UNIVERSITI TEKNOLOGI MARA

THE CHARACTERIZATION OF ZINC OXIDE NANAOSTRUCTURES WITH DIFFERENT DEPOSITION LAYERS USING SOL GEL DIP COATING METHOD

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ABSTRACT

Zinc oxide (ZnO) is one of the compound semiconductors in group II-VI within the periodic table. The objective of this experiment is to characterize the ZnO thin films with different deposition layers to study the effects of ZnO thin films which deposited with different number of layers. The scopes of this research is to deposit five samples of ZnO thin films with different deposition layers. The sol gel dip coating technique was used to synthesize high quality ZnO thin films at different deposition layers. All thin films were deposited on quartz substrates. Lastly, the thin films structural, optical and electrical properties were characterized. These ZnO thin films structural properties were investigated using field emission scanning electron microscope (FE-SEM) to observe thin films surface morphology and measured their grain sizes. The thin films thickness were measured using surface profiler. The results of FE-SEM showed that the grain sizes increased and films porosity slightly reduced when the number of deposited layers increase. ZnO thin films optical properties were characterized using photoluminescence (PL) spectroscopy to examine luminescence properties. The thin films optical properties also determined using UV-Vis spectrophotometer in order to study the films transmittance, absorbance and optical band gap. There are broad strong red bands (650nm) and overlapped sharp ultraviolet emissions (380nm) are show in the PL spectra. The optical transmittance found decreases and as the number of deposited layers increase, while the optical absorbance increased with the increase of number of layers. The films optical band gap was found slightly smaller compared to ZnO crystal optical band gap which about 3.3eV. It was observed that the films resistivity reduce and conductivity increase with the increase of deposited layers. The electrical properties were investigated using current-voltage (IV) measurement to study

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CHAPTER 1

INTRODUCTION

1.1. Motivation and Background of Study

Recently, nanotechnology has received extensive attention to the researchers around the globe. Even there are plenty of nanostructured materials are now being studied cause of their superb properties and can be promising applications for electronic devices, photonics, and optics. However, among those nanostructured materials, ZnO is a very peculiar material for such applications.

ZnO has several unique properties that cause the researchers tightly drawn to study several methods to deposit ZnO thin films with excellent electrical, structural and optical properties. ZnO has many advantages compared to other semiconductors namely GaAs and GaN. It has direct and wide band gap which is about 3.37 eV [1], and large free-excitation binding energy of 60 meV at ambient temperature [2], thus make it a promising material for optoelectronic devices [3] that rely on excitonic effect [4]. Despite, it has a large piezoelectric constant and a strong sensitivity to the exposure of various gases that make ZnO a good material as sensor devices [5][6]. It possessed strong luminescence within the green-white region of the spectrum and high thermal conductivity.

Researchers are concentrated on ZnO for several reasons, the ability of ZnO being etched by wet chemical etching that gives it flexibility in the electronic processing [7]. It has also been observed to exhibit high radiation hardness that makes ZnO suitable for high altitude or in space applications [7]. Several methods have been performed by the researchers to deposit ZnO thin films namely CVD [8] , spray pyrolisis [9] , MBE [10], sol-gel [11], and RF sputtering [12]. In the midst of the techniques, sol-gel process is the most versatile methods to prepare ZnO nanostructure. It is simple and inexpensive deposition technique [13]. The sol-gel process can be specified into few categories namely sol-gel spins coating, dip coating, flow coating, and spray coating. Every method has advantages and disadvantages in the way to deposit thin film. In the present work, the ZnO thin films was fabricated using sol-gel dip coating method because it can provide simple, economic and effective method to produce high quality coatings.