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Magnetic and Photocatalytic Effect of Fe-doped Nano-rod ZnO Synthesized by the Hydrolysis of Metal Powders

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INTRODUCTION

Metal-doped ZnO is generally investigated in the form of diluted magnetic semiconductor (DMS) materials and photo-catalyst, because it shows much higher Curie temperature than room temperature, along with strong stability in UV light [1-2]. Especially, the Fe-doped case has been widely examined [1]. There are several methods for synthesis of Fe-doped ZnO nanopowder [3]. In this work, we have synthesized Fe-doped ZnO nano-rods using a simple process employing the hydrolysis of metal powders, and investigated micro-structure, photocatalytic effect, and magnetic properties as a function of Fe concentration.

EXPERIMENTAL TECHNIQUE

Fe-doped ZnO nano-rods (Fe= 0, 2, 5, 8, and 10 wt. %) have been synthesized by a novel process employing hydrolysis of nano-metal powders. Firstly, high purity Zn and Fe nanopowders were prepared by pulsed wire evaporation (PWE) method and then the spherical-shaped powders with average size of about 80-120nm were immersed into distilled water for the hydrolysis reaction. Hydrolysis has been carried out at 60°C for 24h to produce the precipitation of zinc hydroxide gel and iron doped hydroxide gel. The properties of the Fe-doped ZnO were investigated by the XRD, FT-IR, TEM, neutron powder diffraction and Mössbauer spectroscopy.

RESULTS AND DISCUSSION

Pure ZnO and Fe-doped ZnO have been simply synthesized by a novel hydrolysis method. The results of XRD, FT-IR and UV-vis spectra exhibited that the resultant precipitate materials were completely ZnO phase. The TEM result for ZnO and Fe-doped ZnO showed that the produced powders had rod-like shape. The phase transitions of iron and zinc are same, when the iron is mixed and reacted with zinc at same time. With increasing Fe content up to 5 wt.% the UV-vis spectra were shifted to the long wave length and this result indicates that the band gap was shifted by Fe-doping. The ferromagnetic phase increases with increasing Fe content.

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PA09

Synthesis of Barium Titanate Nanorods Using Hydrothermal Reaction of Potassium Titanate Nanostructures

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The barium titanate (BaTiO₃) nanorods was synthesized by the hydrothermal reaction using barium hydroxide octahydrate (Ba(OH)₂ · 8H₂O) and potassium titanate (K₂O · nTiO₂ · nTiO₂, n = 4 or 6) nanostructures that was prepared by a sol-gel method. Potassium tetra titanate (K₂Ti₄O₉) and potassium hexa titanate (K₂Ti₆O₁₃) nanorods as intermediates were prepared in the range of molar ratio of potassium methoxide (CH₃OK) to tetraethyl orthotitanate [Ti(OC₂H₅)₄] from 1:1 to 1:2 and the heating temperature from 800°C to 950°C. The intermediates having layered- and tunnel-structures through the hydrothermal reaction were transformed into BaTiO₃ nanorods that had tens of nanometers in a diameter, and lengths up to 2 μm, respectively. In order to get the structural information of as-synthesized BaTiO₃ nanorods, the structural refinement was carried out by Rietveld method using X-ray powder diffraction data at room temperature. The final weighted R-factor (R_{wp}) and goodness-of-fit (S = R_{wp}/R_p) were 10.33% and 1.18, respectively. The refinement results showed that BaTiO₃ nanorods were composed of a mixture of tetragonal phase with the mass fraction of 98.05(3)% and cubic phase with 1.95(4)%. The lattice parameters for cubic and tetragonal phases were a (= b = c) = 4.0134(2) Å and a (= b) = 4.0270(2) Å and c = 4.0222(2) Å, respectively.

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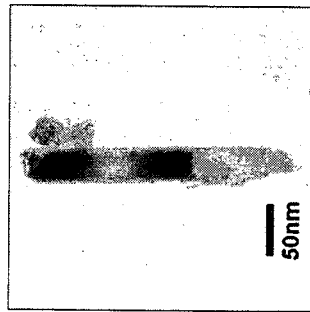


Fig. 1. TEM image for Fe-doped ZnO.