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Electric properties of ZnO thin films by RF Magnetron sputtering technique

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Abstract

The Zinc Oxide (ZnO) thin film deposited on n-type silicon (Si) by radio frequency magnetron sputtering at room temperature. During the Radio Frequency (RF) power, argon/oxygen gas pressure at different Standard Cubic Centimeters per Minute (SCCM), substrate temperature was varied, optimized for crystal structure, surface morphology, roughness, and optical electrical studies. The deposited films were examined crystalline structures and investigated by X-Ray Diffraction (XRD), surface morphology by Field Emission Scanning Electron Microscopy (FESEM) and Atomic Force Microscopy (AFM), optical studies by UV-Vis, electrical studies by IV characteristic. The film post deposition annealed was improving the quality of the film properties

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Keywords: Sputtering Technique, schottky diode, Transparent conducting Oxide, sensor.

1. Introduction

ZnO is an n-type semiconducting oxide material with wide-band gaps are great interest for versatile applications. Zinc oxide nanowires [1], nanorods [2], are widely used for light emitting diodes(LED) [3], sensors [4] and

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photodetectors [5] etc,. ZnO is an extensively used functional material with wide band gap at room temperature, large exciton binding energy, excellent chemical and thermal stability and optical visible transparency [1-4]. Lot of techniques are deposited ZnO thin films such as Chemical vapour Deposition (CVD) Pulsed laser deposition (PLD), Electron Beam Physical Vapour Deposition (EBPVD) and RF Magnetron sputtering system[6-9].Synthesizing high quality ZnO films for the electrical applications has much interesting one. In this study, experimental design methodology, film structure and the surface morphology are fabrication device structure. In general oxide semiconductors materials are used in gas sensors. In this paper we report the deposition of ZnO thin films using RF sputtering technique to improve different properties and performance of the material. Generally nanofibrous are used for sensor to make a Schottky junction with ZnO under test with VI characterization.

2. Experimental

The nanocrystalline ZnO were synthesized by ball milling method. The collected ZnO powdered were used to make a 2 inch target with hydraulic press. The ZnO target was sintered at 1000^{o}c with high temperature furnace. The substrate cleaning plays an important role in the preparation of thin films so the substrates are washed with soap solution cleaned in the distilled water and kept at hot air oven at 80ºC. The silicon and glass substrates were mounted in the suitable designed substrate holder in our RF magnetron sputtering unit. The chamber was evacuated with help of turbo molecular pump in the vacuum of 10^{-6} mbar. Argon was used as a sputtering gas and oxygen was used as a reactive gas to maintain the stoichiometric of title compound. The sputtering power was 80W and the experiment was performed for 1hr at room temperature. The crystalline properties of the films were investigated using XRD, FESEM and AFM. Film electrical properties investigated by VI characteristic testing and an optical property was measured by UV-vis spectrophotometer.

3. Results and discussion

The deposited ZnO thin films X-ray diffraction studied to find the crystalline structure. Fig. 1(a, b, c) Shows the XRD patterns of ZnO thin films deposited at 2, 5 and 8SCCM of oxygen during the deposition. The deposited film was well crystallized in the hexagonal system and matched with JCPDS card no.36-1451 [10-11] a=3.249 c=5.249. Fig.2(a, b, c) shows the different pressure of oxygen thickness of cross-section view has been columnar growth and surface particles are crystalline structure also studied in FESEM report.

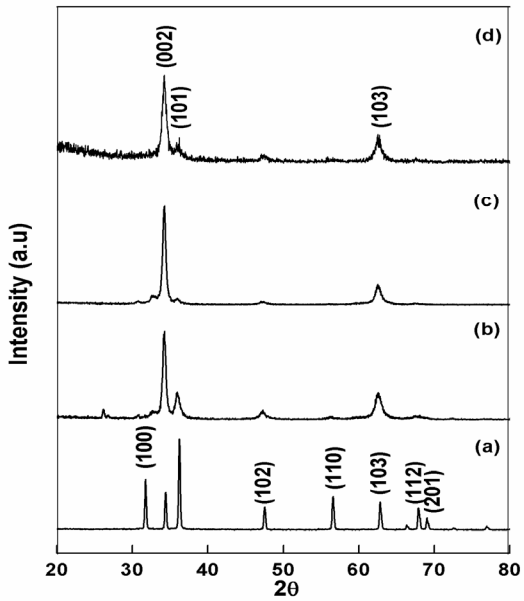

Fig.1 XRD pattern of ZnO Powder (a) and ZnO Thin film deposited at (b) 2, (c) 5, (d) 8 SCCM of Oxygen.