – 103.89 nm for pure ZnO and AgZnO at different annealing temperature ranging from 500 until 900 °C. AgZnO-700 °C has a smaller particle size than pure ZnO and other samples. The FESEM results exhibit the morphology AgZnO produced was spherical in shape for annealing temperature of 500 °C and bigger and coarsen particle for AgZnO annealed in 900 °C. The AgZnO samples were tested for photodegradation of Methylene Blue (MB), under UV light. The parameter affecting the degradation performance had been investigated is the effect of different annealing temperature of AgZnO. The results shows AgZnO at annealing temperature of 700 °C is the optimum annealing temperature as it performed higher  $k$  value compared to other samples.

## TABLE OF CONTENTS

	<b>Page</b>
<b>ACKNOWLEDGEMENTS</b>	iii
<b>TABLE OF CONTENTS</b>	iv
<b>LIST OF TABLES</b>	vi
<b>LIST OF FIGURES</b>	vii
<b>LIST OF ABBREVIATIONS</b>	ix
<b>ABSTRACT</b>	x
<b>ABSTRAK</b>	xi
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 Background and problem statement	1
1.2 Significance of study	4
1.3 Objectives of study	5
<b>CHAPTER 2 LITERATURE REVIEW</b>	
2.1 Introduction to ZnO	6
2.1.1 Fundamental Properties of ZnO	6
2.1.2 Crystal Structure of ZnO	7
2.1.3 Properties of ZnO	9
2.1.3.1 Mechanical properties	9
2.1.4 Doped ZnO/ Modification of ZnO specifically by Ag	10
2.1.5 Effect of different annealing temperature to the structural properties of ZnO	11
2.2 Synthesis Methods	12
2.2.1 Sol-gel method	13
2.3 Principle of Photocatalysis	13
2.3.1 Dye	15
2.3.2 Photocatalytic Mechanism	16
2.4 Semiconductors as Photocatalyst	18
2.4.1 Application of Zinc Oxide as Photocatalyst	18
<b>CHAPTER 3 MATERIALS AND METHODS</b>	
3.1 Materials	21
3.1.1 Chemicals	21
3.1.2 Apparatus and Instruments	21

3.2 Methods	22
3.2.1 Preparation of ZnO decorated with AgNPs as photocatalyst by sol-gel method	22
3.2.2 Photocatalytic measurement	24
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>	
4.1 Characterization of the Pure ZnO and ZnO microstructures decorated with AgNPs Photocatalysts	26
4.1.1 X-ray diffraction (XRD) analysis	26
4.1.2 Field emission scanning electron microscopy (FESEM) and Electron dispersive X-ray spectroscopy (EDS) results	29
4.2 Photodegradation of methylene blue under UV irradiation	33
<b>CHAPTER 5 CONCLUSION AND RECOMMENDATIONS</b>	39
<b>CITED REFERENCES</b>	41
<b>CURRICULUM VITAE</b>	43

## LIST OF TABLES

<b>Table</b>	<b>Caption</b>	<b>Page</b>
2.1	Basic physical parameters for ZnO	6
2.2	Key mechanical properties of <i>c</i> -axis oriented wurtzite ZnO	10
4.1	Average crystallite size ( <i>D</i> ) of (1 0 1) plane related to synthesized photocatalysts.	29