INVESTIGATION ON TITANIUM DIOXIDE THIN FILM FOR OPTICAL SENSOR APPLICATION

Thesis is present of fulfillment for the award of
Bachelor of Engineering (HONS) Electronics
Universiti Teknologi Mara

MOHD FARHAN AIZAT BIN MOHAMED NAWI

FACULTY OF ELECTRICAL ENGINEERING

UNIVERSITI TEKNOLOGI MARA MALAYSIA

ACKNOWLEGDEMENT

I would pleasantly impress my sincere and honor gratitude to Dr. Puteri Sarah binti Mohamad Saad as supervisor and my senior Miss Irma Hidayanti for the continues and supportive encouragement of my degree study and research. Not to forget her patience, motivation, enthusiasm and immense knowledge on guiding me towards the completion of the final year project and also not forget to staff and member NANO-Electronic Centre (NET) for always give hand and support when there is a problem during finishing the research.

ABSTRACT

Titanium dioxide (TiO_2) exists as amorphous phase. It is non-crystalline that lack of repetitive structure and demonstrate structural disorder at the atomic level. For optical sensor application, the TiO_2 thin film is largely influenced by thickness of the film. Hence the thickness of the TiO_2 thin film can influence the ability of the thin film to absorb the light. This thesis investigates the optical properties for optical sensor applications using Sol-Gel spin coating technique. TiO_2 thin film with various numbers of coatings has been successfully prepared. The numbers of coatings TiO_2 thin film are varied at 1 time, 3 times, 5 times 7 times and 9 times. The effects of different numbers of coatings of the TiO_2 thin films are characterized by means of structural, optical properties and electrical properties. The characterizing involved Atomic force microscope (AFM), Field Emission Scanning Electron Microscopy (FESEM), Ultraviolet visible spectroscopy (UV-Vis) and spectral sensitivity measurement (*I-V* measurement). For structural properties, 9 times sample gives the highest roughness among the other sample. As for optical properties, it also showed high absorbing light compare to other samples. The electrical properties show current decrement when the numbers of coating increased. The results showed that number of coatings affected the roughness, conductivity and absorbance of light of the TiO_2 thin films. These differences determined the suitable properties of TiO_2 thin film for optical sensor application.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Titanium Dioxide (TiO_2) has been used for a long time in industrial. It used in paints and coatings, including glazes and enamels, plastics, paper, inks, fibers, food, pharmaceuticals, cosmetics and pigment [1]. TiO_2 also resistant to discolorations under ultraviolet light in exposed applications and is used in plastics and sunscreens [2, 3]. The advantages using TiO_2 are non-toxic, thermally stable, non-flammable and not hazardous. TiO_2 is the oxide of the metal titanium; occur naturally in several kinds of rock and mineral sands. Titanium also is the ninth most of common elements in the earth crust [4].

A few methods were used to fabricate TiO_2 film, include sputtering, chemical vapor deposition and sol-gel process [5-7]. However, the sol-gel method is the one most suitable technology to prepare thin oxide coating. There are several advantages of using sol-gel method such as better homogeneity, ease of composition control, low processing temperature, large area coatings, low equipment cost and good photocatalytic properties [8]. There are 3 basic needs to be considered in characterizing the properties of TiO_2 thin films which are electrical properties, optical properties and physical properties [9, 10]. Recent study, the optical properties were measure using UV-Vis. The absorption coefficient and