

Zinc Oxide Nanostructure by Oxidization of Zinc Thin Films

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ABSTRACT

The zinc oxide nanostructures were synthesized by oxidizing zinc thin films. The zinc thin films were grown on silicon and alumina substrates by dc sputtering at various times from 30, 60 and 90 minutes. The zinc thin films were then heated at various temperatures from 600, 800 and 900°C for 6 hr. The obtained zinc oxide nanostructures were investigated by Field Emission Scanning Electron Microscopy (FE-SEM). The zinc oxide nanostructures are found to have a potential application for nanodevices such as nano gas sensor.

Key words: Zinc oxide, Nanostructures, Oxidation, dc sputtering

INTRODUCTION

ZnO is an n-type wide band gap semiconductor with the band gap of 3.37 eV and has various potential applications such as optoelectronic devices, chemical sensors and gas sensors. Also, bio-safe characteristics of ZnO make them very attractive for biomedical applications. Moreover, ZnO in the form of nanostructures would enhance the gas-sensing properties of gas sensors due to a huge surface area. Thus, it is a great interest to study the synthesis of ZnO nanostructures.

ZnO nanostructures can be synthesized by several methods such as sputtering technique (Choopun et al., 2005(b)), vapor deposition (Chen et al., 2005), pulsed laser deposition (PLD) (Choopun et al., 2005(a)), metalorganic chemical vapor deposition (MOCVD) (Xu et al., 2005) and oxidation (Chen et al., 2004; Sekar et al., 2005; Zhang et al., 2005). The oxidation method is a simple, low-cost and most commonly used for the synthesis of ZnO nanostructures. Chen and co-workers (Chen et al., 2004) reported that ultra-fine ZnO nanowires could be easily synthesized at 800°C in air via oxidation of ZnO nanowires which was produced by heating ZnO+C mixture at 1,100°C under a flow of nitrogen gas. Zhang and co-workers (Zhang et al., 2005) have successfully synthesized ZnO nanostructures by oxidizing zinc foils at 700°C in air without the presence of catalyst and carrier gas. The different morphologies of ZnO nano- and micro-structures such as porous membrane, nanowires (or nanorods), nanobelts, nanoneedles and nanotetrapods have been achieved through tuning the heating rates in a tube furnace. Sekar and co-workers (Sekar et al., 2005) reported that ZnO nanowires were grown on Si (100) substrates by oxidation of metallic Zn powder at 600°C. Sea-urchin-like nanostructures, consisting of straight nanowires of ZnO with blunt-faceted ends, have been observed.

Most of the oxidation works were on the oxidation of zinc powder or zinc metallic foil or sheet. However, the work on the oxidation of zinc thin films has been rarely reported. In this work, we report on the preparation of ZnO nanostructures by oxidation of zinc thin films. The zinc thin films were prepared by dc sputtering technique.