ELECTRICAL PROPERTIES NANOSTRUCTURED OF ZnO THIN FILM PREPARED BY DIP-COATING METHOD

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ABSTRACT

Zinc Oxide (ZnO) nanostructured thin films were deposited on a glass substrate by the sol-gel process associated with dip-coating method. Zinc acetate dehydrate $Zn(O_2CCH_3)2(H2O)_2$ are used as a starting material while 2-methoxyethanol ($C_3H_8O_2$) and monoethanolamine (MEA) are used as a solvent and stabilizer. The molar ratio of zinc acetate dihydrate to monoethalomine is 1:1. The molarity of solution, pre-heating and annealing temperature were kept constant at 0.4M, 150^{0}Cand at 550^{0}C but the withdrawal speed was varied from 1mm/s to 9mm/s. The effects of withdrawal speed on electrical, optical and surface morphology properties of the ZnO thin films were investigated. The electrical, optical and surface morphology properties of the thin films were characterized by I-V measurement, photoluminescence spectrometer (PL), ultraviolet-visible spectroscopy (UV-Vis) and atomic force microscopy (AFM). The electrical measurement showed that current decrease when the withdrawal speed increases and has linear ohmic, current direct proportional to voltage. High conductivity at $4.22x10^{-3}$ S/cm and lowest resistivity about $2.3x10^3$ Ω/cm has been obtained for 1mm/s withdrawal speed. PL spectra show strong and sharp UV emission located at 383nm, which is related to near band gap exciton emission of 3.24 eV. AFM micrographs showed average grain size of ZnO thin films increases from 120.862nm to 138.521nm with increasing in withdrawal speed.

Keywords: Zinc Oxide; ZnO; Dip-Coating; Sol-gel;

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

1.1.1 Zinc Oxide (ZnO)

Zinc Oxide (ZnO) is a chemical compound with nearly soluble in acids and bases, however insoluble in water. ZnO is a n-type semiconductor with wide and direct bandgap of 3.37eV. As compared to the other wide band gap material, the ZnO have very large exciton binding energy large at 60meV at room temperature that gives the more efficient excitonic emissions at the room temperature [1].

ZnO are excellent chemical and thermal stability, non-toxicity, good piezoelectric properties and bio- compatibility[1]. ZnO is one of the semiconductors having good chemical stability and suitable for photovoltaic applications because of its high-electrical conductivity and optical transmittance in the visible region of the solar spectrum, which is primarily important in solar cell fabrications[2]. Thin films of ZnO can be used as a window layer and also as one of the electrodes in solar cells[4]. Along with this application, ZnO thin films have been used in varistors[5], gas sensors[6], solar cell transparent contact fabrication[7], etc.

The electrical properties of ZnO are hard to quantify due to large variance of the quality of samples available. Optical properties of ZnO are heavily influenced by the energy band structure and lattice dynamics. For optical properties of excitonic recombinations in bulk, n-type ZnO gives a comprehensive treatment and analysis of the excitonic spectra obtained from ZnO, and assigns many defect related spectral features, as well as donor–acceptor pair (DAP) emission. A broad defect