INVESTIGATION OF ZINC OXIDE NANOSTRUCTURES PREPARED BY CHEMICAL DEPOSITION AND RAPID PHOTO-THERMAL PROCESSING TECHNOLOGY

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Abstract–*A novel and efficient low-temperature aqueous chemical method has been used to synthesize a new generation of smart and functional zinc oxide nanomaterials. The ZnO nanostructures are obtained and the physical and structural requirements of their applications in chemical sensors and solar cells are analyzed. Post-growth rapid photothermal annealing of nanostructures at 650 °C in an atmosphere of N_2 leads to the decrease in structure defects as compared to the as-grown nanostructures. The sensing behaviour of the nanostructured elements when exposed to 100 ppm ammonia is investigated.*

Keywords: *ZnO nanowires, RPP, sensor*

1. INTRODUCTION

Over the past years, attention has been focused on the understanding of the growth mechanisms and physical properties of the wide band gap nanostructured materials, such as nanowires, nanobridges and nanowalls, due to their potential in building novel functional nanometer-scaled devices [1-2]. ZnO has received considerable attention as a multifunctional material due to direct band gap energy of 3.37 eV, and a large exciton binding energy of 60 meV; higher than of ZnSe (20 meV) and GaN (21 meV), and is of interest for various high technology applications, such as optical devices, solar cells, piezoelectric devices, varistors, surface acoustic wave devices, and chemical sensors [3-7].

A key challenge in these investigations is to deposit nanostructures with consistent morphology and reproducible properties with long-term stability.

ZnO nanostructures have been prepared by different techniques such as metalorganic chemical vapor deposition, the vapor-liquid-solid method, thermal oxidation, molecular beam epitaxy, reactive sputtering, pulsed laser deposition, spray pyrolysis, sol-gel, chemical deposition, etc [1-7]. Among them, chemical deposition has attracted our interest for preparation of nanostructured functional metal oxides nano- and micro-particulate thin films due to its simplicity and low cost. These advantages result in a cost-effective processes that are environmentally benign, using uncomplicated equipment and easy-to-handle starting products. The post-growth annealing process is guided by the requirements of structure defect removal and electrical conductivity in metal oxide architectures. Lamp-based rapid photothermal processing (RPP) systems have been introduced as an alternative thermal annealing equipment solution. This is based on rapid radiative heating by using halogen lamps followed by cooling of substrates in air, or vacuum, or in inert atmosphere. The RPP system's halogen lamps provide both heating and radiation effects due to the wide spectrum from 0.4 μm to 1 μm [8].

Therefore, in the present work, a novel method combining the aqueous solution process with post-growth rapid photothermal procesing is proposed to develop ZnO nanostructures. We expected to obtain inexpensive nanostructures for nanodevices with applications in environmental and industrial monitoring and in medical diagnostics.

2. EXPERIMENTAL

Chemical deposition [9] is a method of growing thin films on a substrate immersed in aqueous solutions containing appropriate reagents at relative low temperatures (up to

1-4244-0847-4/07/$20.00 © 2007 IEEE