FABRICATION AND CHARACTERIZATION OF ZINC OXIDE THIN FILMS AT DIFFERENT ANNEALING TEMPERATURES BY SOL-GEL METHOD

Thesis is presented in partial fulfillment for the award of the

Bachelor of Engineering (Honors) in Electrical Engineering

UNIVERSITI TEKNOLOGI MARA

NORHAFIZAH BT ABDUL GHANI

Faculty of Electrical Engineering

UNIVERSITI TEKNOLOGI MARA

40450 SHAH ALAM

SELANGOR, MALAYSIA

NOVEMBER 2007

ACKNOWLEDGEMENT

I would like to record all my grateful thanks to my supervisor, En Uzer Mohd Noor, my Co-supervisor, Dr Mohamad Rusop Mahmood, as well as Mohamad Hafiz Mamat, for their kind guidance, criticism and advices in complete this project. To all master students special thanks for their help and time to answer my never-ending in order to gain as much knowledge on semiconductor technology. I also wish to thank to Dr. Zaiki b. Awang for his technology on SEM measurement, technicians; Mr. Mohd Zaidi b. Marlan, Mr. Mohd Azlan b. Jaafar and Mr. Hisham b. Mahamad for their help and consistency in preparing the laboratory equipment. My course mate and friends provided the motivation needed to undertake this project. Thank you for all their support and consistence.

Thank you very much and may God bless you always.

ABSTRACT

Zinc Oxide (ZnO) thin films were deposited on silicon and glass substrate by sol-gel method using $Zn(CH_3COO)_2.2H_2O$ (Zinc Acetate) as a starting material. ZnO solution has been prepared by dissolving Zinc Acetate (ZnAc) in 2-Metoxyethanol and Monoethanolamine solution. ZnO thin films was prepared by depositing ZnO solution onto silicon and glass substrate by spin coating technique and annealed at various temperatures between 350°C to 500°C. The film growth process was characterized by using Scanning Electron Microscopy (SEM) and current-voltage (I-V) measurement method. Current-voltage (I-V) measurement study indicated resistivity of ZnO films decreases with increasing annealing temperature. The effect of ZnO thin films on the surface morphology and electrical properties with varying the annealing temperature was also studied. It was investigated that the grain size of ZnO becomes bigger and denser with higher annealing temperature up to 500°C.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

ZnO is a fascinating material with a vast range of applications, including varistors, piezoelectric transducers, sensors, surface acoustic wave devices, phosphors, and transparent conducting oxides. Recent progress in single-crystal growth has now opened up prospects for optoelectronic applications [1]. Worldwide research on ZnO has already produced high-quality bulk and epitaxial n-type material, but not reproducible p-type material [2]. Thin films of undoped and doped ZnO are utilized for a wide variety of electronic and optoelectronic applications, such as surface acoustic wave devices [3], transparent conducting electrodes [2], and heat mirrors [4]. Nanoscale porous structures of ZnO with a high surface area find their application in chemical sensors [5] and dye-sensitized solar cells [6]. Various techniques have been used to prepare ZnO thin films on different substrates such as spray pyrolysis, organometallic chemical vapour deposition, pulsed laser deposition and sōl-gel method.

Sol-gel is a colloidal suspension that can be gelled to form a solid. The sol-gel approach is interesting in that it is a cheap and low-temperature technique. It can be used by means of producing very thin films for various purposes. Sol-gel derived materials have diverse applications in optics, electronics, energy, space, (bio) sensors, medicine (e.g. controlled drug release) and separation (e.g. chromatography) technology. The precursor sol can be deposited on a substrate to form a film by using spin-coating technique.