Qualitative Studies of Zinc Oxide (ZnO) Nanoparticles grown by Hydrothermal Technique

[1]Neel A. Patel , [2]I. B. Patel
[1, 2] Department of physics, Veer Narmad South Gujarat University, Surat, India
Email-[1] Neelpatel5533@yahoo.com

Abstract: *In this study Zinc Oxide Nanoparticles was grown by Hydrothermal Technique using the solution of zinc acetate dehydrate ($Zn(CH_3COO)_2.2H_2O$) (0.1M in 50ml methanol) and Sodium Hydroxide (NaOH). We get the white solid powder from the stock solution by maintaining temperature 180°C for 12 hours into Teflon lined sealed cylindrical flask autoclaves, Quantitative result of Zink and oxygen was obtained by Energy-Dispersive X-Ray Spectroscopy.*

Key Words: *Zinc Oxide, Hydrothermal,Energy-Dispersive X-Ray Spectroscopy.*

1. INTRODUCTION:

Zinc Oxide is the one of the most important n-type semiconductor materials with a 3.37 eV band gap at room temperature and 60 meV excitation binding energy that is in the UV region and makes this nanoparticle as an efficient UV absorber.[1] Semiconductor nanomaterials have been received great attentions. Among these various semiconductor nanomaterials zinc oxide is a versatile material because of its physic-chemical properties such as mechanical, electrical, optical, magnetic and chemical sensing properties.[2] Zinc oxide a chemical compound found naturally in the mineral called zincite has attracted much attention in recent times due to its low cost and because it can be obtained by simple techniques.[3] Chemical synthesis is one of the most important techniques which can be performed by using a range of precursors and different conditions like temperature, time, concentration of reactants, and so forth. Variation of these parameters leads to morphological differences in size and geometries of resulting nanoparticles. Among the nanoscale metal oxides, Zinc Oxide is a common host material that has been widely used due to its excellent chemical and thermal stability, low cost and environmental-friendliness.[4] In this study, ZnO particles have been produced by hydrothermal method using Zinc Acetate Dehydrate ($Zn(CH_3COO)_2.2H_2O$) (0.1 M), Sodium Hydroxide (NaOH) and Methanol. Nanoparticles quantitative and qualitative composition analysis studied by Energy-Dispersive X-Ray Spectroscopy.

2. MATERIALS:

The chemicals used in this experiment are Zinc Acetate Dehydrate ($Zn(CH_3COO)_2.2H_2O$) (0.1 M), Sodium Hydroxide (NaOH), Methanol. All the Chemicals for the experiment were highly pure and there was no delay for their utilization for the experiment after receiving them.

3. METHOD:

In order to synthesize the ZnO nanoparticles, stock solutions of zinc acetate dehydrate ($Zn(CH_3COO)_2.2H_2O$) (0.1M) was prepared in 50ml methanol under stirring. To this stock solution 25ml of Sodium hydroxide NaOH (varying from 0.2 M to 0.5 M) solution prepared in methanol was added under continuous stirring in order to get the pH value of reactants between 8 and 11. These solutions was transferred into Teflon lined sealed cylindrical flask autoclaves and maintained at temperature 180°C for 6 to 12 hour under autogenous pressure. It was then allowed to cool naturally to room temperature. After the reaction was complete, the resulting white solid products were washed with methanol, filtered and then dried in air in a laboratory oven at 60°C. [5]

4. RESULT AND DISCUSSION:

We get the white solid powder from the stock solution by maintaining temperature 180°C for 12 hours, it turns lemon yellow on heating and reverts to white on cooling. The crystalline size of the prepared nanoparticles where determine by scherrer's equation and it was in the range of 28 nm [5] [8].

Energy-Dispersive X-Ray Spectroscopy (EDS)

The EDS system which is interfaced with electron microscopy (SEM, FE-SEM, and HR-TEM) is used for the composition analysis, presence of coating layer, and atomic composition analysis of ZnO. For obtained material the peaks observed in the spectrum related to Zinc and Oxygen. The elemental constitution of ZnO nanoparticles with two

major peaks was found to have weight percentage 73.77 of Zinc and 26.23 of Oxygen. The prepared ZnO nanoparticles have atomic percentage 40.76 of Zinc and 59.24 of oxygen.

