ISSN:0976-4933
Journal of Progressive Science
Vol.10, No.01 & 02, pp 9-11 (2019)

Synthesis and structural characterisation of ZnO nanoparticles

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Abstract

Zinc oxide (ZnO) nanoparticles have been synthesized using a chemical route. These nanoparticles have been produced using precipitation method.Properties of the Zinc oxide products was assessed. The resulting particles were characterized by X-ray diffraction (XRD, Rigaku D/MAX- 2200H/PC, Cu Kα radiation). The x-ray diffraction patterns shows peaks for synthesized ZnO nanoparticles as well as for annealed samples.

Introduction

Semiconductors nanoparticles have been widely investigated in past two decades, particularly due to their size dependent optical properties [1-4]. The various nanoparticles investigated so far. ZnO nanoparticles have gained much attention due to their potential applications in field emission displays, photo catalysis, phosphors, spintronics, cosmetics etc. [5-10]. Zinc oxide (ZnO) has wide band-gap energy (3.37 eV at room temperature) [11] which makes an excellent candidate for use in UV light emitting diodes (LEDs), LASERS, transparent transistors , gas sensing , pigments, sunscreens etc. There is also the desire to find new luminescent materials to use as biological levels for application such as flow cytometry, medical imaging and drug delivery. Furthermore, ZnO is an environmentally friendly material and is expected as the new materials for the future optoelectronic devices. In recent years, there have been numerous studies and various techniques have been used to synthesize ZnO nanoparticles, including sol gel method, hydrothermal synthesis, chemical vapor deposition, thermal oxidation etc .However, a comprehensive investigation of these aspects might gain more insight into the understanding of structural behaviors of ZnO nanoparticles. In this work, ZnO nanoparticles have been synthesized by precipitation method. The resulting products have been characterized by X-ray diffraction (XRD).

Materials and methods

In this work, precursor of zinc oxide nanoparticles was synthesized by precipitation method. The chemicals used for synthesis are Zinc acetate 2.1g in 100ml, Ammonium carbonate 0.96g in 100ml, Polyethylene glycols (5%) 5g in 100ml. Instruments used for synthesis are Muffle furnace, Magnetic stirrer, scanning electron microscope (JOEL MODEL 6390)and X-ray diffractometer (SHIMADZU-MODELXRD-6000).

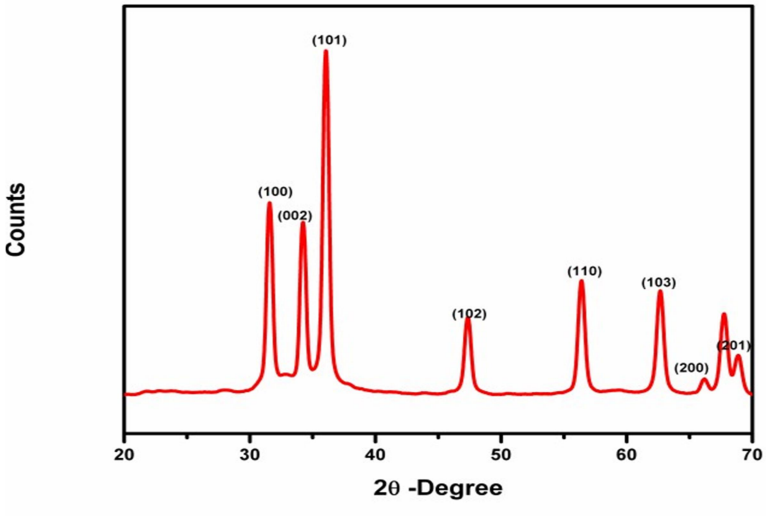
Synthesis of Zinc Oxide nanoparticles

The zinc oxide nanoparticles were synthesized by precipitation the surfactant Solution (5% PEG) was poured into a three- neck flask, then zinc acetate ,ammonium carbonate were dropped into the flask at same time with vigorous stirring[12].After the reaction, the suspension was kept under stirring for 2 hours at room temperature, precipitate was filtered washed with ammonia solution and absolute ethanol several times, dried under vacuum for 12 hours, and then calcinated in an oven at 450 ^{0}C for 3 hours. Then zinc oxide nanoparticles were obtained [13].

Results and discussion

Fig. 1 shows the XRD pattern of ZnO nanoparticles synthesized by precipitation method. The peaks are obtained nearly at 31^0, 34^0 , 37^0, 47^0 , 56^0, 62^0 , 66^0,67^0, 68^0.All of the peaks matched well with XRD pattern of Europium doped bunches of ZnO, which could be indexed as the hexagonal wurtzite structure of ZnO (P63mc, a=3.2498 Å, c = 5.2066 Å, JCPDS no. 36-1451).

Figure. 1. XRD pattern of ZnO nanoparticles synthesized by precipitation method



The broadening in the X-ray diffraction pattern indicate the nanocrystalline nature of material and are of high purity. Furthermore, it can be seen that the diffraction peaks are higher and narrower also, implying that the ZnO crystallizes well.

Conclusion

The Authors have been successfully synthesized ZnO nanoparticles by precipitation method. X-ray diffraction studies reveal the characterization through X-ray diffraction graph as shown in Figure 1.Here 9 peaks are noticed in accordance with zincite phase of ZnO. No peaks due to impurity were observed, which suggest that high purity zinc oxide was obtained. In addition the peak was widened implying that the particle size is very small.

Acknowledgement- Authors are thankful to the Department of Physics, B.H.U. Varanasi U.P. India for valuable support.

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Received on 13.10.2019 and accepted on 12.12.2019