INVESTIGATION OF BANDGAP ENERGIES OF A SINGLE PHASE $Zn_{(1-x)}Cu_xO$ NANOPARTICLES

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PEMENANG
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Y. Bhg. Prof/Prof. Madya/Dr./Tuan/Puan

KELULUSAN SKIM GERAN PENYELIDIKAN FRGS FASA 01/2010

Tajuk Projek	:	Investigation Of Bandgap Energies Of Single Phase Zn (1-X) Cux O2 Nanoparticles
Kod Projek	:	600-RMI/ST/FRGS 5/3/Fst (37/2010)
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Dengan hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan pihak Kementerian Pengajian Tinggi melalui surat JPT.S(BPKI) 2000/011/010 Jilid. 2 (19) telah meluluskan cadangan penyelidikan Prof/Prof. Madya/Dr./Tuan/Puan untuk di biayai di bawah Skim Geran Penyelidikan Fundamental (FRGS) Fasa 1/2010.

Bagi pihak Universiti kami mengucapkan tahniah kepada Prof/Prof. Madya/Dr./Tuan/Puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

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Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar

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5.0 Report

5.1 Proposed Executive Summary

ZnO nanostructures are extensively studied due to their attractive characteristics and behaviour with wide band gap (3.4 eV) and large exciton binding energy (60 meV) Recently, there have been a lot of interests in studying modified ZnO nanostructures. The prospect of magnetically controlled operation of semiconductor devices has provoked intensive research to develop transition metal doped wide-band-gap semiconductors,i.e. diluted magnetic semiconductors (DMS) with room temperature ferromagnetism. Among transition metals, Cu is an especially interesting dopant because that Cu-related compounds are not strongly ferromagnetic. Transition metal-doped ZnO offers the potential for realizing room temperature operation of active spintronic devices as well as rich and fascinating fundamental physics.

The major focus of this research is to obtain the band gap of single phase $Zn_{(1-x)}Cu_xO_2$ from the optical absorption. Besides that, the aim of this research is to synthesize a single phase $Zn_{(1-x)}Cu_xO_2$ and characterize the single phase $Zn_{(1-x)}CuO_2$ material.

The material will be synthesized by using the sol-gel method. Thermal characteristics of the material will be studied using a simultaneous thermal gravimetric analyzer and from the results, a sintering temperature will be identified. Various characterization instruments will be used to investigate the properties of $Zn_{(1-x)}Cu_xO_2$ material. X-ray diffraction (XRD) will be used to analyze the crystalline structures. The materials will be characterized using a Field emission scanning electron microscope (FESEM) and a High Resolution Transmission Electron Microscope (HRTEM) to study the nano-structures and to see if these nano powders are crystalline or amorphous in nature.

This research will provide knowledge about the crystal parameters and properties of $Zn_{(1-x)}Cu_xO_2$ nanoparticles with bandgap energies.

5.2 Enhanced Executive Summary

In this work, Cu with concentration of 0.01 has been substitute into ZnO and this material has been synthesized by using sol-gel method which is an easy method and produces high yield of end products. The precursors were annealed at 6 different temperatures which were 400°C, 500°C, 600°C, 700°C, 800°C and 1200°C for 24 hours. The samples were characterized by using X-Ray diffraction (XRD) and Field Emission Scanning Electron Microscopy (FESEM). The band gap energies were analyzed by using UV-Vis spectrometry. Based on the XRD result, all materials were single phase with hexagonal wurtzite structure without formation of impurities like CuO. It indicates that the Cu has been successfully partly substituted into ZnO. According to FESEM result, the average particle size for 400°C, 500°C, 600°C, 700°C, 800°C and 1200°C were 75.366 nm, 82.400 nm, 132.630 nm, 312.530 nm, 665.200 nm and 6624.870 nm. The band gap energy values, determined from optical reflectance spectra shown that the band gap of materials decrease as the annealing temperature increase.

5.3 Introduction

Nowadays, Zinc Oxide (ZnO) has received great attention from many researchers and has become the promising candidates for semiconductor device applications. This is due to their properties that can be modifying for different applications. ZnO has wurtzite structure with direct and wide band gap (3.37eV at room temperature). It has being considered as strong competitor to GaN, which possess same wurtzite structure but the advantage of ZnO over GaN is that ZnO has large exciton binding energy (60meV) that should favor light emission at room temperature. ZnO has various applications such as in spintronics, pharmaceutical, light emitting diodes (LED), solar cell windows and piezoelectric transducers.

ZnO is a semiconductor and can only absorb ultraviolet radiation. In order to make them be able to absorb visible light radiation, other elements have been introduced into ZnO. It has been proven that by doping with other elements, the doped ZnO has been able to absorb visible light. The optical