



Impact of different post-annealing temperatures on photoluminescent and structural properties of ZnO films prepared by sol-gel technique

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Abstract

In this work, the effects of different post-annealing temperatures on the prepared ZnO glass films were studied. The deposited ZnO films were prepared by a sol-gel spin coating technique. The influence of the annealing temperature on the photoluminescent, elemental, optical, structural, crystallite size properties were investigated. The PL spectra show a blue shift in DLE and the intensities of the DLE emission decreased due to the annealing temperature increasing. EDS peaks confirm the successful synthesis of ZnO film. The optical transparency of ZnO films was measured at different annealing temperatures and showed a visible transmittance of 94%. The optical band gap of ZnO film was increased as the annealing temperature increased. The XRD results show the deposited ZnO film has a hexagonal wurtzite structure. Diffraction intensity and crystal size increase with the increase in annealing temperature, while full width at half maxima decreases.

Keywords post annealing, photoluminescent, wurtzite structure

1. Introduction

Zinc oxide thin films have received a lot of attention due to their high potential for a variety of applications such as light-emitting diodes, solar cells, UV photo detectors, gas sensors, photocatalytic agents, transparent electrodes, and so on. They have unique physical and chemical properties, like high chemical stability, high photo-stability, a wide range of absorption light. It has an n-type semiconductor oxide material with a large band gap energy of 3.37 eV, a high exciton binding energy of 60 meV, a wide resistivity range, and high transparency at room temperature [1-3]. In the literature, several factors have been reported that influence ZnO thin films: shape, size, and optical properties, both individually and collectively. Precursors, concentrations, temperature, stirring time, duration, surfactant concentrations, dopant concentrations, and annealing temperature are all factors to consider during synthesis [4-5]. Spray pyrolysis, Pulsed laser deposition, chemical bath deposition, chemical vapour deposition and sol-gel are some of the methods now used to make ZnO thin films [6-9]. Among these methods, sol-gel is one of the best due to its simplicity and the low cost of the required equipment. In this work, the annealing effects of ZnO sol-gel deposited using the spin coating method onto glass samples were investigated. The primary goal of this work is to optimise ZnO thin film crystallinity using an annealing treatment. This post-annealing treatment was performed in an open air furnace to compare the effects on the crystalline orientation of ZnO thin films. Photoluminescence (PL), UV-Vis and X-ray diffraction (XRD) analysis were used to investigate the Photoluminescence and structural properties.