CuO Nanowires by Oxidation Reaction

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ABSTRACT

CuO nanowires were prepared by an oxidation reaction. For oxidation reaction, a copper plate was heated in a furnace tube under a normal atmosphere. The heating temperature was varied from 400, 500 and 600°C. The nanowires were then characterized by Field Emission Scanning Electron Microscope (FE-SEM), Energy Dispersive Spectroscopy (EDS) and Transmission Electron Microscope (TEM) for morphology, chemical composition and crystal structure, respectively. After heating, the color of the copper plate turned black. It was found that the black products were the copper CuO which exhibited nanostructure with a diameter ranging from 100–300 nm. The diameters of CuO nanowires was about 100 nm at the heating temperature of 400°C and about 200–300 nm at 500–600°C. Moreover, from cross-section of FE-SEM image, it suggested that the growth process began with the formation of thin layer of Cu_2O, then thick layer of CuO and finally, CuO nanowires.

Key words: CuO nanowires, Oxidation reaction

INTRODUCTION

CuO is a p-type metal-oxide semiconductor with a narrow band gap of 1.2 eV and a monoclinic crystal structure. It has received much attention due to a wide range of potential applications such as photoconductive, photothermal, catalysis and gas sensor (Hu et al., 2003). Also, CuO is an important building block of most high-temperature superconductors.

Recently, research community has a great interest on the nanostructures. The nanostructures would open new potential applications due to the distinctive and novel properties from conventional bulk materials. For example, the band gap of CuO nanoparticles (E_g= 2.43 eV) is much larger than that in bulk CuO (Huang et al., 2004).

CuO nanostructures can be synthesized by various techniques such as thermal evaporation (Huang et al., 2004), thermal decomposition (Xu et al., 2002) and oxidation (Xu et al., 2004(b)). The oxidation technique is a simple, cheap and most commonly used for the synthesis of CuO nanostructures.

Huang and co-workers (Huang et al., 2004) synthesized CuO nanowires by thermal evaporation of copper foil in O_2 ambient at the temperature from 300°C to 900°C. The diameter of nanowires was about 40–150 nm. Xu and co-workers (Xu et al., 2002) synthesized CuO nanorods by thermal decomposition of CuC2O4. The results showed that the nanorods were composed of CuO with diameter of 30–100 nm, and length ranging from 1 to 3 μm. XU and co-workers (Xu et al., 2004(a)) prepared CuO nanowires from copper foils,