ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.8

Synthesis and Characterization of ZnO Nanoparticles and ZnO/xSn2o3 Nanocomposites by Co-Precipitation Method

Kiruba.S[1] Bhavya.D[2], Revathi [3], Divya.S[4]
M.Phil Scholar[1, 3], Assistant Professor[2, 4]
Department of Physics
Prist University, India [1, 2, 3]
SRRCET, Amaravathipudur, India[4]

Abstract:
ZnO nanoparticle and ZnO/xSn2O3 nanocomposites were synthesized by co-precipitation method. In this method, zinc acetate and tin (II) chloride are taken in the ratio of 1:0.25, 1:0.5, 1:0.75, and 1:1.The synthesized nanocomposites are characterized using powder XRD, FTIR studies, DRS, photoluminescence, SEM and photo catalytic analysis. From the XRD results revealed that the nanocomposites composed of hexagonal wurtzite ZnO and triclinic structure of Sn2O3 nanoparticles. The crystallite sizes are changed unsystematically by increasing the mole concentration of Sn2O3 nanoparticles. From the FTIR studies, frequency assignments of the bands in the infrared spectra are performed for the ZnO nanoparticle and ZnO/xSn2O3 nanocomposites

Keywords: ZnO, xSn2O3, XRD, FTIR

I. INTRODUCTION

1.1 INTRODUCTION TO NANOTECHNOLOGY

Nanotechnology is actually the technology development at the atomic, molecular or macromolecular range approximately 1-100 nm to create and use structures, devices and systems that have novel properties [1]. Nanotechnology is the technology of building devices, such as electronic circuits, from single atoms and molecules. In the United states, nanotechnology has been defines as being " concerned with materials and systems whose structures and components exhibit novel and biological properties of phenomena and processes due to their nanoscale size [2].

1.2 NANOCOMPOSITES

In broad sense the word "composite" means "made of two or more different parts." A composite is a combination of two or more different materials that are mixed in an effort to blend the best properties of both." A composite material consists of an assembly of two materials of different natures completing and allowing as obtaining a material of which the set of performance characteristics is greater than that of the components taken separately. Mostly composite materials consist of one or more discontinuous phases of distributed in one continuous phase. A nanocomposite is a composite material, in which one of the components has at least one dimension that is nanoscopic in size that is around 10^{-9}m [3].

1.3 CLASSIFICATION OF NANOCOMPOSITES

On the bases of their engineering applications, nanocomposites can be classified as either,

- Functional materials i.e. based on electrical, magnetic, and or optical behavior, example is nanolayered semiconductor (semiconductor super lattice) composed of alternating layer of single crystal GaAs.
- Structural materials i.e. based on their mechanical properties.

Nanocomposites can be classified as:

- Polymer based nanocomposites
- Non-polymer based nanocomposites

II. MATERIALS AND METHODS

2. MATERIALS USED

2.1 ZINC ACETATE

Zinc acetate dihydrate is salt available as a fine white crystals which are easily soluble in water. In zinc acetate dihydrate the zinc is octahedral, where in both acetate groups arebidentate [6, 7].

2.2 TIN (II) CHLORIDE

Tin (II) chloride also known as stannous chloride, is a white crystalline solid. It forms a stable dihydrate, but aqueous solutions tend to undergo hydrolysis, particularly if hot. In a solid state crystalline forms chain linked via chloride bridges. The dihydrate is also three co-ordinate, with one water coordinate on to the tin, and a second water coordinate to the first. The main part of the molecule stacks into the double layers in the crystal lattice, with second water is sand witched with double layers [8].

2.3 SYNTHESIS OF THE ZnO/xSn2O3 NANOCOMPOSITES

ZnO/xSn2O3 photocatalysts nanoparticles were prepared by the co-precipitation method. Zinc acetate and tin(II) chloride were used as a starting material. Sodium hydroxide solution was used as a precipitating agent without further purification. The corresponding precursors of ZnO-xSn2O3 with the Zn/Sn molar ratios of 1:0.25, 1:0.5, 1:0.75 and 1:1 labeled respectively ZnO/0.25Sn2O3, ZnO/0.5Sn2O3, ZnO/0.75Sn 2O3 and ZnO/Sn2O3 respectively ZnSn0.25, ZnSn0.5, ZnSn0.75 and ZnSn were dissolved in ethanol. Then sodium hydroxide NaOH was added dropwise

