OPTICAL AND STRUCTURAL PROPERTIES OF ZINC OXIDE THIN FILM ANNEALED AT DIFFERENT TEMPERATURE

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TABLE OF CONTENTS

ABSTRACT

Zinc oxide (ZnO) thin films deposited on silicon and glass substrate were prepared using chemical vapor deposition (CVD) method utilizing zinc acetate dehydrate as the zinc sources. The deposited film then annealed at 300°C to 500°C for 1 hour. The optical and structural properties of ZnO thin films were characterized using photoluminescence (PL) and Scanning Electron Microscopy (SEM) respectively. SEM images show that the ZnO thin film on silicon substrate formed unique morphology of flower-like and ball-shaped structures at annealing temperature 300°C and 400°C. Increasing annealing temperature to 450°C for ZnO deposited on glass substrate had increased the grain size of particle which implies the improvement of crystalline grain of thin film. PL results observed that the defect of oxygen vacancy decreased after annealing process for films deposited on silicon substrate. The blue peak emission at 437 nm appears only on the glass substrate. Based on the highest PL intensity value, the optimum annealing temperature for silicon and glass substrate is 350°C and 450°C respectively.

CHAPTER 1

INTRODUCTION

1.1 Brief Overview on Zinc Oxide Thin Film

Zinc oxide, ZnO is a chemical compound with the formula ZnO which is soluble in acids and alkalis but insoluble in water. It occurs as white hexagonal crystals or a white powder commonly known as zinc white (http://en.wikipedia.org/wiki/Zinc_oxide). ZnO is a direct band-gap semiconductor having an energy gap of 3.37 eV at room temperature. However, its band gap energy can be extended to 4.0 eV by adding Mg and narrowed to 2.8 eV by alloying with CdO. Its high exciton binding energy, 60 meV is used in UV semiconductor laser material in order to compete with only 25 meV for GaN (Wang et al, 2005). ZnO has strong resistance makes it useful for varistors. Its large piezoelectric constant applicable in transducers and its luminescence is used in phosphor. Zno surfaces are sensitive to the presence of adsorbates, allowing applications as sensors. ZnO also exhibits large optical nonlinearities that can be exploited in optical devices, and its high thermal conductivity makes it suitable as a substrate for growth of other materials, including GaN (Chris, 2001).

In recent years, ZnO has been introduced to the ZnO based thin films. Thin films are thin material layer with a fraction of nanometer to several micrometers in thickness in the range of 600 nm to 3 μm (Wang et al, 2005, Wei et al, 2006 and Liang et al,