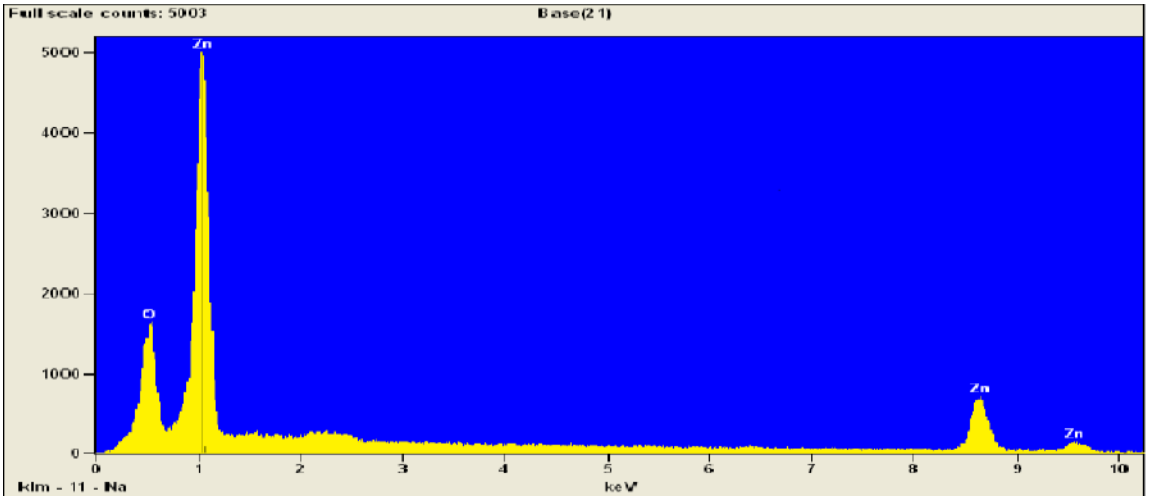

Figure 4.1: EDS spectra of ZnO Nanoparticles.

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Date: - 11.03.2016
Sample Name: - ZnO

Quantitative Results Base (21)

Element	*Net Counts*	*Net Counts Error*	*Weight %*	*Atom %*
O	19956	+/- 324	26.23	59.24
Zn	15329	+/- 349	73.77	40.76
Zn	76103	+/- 587	---	---
Total			100.00	100.00

Table 4.1: Quantitative result of Zink and oxygen

Table 4.1 shows the photographs of ZnO particles prepared by Hydrothermal method from the solution of zinc acetate dehydrate ($Zn(CH_3COO)_2.2H_2O$) (0.1 M) (in 50ml methanol) and Sodium Hydroxide (NaOH), It shows the nanosize particles with uniform particle size distribution and their morphology was grain-like.

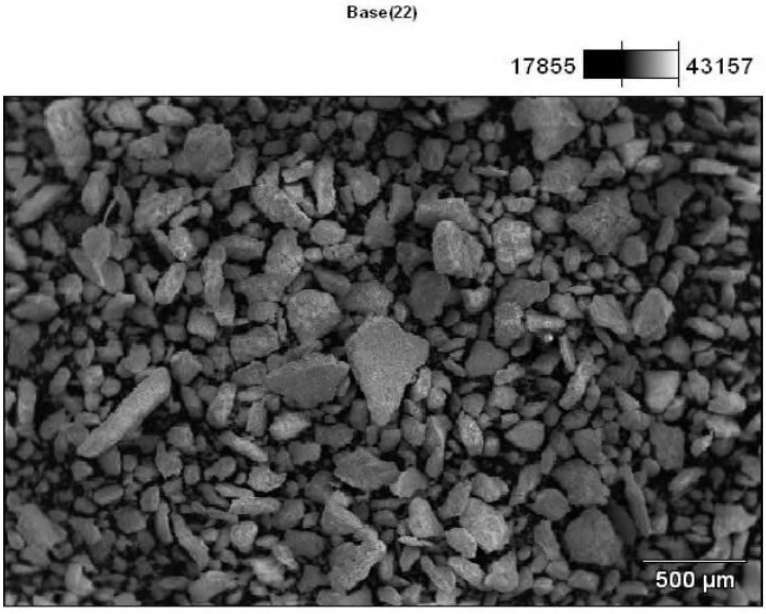

Figure 4.2: EDS image of the ZnO nanoparticles.

5. CONCLUSION:

From the hydrothermal method we successfully synthesised the ZnO nanoparticles. Chemical purity and stochiometry of the sample were examined using EDS. The strong peak observed in the spectrum confirms the presence of Zinc and Oxygen. The developed ZnO nanoparticle has atomic percentage 40.76 of Zinc and 59.24 of oxygen. The elemental constitution of ZnO nanoparticles was also investigated. Two major peaks were found to have weight percentage 73.77 of Zinc and 26.23 of oxygen.

6. ACKNOWLEDGEMENT:

The Author expresses his sincere gratitude towards Prof. Dr. I. B. Patel, Department of Physics, Veer Narmad South Gujarat University, for his valuable suggestions, and thanks to Head of Department of Physics, VNSGU, Surat for gave us necessary facilities. The Author Also thanks to Mechanical Department of Sardar Vallabhbhai National Institute Technology, Surat.

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