OPTICAL AND ELECTRICAL PROPERTIES OF AL-DOPED ZINC OXIDE NANOROD THIN FILMS FOR UV SENSOR APPLICATIONS

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ABSTRACT

Aluminium (Al) doped zinc oxide (ZnO) thin films with doping concentration of 1% at have been prepared using sol-gel spin coating method. Then the nanorod structure was grown on top of the Al-doped ZnO which act as the seed layer on the glass substrate using sonicated sol-gel immersion technique. The nanorod structure was grown at different immersion time from 1 hour to 5 hour. The nanorods was characterized using X-ray diffractometer (XRD), atomic force microscope (AFM), surface profiler, UV-Vis-NIR spectrophotometer, UV photo response, 3540 pH and conductivity meter and current voltage measurement (I-V) for structural, optical and electrical properties respectively. The optimal time obtained in this research is 1 hour immersion time. The results for 1 hour immersion time indicate high transmission in the visible region (400-800nm) and high absorbance in the UV region (<400nm). It also indicates an Ohmic behavior at I-V characteristics. 1 hour immersion time can be used for UV sensor application fabrication since the photocurrent under UV illumination indicates high responsivity due to the effect of oxygen absorption and deabsorption process from its nanostructure crystal.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Background studies

UV sensor stands for ultraviolet sensor are important devices that can be used in commercial and military applications including space research, gas sensing, high temperature flame detection, air quality monitoring and many more. UV detectors currently used silicon-based detectors and photomultiplier tubes. These materials require costly filters and attenuators. However by replacing those technologies with wide band-gap semiconductors such as zinc oxide (ZnO) have been suggested [1]. Several of the zinc oxide applications are UV light emitting or receiving devices, transparent electrode, gas sensor and solar cells. Chemical vapor deposition, molecular beam epitaxy and sputtering were some of the deposition method that used to fabricate ZnO thin films. However, these deposition methods are high production cost because required high temperature processing and vacuum technology [2]. Zinc oxide is an n-type semiconductor with a direct band gap of 3.3eV to 3.4eV [4] and large exciton binding energy of about 60meV [3]. ZnO is non-toxic, inexpensive [6] and has a unique position among materials due to its higher and various properties such as optical transparency in the visible region [4], piezoelectricity [5], and stable against thermal and chemical reaction [3]. ZnO has been used in many applications such as in UV light emitting/receiving devices, solar cells and gas sensor due to its good electrical properties [4].