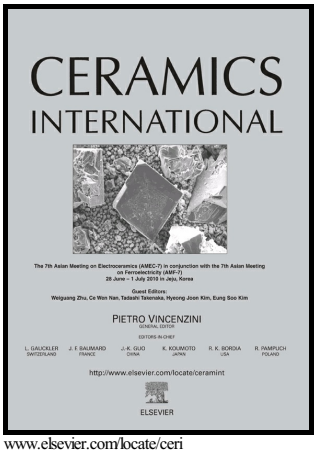

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PII: S0272-8842(17)30588-6
DOI: http://dx.doi.org/10.1016/j.ceramint.2017.03.201
Reference: CERI14970

To appear in: *Ceramics International*

Received date: 16 October 2016
Revised date: 25 February 2017
Accepted date: 31 March 2017

Cite this article as: Darshan Sharma and Ranjana Jha, Analysis of structural optical and magnetic properties of Fe/Co co-doped ZnO nanocrystals, *Ceramic International,* http://dx.doi.org/10.1016/j.ceramint.2017.03.201

Analysis of structural, optical and magnetic properties of Fe/Co co-doped ZnO nanocrystals

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Abstract

In this paper, the structural, optical and magnetic properties of pure ZnO and Fe/Co co-doped ZnO nanoparticles are presented. Rietveld refinement of XRD pattern revealed the single phase wurtzite structure for prepared samples. FTIR study confirmed the formation of tetrahedral coordination between zinc and oxygen ions. SEM and TEM techniques were used to examine the morphology of samples. The absorption spectra showed the decrease in optical energy band gap with Fe/Co co-doping in ZnO. PL spectra demonstrated five peaks correspond to the ultraviolet region, violet, violet-blue, blue-green and green in the visible region. Emission peak in the UV region is attributed to near band-edge excitonic emission. Other four emission peaks in PL spectra are related to different defect states. M-H curve showed room temperature ferromagnetic (RTFM) behaviour of doped ZnO sample. This paper enhances the understanding of structural, optical and magnetic properties of Fe/Co co-doped ZnO nanocrystals for application in spintronics, solar cells, and ceramics.

Keywords Dilute magnetic semiconductor; C. Optical properties; C. Magnetic properties; D. ZnO

1. Introduction

In spintronics, diluted magnetic semiconductors (DMSs) have attracted the great interest of numerous research groups [1–3]. Both spin and charge are utilized in spintronic device which includes LEDs, FETs, spin-based quantum computers, memory devices and solar cells. Room temperature ferromagnetism is most sought behaviour in DMSs for practical realization of spintronic devices. RTFM could be achieved through transitional metal (TM) ions doping in semiconductors[4–8]. Optical properties can also be tuned by doping of TM ions in semiconductors[4,5]. In addition, physical properties of nanocrystals can be modified with its size and surface functionality. Numerous research groups have studied the TM doped semiconductors with RTFM nature [9–15].

Zinc Oxide (ZnO) is an optically transparent II-VI semiconductor which has direct band gap (E_g~3.37 eV at 300 K), large exciton binding energy (~60 meV) and wurtzite crystal structure. ZnO is considered as a most popular host material for TM ions doping. Theoretical studies have predicted