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NOTE

Synthesis and Characterization of Zinc Oxide Nanoparticles by Modified Sol-Gel Method

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In the present work a modified sol-gel method is used for the synthesis of ZnO nano particles using zinc acetate dihydrate, ethylene diaminedihydrochloride and NaOH as precursors and poly(vinyl pyrrolidone) as surfactant to control the morphology and shape of synthesized ZnO nanoparticles. Poly(vinyl pyrrolidone) are used as capping agent and distilled water as solvent, using magnetic stirrer. The synthesized ZnO nano particles are dried in oven at 100 °C for 2 h and then calcinated at 500 °C in muffle furnace for 2 h. The synthesized nanoparticles were characterized by using X-ray diffraction, scanning electron microscopy, energy dispersive X-ray spectra and Fourier transform infrared spectroscopy.

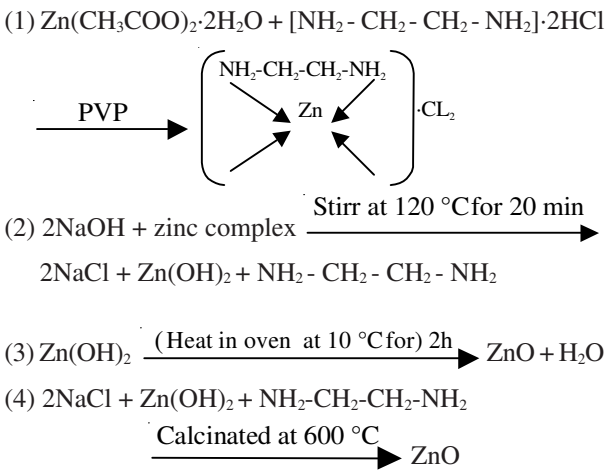
Keywords: ZnO, Sol-gel method, Nanoparticles, X-ray diffraction, Scanning electron microscopy, TGA, FTIR.

In the present era synthesis of nano-material with specific size and morphology has gained importance due to its use in various fields. Zinc oxide is *n*-type semiconductor and has direct wide band gap of 3.37ev and large exciton binding energy of 60 mev at room temperature[1,2]. It is used in gas sensors, near UV emission, piezoelectric application and transparent conductor[3-5]. It is widely used in solar cells, luminescent material, electrical and acoustic devices, gas and chemical sensors, coatings material, as catalysts, in micro lasers, memory arrays and biomedical applications[6-8]. Various methods are used for the synthesis of ZnO nano particles like solid state reaction[9,10], hydro thermal[11], son chemical assisted[12], micro wave assisted combustion[13] and by polyol synthesis[14]. Sol-gel method[15-17]. In the present work ZnO nano particles has been synthesized through modified sol-gel process, using zinc acetate dihydrate, ethylene diaminedihydrochloride as precursors. Sol-gel is easy and low cost method.

The precursors used for the synthesis of ZnO nanoparticles is zinc acetate dihydrate, sodium hydroxide, poly(vinyl pyrrolidone), ethylene diaminedihydrochloride. Dissolve 5.39 g of zinc acetate in 50 mL distill water and stir on magnetis stirrer at 700 rpm for 20 min, in second beaker dissolve 2 g of ethylene diaminedihydrochloride in 50 mL distil water and stir on magnetic stirrer for 20 min and also dissolve 1 g of sodium hydroxide and 1 g poly(vinyl pyrrolidone) in 50 mL distilled water. Now mix 50 mL of zinc acetate solution, 30 mL of ethylene diaminedihydrochloride in 1000 mL beaker, with drop wise addition of NaOH solution (30 mL) and also add 20 mL of PVP and stir on magnetic stirrer at 120 °C for 20 min at 500 rpm. White ppt obtained is left for 0.5 h; filter and wash with distilled water for 5-6 times. Dry in oven at 100 °C for 2 h, now ground it in pestle & mortar using agate pestle and mortar and calcinated at 500 °C in muffle furnace for 2 h[15-17], process given in **Scheme-I**.

