Zinc Oxide Nanowires by Oxidation of Zinc Powder for Ethanol Gas Sensor Application

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ABSTRACT

Zinc oxide nanowires were prepared by oxidation of zinc powder. The oxidation of zinc was performed by heating a tube of zinc powder at various duration times and temperatures. Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive Spectrometry (EDS) and Transmission Electron Microscopy (TEM) were used to characterize the tube. It was found that the diameter of zinc oxide nanowires ranged from 60–620 nm and depended on the heating time and temperature. Also, from TEM results, it was found that the obtained zinc oxide nanowires exhibited single-crystalline property. These zinc oxide nanowires could be used for ethanol gas sensor application.

Key words: Zinc oxide, Nanowires, Oxidation

INTRODUCTION

For gas sensor applications, ZnO is one of the promising metal oxide wide-band gap semiconductors. ZnO ceramic and thin film gas sensors were widely investigated in the past. However, ZnO nanostructure gas sensors are expected to possess high performance due to a huge surface-to-volume ratio of nanostructures. Therefore, it is essential to synthesize high-quality ZnO nanostructures.

ZnO nanostructures can be synthesized by various growth techniques, such as pulsed laser deposition, sputtering and oxidation. The oxidation technique is a simple, low-cost and most commonly used for the preparation of ZnO nanostructures.

Zhang and co-workers (Zhang et al., 2005) reported the growth of ZnO nano- and micro-structures by oxidation of zinc foils at 700°C for 15 min, with heating rates of 27.5, 68, 97 and 340°C/min. They found that the different morphologies of ZnO nanostructures such as nanowires, nanoneedles and nanotetrapods had been obtained through controlled heating rates.

Also, Sekar and co-workers (Sekar et al., 2005) obtained ZnO nanowires on Si (100) substrate by oxidation of zinc powders at 600°C for 90 min in oxygen and nitrogen ambient. They observed ZnO nanowires with diameters of 30–60 nm and lengths of 2–4 μm.

Meng and co-workers (Meng et al., 2005) reported the growth of ZnO nanowires on Si (111) substrate by oxidation of zinc powders at 430 and 520°C for 30 min in argon and nitrogen ambient. They observed needle-like ZnO nanowires with the length of 2.8–3.2 μm, a top diameter of 30 nm and root diameter of 100 nm at 430°C. They also observed rod-like