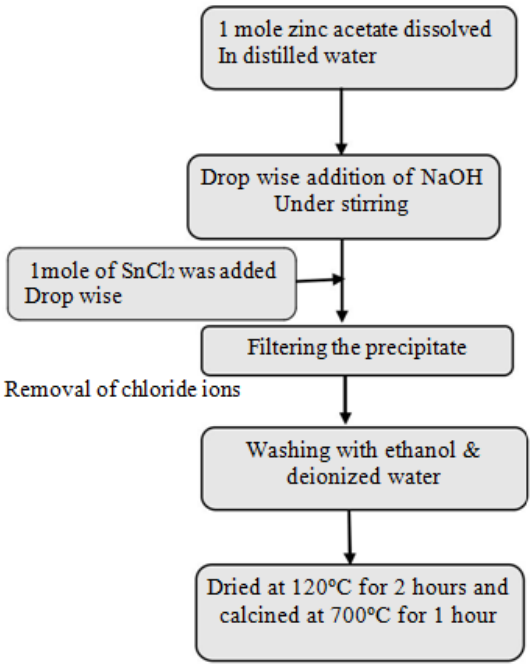

Figure.1. Flow chart for the synthesis of ZnO/xSn2O3 nanocomposite

III. RESULTS AND DISCUSSION

3.1 INTRODUCTION

Synthesis and characterization of nanomaterials created so much interest on research work. The size depended property of nanoparticles opened a new way to all fields of technology. While reducing the size of the particles, the properties such as physical, chemical, electronic magnetic etc changed numerously as compared with bulk materials of those particles. In this work, ZnO nanoparticle and ZnO/xSn2O3 nanocomposites were synthesized by co-precipitation method. These samples are subjected to various studies such as Powder XRD, FTIR, DRS, PL and Photo catalytic studies.

3.2 XRD ANALYSIS FOR ZnO/xSn2O3 NANOCOMPOSITES

The phase identification and structure analysis of the as-prepared samples were conducted by powder XRD. Powder X-ray diffraction patterns of pure ZnO and ZnO/xSn2O3 nanocomposites taken in the range of 10º to 80º.

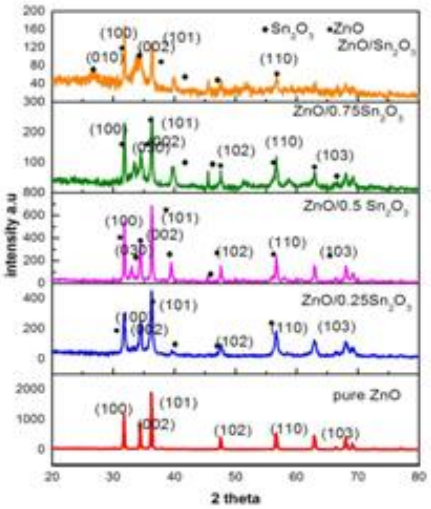

Figure.2. XRD pattern of the pure ZnO nanoparticles and ZnO/xSn2O3 nanocomposites

Table.1. XRD data for pure ZnO nanoparticles

2θ in deg.	FWHM (β)	Particle size D in nm	d-spacing (Å)	hkl value
31.7	0.1476	55.89	2.81848	100
34.4	0.1476	56.27	2.60640	002
36.2	0.1968	42.92	2.47919	101
47.5	0.2460	35.25	1.91209	102
56.5	0.2460	36.63	1.62622	110
62.8	0.2952	31.26	1.47873	103
66.4	0.2952	31.88	1.40761	200
67.9	0.2460	38.89	1.3798	112

Table.2. XRD data for ZnO/0.25mole Sn2O3

2θ in deg.	FWHM (β)	Particle size D in nm	d-spacing (Å)	hkl value
16.2	0.1476	54.30	5.46477	100
31.7	0.3444	55.89	2.81927	100
34.4	0.3936	56.27	2.60127	002
36.2	0.3444	42.92	2.47757	101
39.5	0.2952	28.34	2.27888	220
47.5	0.3936	35.25	1.91362	102
56.5	0.2952	36.63	1.62622	110
62.8	0.2952	31.26	1.47842	103
66.4	0.3936	31.88	1.40806	200
67.9	0.5904	38.89	1.37890	112

3.3 FTIR ANALYSIS FOR THE ZnO/xSn2O3 NANOCOMPOSITES

The FTIR spectrum of the sample acquired in the range of 4000cm^{-1} to 400cm^{-1}. Analysis of the ZnO nanoparticles and ZnO/xSn2O3 nanocomposites synthesized and annealed at 700ºC for 1 hour. The FTIR spectrum for the ZnO nano particles and ZnO/xSn2O3 nanocomposites are shown in Figure 4.2.

