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Synthesis, Characterization and Optical Properties of ZnO Nanoparticle

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Abstract

Zinc oxide nanoparticles have been synthesized by precipitation method from Zinc nitrate.The powder was obtained at 90^{0}C by a simple wet chemical route.The synthesized and Bulk Zinc oxide based thick film resistors were prepared by standard screen printing technique and annealed at 500^{0}C for 30 minutes. The ZnO thick films were characterized by X-ray diffraction (Structural), XRD patterns showed that ZnO nanoparticle has hexagonal wurtzite unit cell structure. The UV-VIS absorption spectrum shows an absorption band at 259 nm and 261nm due to synthesized and bulk ZnO powder sintered at 400^{0}C. FT-IR shows the absorption peak of synthesized ZnO and bulk ZnO was observed in the range 600-450 cm^{-1} and 400- 374 cm^{-}1 which are attributed to the stretching Zn-O bonds respectively. This IR suggests no hydrogen bonding was observed in the bulk ZnO whereas in synthesized ZnO hydrogen bonding was observed at 3414 cm^{-1}.

Key words: Zinc nitrate, Material behavior, UV-absorbance, FT-IR.

INTRODUCTION

Nowadays nanotechnology has drawn the attention of researchers worldwide due to the many innovations revealed by reducing the size of the materials to the nanoscale. Such innovations include very peculiar properties, different even from the material itself on a larger scale. A material is considered nanometric when its structural components have at least one dimension in the nanometer scale [1].There has been an increasing demand for the development of nanosized semiconductors due to their significant electrical, chemical, optical, magnetic and gas sensing properties which are useful in electronic devices with multi-functionality [2-4].Among various semiconducting materials, zinc oxide is one of the most studied materials in nanotechnology. Zinc oxide has hexagonal wurtzite structure, lattice parameters a= 3.2539AU and C=5.2098A^0 [2]. The material stands out among the semiconductors due to large band gap 3.34 eV associated with a high exction binding energy(60mev)[5,6].ZnO nanoparticles are promising candidates for various applications depend upon the control of both physical and chemical properties such as size, size dispersity, shape, surface state, crystal structure, crystal structure, organization onto a support and dispensability[7], such as nano-generatots[8], gas sensors[9], biosensors[10] solar cells[11] varistors[12], photo detectors [13] and photo catalysts [14]. It has found applications in various fields [15]. It is environmental friendly oxide, because of its nontoxicity and the ability to absorb in the UV range. It is as such as a UV absorbent in the sunscreen and in solar energy conversion [16] other applications of ZnO include optoelectronic devices, catalysts,photovoltaic devices, gas sensors, photo catalysis, cosmetics, varistors and pigments, transparent conducting coating and electrostatic transducers [17]. It is well documented that the shape and size of the material strongly affect the properties and the applications of the material. Reducing the size of the ZnO to the nanoscale changes its properties significantly [18-21]. Hence, much effort is being dedicated on controlling the size and shape of the