ZINC OXIDE THIN FILMS PROPERTIES DEPENDENCE ON THE GAS FLOW RATE OF THERMAL CHEMICAL VAPOR DEPOSITION

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MOHAMAD FAID MUZAHID BIN ALI
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM
SELANGOR, MALAYSIA
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ABSTRACT

Zinc oxide (ZnO) thin films were deposited using thermal chemical vapor deposition (TCVD) method with a two furnaces system. To enhance the growth of the nanostructure, the sol-gel spin coated ZnO templates were used. To study the effect of oxygen gas flow rate on the properties of the thin films, the gas flow rate were varied from 5 to 25 standard cubic centimeter per minute (sccm). The samples were characterized using field emission scanning electron microscopy (FE-SEM), photoluminescence (PL) spectra, current-voltage (I-V) measurement, X-Ray Diffraction (XRD). The FE-SEM images showed by increasing the gas flow rate of oxygen the feet of the nano-tetrapod became longer and thinner. Additionally, I-V curve shows that resistance of the thin films increase as the deposition oxygen gas flow rate increases.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Zinc Oxide (ZnO) based thin films are certainly interesting for their applications in semiconducting, photoconducting or piezoelectric and optical waveguide materials [1]. ZnO has been recognized as a promising semiconductor material owning to its wide bandgap of 3.37 eV and a large exciton binding energy of 60 meV. ZnO also has a stable wurtzite structure with lattice spacing a = 0.325 nm and c = 0.521 nm [2]. These properties make it a potentially promising photonic material for rich optoelectronic applications, such as solar cells [3], UV photodetectors [4], blue-UV laser diodes [5], light emitting diodes [5], field emission displays [6], and so on [7]. It has attracted intensive research effort for its unique properties and versatile applications in transparent electronics, ultraviolet (UV) light emitters, piezoelectric devices, chemical sensors and spin electronics [8]. Many studies had been done to produce nanostructured ZnO thin film such as nanorods, nanotubes, nanowires, nanoflowers and etc [9]. Recently, multiple synthesis techniques have been developed to fabricate ZnO nanostructure such as r. f. sputtering [10], thermal chemical vapor deposition (TCVD) [2], sol-gel spin coating [2], and plasma enhanced chemical vapor deposition (PECVD) [11]. The white appearance of a white powder is referred to as Zinc white or zincite [12]. ZnO also consists of three crystal forms which the hexagonal wurzite, the cubic zinc blend and the cubic rock salt [12]. Other than that, ZnO also is considered to be a soft material according to its hardness scale which is 4.5 Mohs [12]. Good thermal properties is also one of the reason to use ZnO, it's have a high thermal capacity, high melting point and also conductivity [12]. The wurzite structure having the highest stability under normal working condition which made it the most commonly used. Thermal Chemical Vapor Deposition (TCVD) method requires a high temperature involvement thus making ZnO as one of the most sensible materials to be selected with all the good properties. In this research, TCVD method is used because it is more effective, low cost and as a common method compare to the others. Sol-gel spin coating method is use to apply uniform thin films onto the substrates. Generally the process involved dispersing an amount of solution onto the