Zinc oxide nano particles have been synthesized through modified sol-gelprocess[16] and were characterized by X-Ray diffraction technique as shown in Fig. 1. XRD data of synthesized material is matched with refrence 00-001-1136 which confirm zincite phase of the synthesized material.

SEM micrograph of the synthesized material shows spherical morphology and particles size ranges from 40-60 nm. EDX spectra shows metal to oxygen ratio is 52:47 and in pure form (Fig. 2).



Scheme-I: Synthesis of ZnO nanoparticles

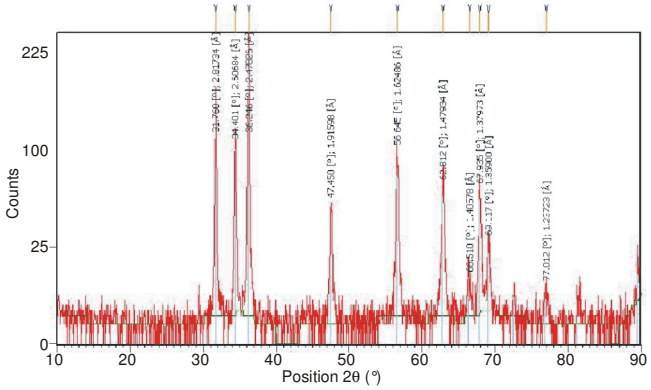


Fig. 1. X-ray diffraction pattern of synthesized ZnO nanomaterial

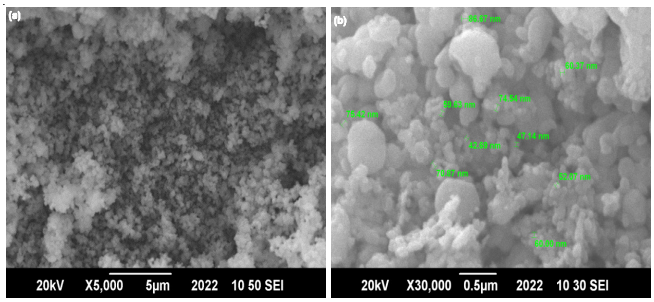
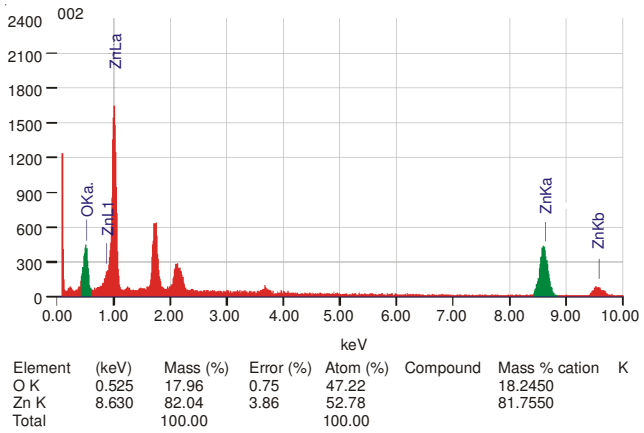


Fig. 2. SEM micrograph of synthesized ZnO nanoparticles (a) and (b)

EDX spectra of synthesized material shows that synthesized material is pure with no impurities and their metal to oxygen ratio is 52:47 (Fig. 3).

Conclusion

Zinc oxide nanoparticles were synthesized by modified sol-gel process by keeping proper stirring and temperature of the mixture. XRD result of the synthesized material shows



Element	(keV)	Mass (%)	Error (%)	Atom (%)	Compound	Mass % cation	K
O K	0.525	17.96	0.75	47.22		18.2450	
Zn K	8.630	82.04	3.86	52.78		81.7550	
Total		100.00		100.00			

Fig. 3. EDX spectrum and list of elements present in the sample

hexagonal phase formation and SEM micrograph shows that the particles are spherical in shape and their size ranges from 40-60 nm. EDX of synthesized zinc oxide nanoparticles shows metal to oxygen ratio is 52:47 and in pure form with no impurities.

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