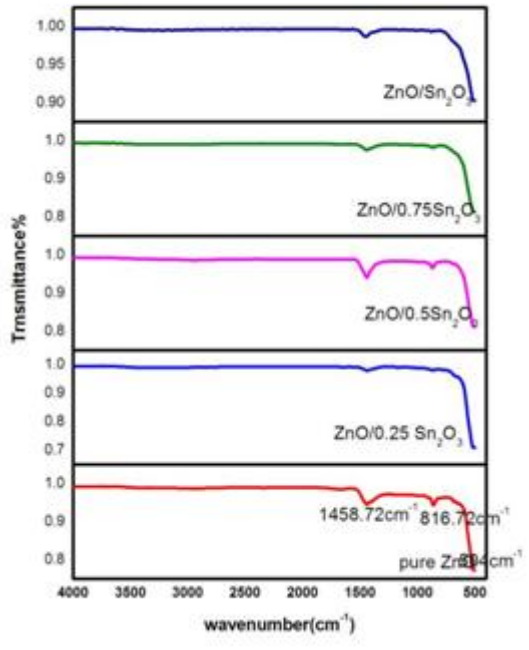

Figure.3. FTIR spectra for the pure ZnO nanoparticles and ZnO/xSn2O3 nanocomposites

3.4 DETERMINATION OPTICAL BAND GAP OF ZnO NANOPARTICLES AND ZnO/ xSn 2O3 NANO COMPOSITES

3.4. 1. Optical diffused reflectance of nanocomposites

UV-Vis diffuse reflectance spectroscopy is one of the most employed technique to describe the electronic behavior of the solid semiconducting materials by specifying the type of orbitals that are involved in the electronic transition [5].The spectrum diffused reflectance is a ratio of the light scattered from an infinitely thick layer and the scattered light from an ideal non-absorbing sample ia measured as a function of the wavelength [4].

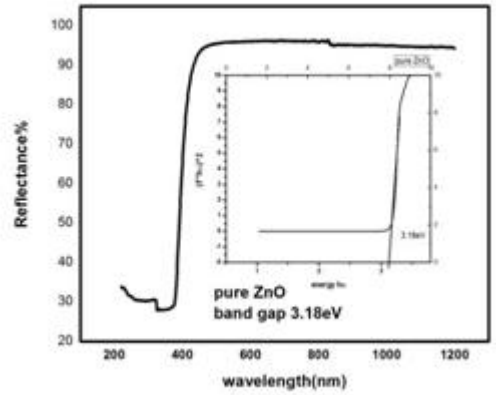

Figure.4. (a) DRS and band gap for undoped ZnO nanoparticle

3.4.2 Band gap determination from DRS

To determine the band gap of the as-synthesized samples UV visible spectrum were recorded in the Diffuse Reflectance mode using UV visible spectrometer. The percentage of reflectance transferred to absorbance using the Kubelka-Munk formula [77]. The kubelka-Munk theory was used to analyze and interpret the diffuse reflectance spectrum for pure ZnO nanoparticle and ZnO/xSn2O3 nanocomposites. Frequent use of diffuse reflectance spectra for the determination of electronic transitions in solid material is highly justified. The optical excitation of the electrons from the valence band to the conduction band is evidenced by an increase in the absorbance at a given wavelength *i.e.* band gap energy [5].

IV. REFERENCES

[1]. Morris Sylvin, "Nanotechnology", ISBN: 9788176256667 8176256668 309 Yr. of Pub.2006 Hard Bound English Sarup & Sons, New Delhi.

[2].ShaliniSuri, "Nanotechnology Basic Science to Emerging Technology", APH Publishing Corporation, New Delhi, 2006.

[3].http://www.academia.edu/3038972/Nanocomposites_ and_its_Applications-Review.

[4].M. Hefez, I.S. Yahia, S. Taha, Spectrochimica Acta Part A: Molecular and Biomolecular spectroscopy 1127 (2014) 521-529.

[5]. Mohammed Mansoob Khan, Sajid Ali Ansari, Jintae Lee, Hwan Cho, Journal of Industrial and Engineering Chemistry 19 (2013) 1845 – 1850.

[6].Van Niekerk J.N, Schoening F.R.L, Talbot, J.H. (10 September 1953), Acta Crystallographica 6 (8): 720– 723.

[7].Ishioka. T, Murata A, Kitagawa Y, Nakamura K. T., (15 August 1997), Acta Crystallographica Section C Crystal Structure Communications 53 (8): 1029– 1031.

[8].http://en.wikipedia.org/wiki/Tin(II)_chloride

[9]. N. Uma sangari, S.Chitra Devi, Journal of solid state chemistry 197 (2013) 483-488