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EFFECT OF SURFACTANT AND ANNEALING TEMPERATURE ON Cu-ZnO NANOCRYSTALLINE PARTICLE SIZE

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ABSTRACT:

The current article presents the effect of different annealing temperature and the use of surfactant i.e. Triton x 100 in the particle size and shape of 5% copper doped zinc oxide nanocrystalline particles. EDAX results confirms the doping of copper in zinc oxide whereas SEM results successfully demonstrates the increase in particle size with increase in temperature and also the size lowering effect of surfactant used on the particles as the particles formed without surfactant are agglomerated.

Keywords: Copper doped ZnO, Zinc oxide, Triton x100, Annealing temperature, Cu-ZnO

INTRODUCTION:

Nanocrystalline materials have attracted a wide attention in the field of material science and technology due to their unique properties and immense potential in various applications. ZnO is one of the most studied metal oxide semiconductor due to its potential in many application areas [1-3]. A ZnO nanomaterial has shown the unique multifunctional properties [4] and also shows a high exiton binding energy (60 meV) with a direct band gap of 3.37eV [5]. Metal doping is effective way to modify grain size, crystalline structure, phase and other properties successfully [6]. Crystalline parameters of nanomaterials synthesized with the help of co-precipitation method can be modified [7-9] and controlled by altering various operating parameters such as operating temperature, solvent properties, annealing temperature, use of different surfactant etc.

Experimental Details:-Materials:

The materials used in this experiment are copper sulphate pentahydrate ($CuSO_4.5H_20$), Zinc Sulphate ($ZnSO_4.7H_20$), Sodium hydroxide flakes (NaOH) which are all obtained from “Finar India”. The surfactant used Triton X 100 were produced from “Aldrich”. All chemicals used are of A R grade without further purification.

Experimental Method:

Two types of procedures were used in order to prepare Nano crystalline, copper doped zinc oxide nanoparticle. In first batch Zinc Sulphate haptahydrate and copper sulphate were mixed together with a molar ration of 95:5 respectively in 440 ml of deionized water. Second batch was prepared by mixing Triton-X 100 in 440 ml of water. To make 1% w/w Triton X-100 solution. Zinc Sulphate and copper sulphate were again mixed together in which solution with a molar ration of 95:5 respectively. Rest of the procedure is same as before until final preparation of samples (of batch 1 & 2).A 3 Molar solution was prepared by adding 60 g of Sodium Hydroxide flakes in deionized water to prepare 500 ml solution. This Sodium hydroxide solution was added drop wise in the precursor bluish solution with constant stirring maintained at 450 rpm at room temperature. In both the solutions gelatinous bluish colored precipitate was observed. Both the solutions were constantly stirred at 600rpm at room temperature for 2 hours. Both the precipitated solutions were filtered out using Buchner funnel and Whatman paper using vacuum setup. Filtrate was washed several times using deionized water and acetone in order to remove residual and unwanted impurities. The yield product was then dried in hot air oven at constant temperature of 80 C for 12 hours. The dried patch was those subjected to heat treatment at different temperatures (300’C, 550’C, 750’C) for two hours each.

Results and Discussion:

EDAX results:-EDAX (JEOL-5610LV) confirmed the composition of copper doping in ZnO ass the copper was found to be 5.67% by weight for Table.1. This successfully confirms that co-precipitation method is a successful method for the doping of copper in ZnO. EDAX results also confirm the homogenous doping of copper in Zinc oxide nanocrystalline samples.

Element	Weight%	Atomic%
O K	13.69	36.58
Cu L	5.47	3.94
Zn L	80.84	54.91

Table.1 EDAX results of doped Cu-ZnO

SEM analysis:-

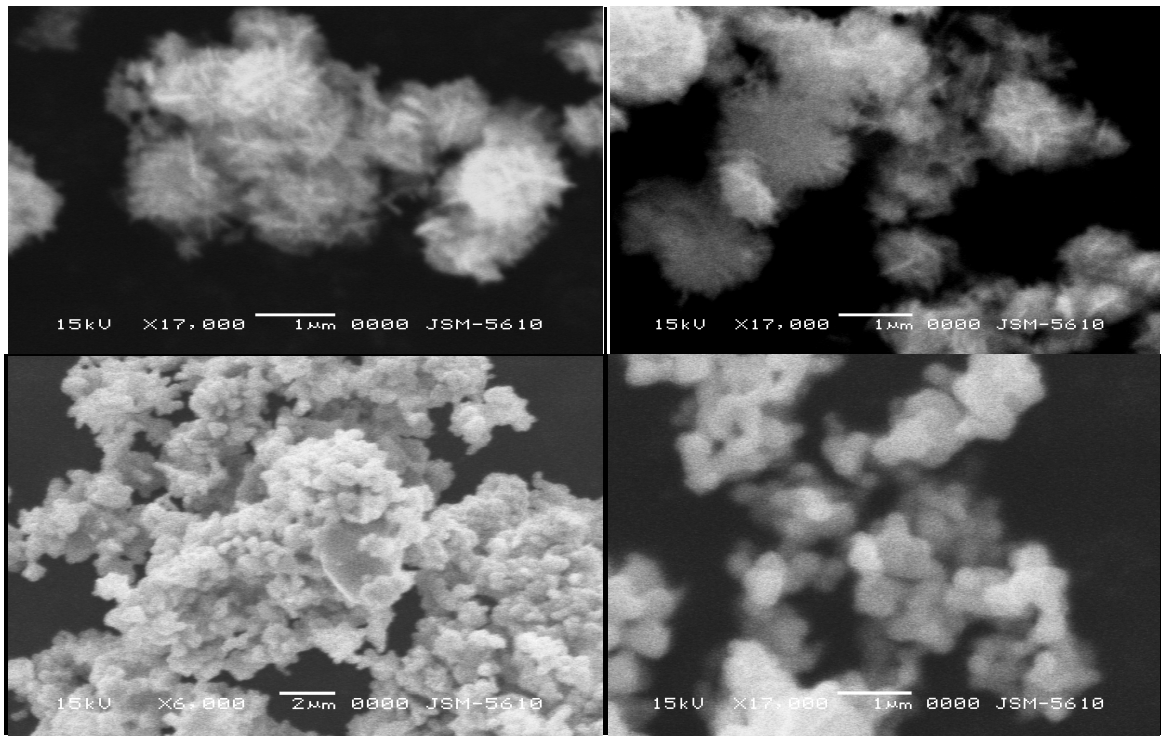

Figure1 a) At 300°C with Triton X100 **b)** At 550°C with Triton X100 **c)** At 750°C **d)** At 300°C without surfactant.

SEM (JEOL-5610LV) results for cu doped ZnO at various temperatures (300'c, 550'c, 750'c) as shown in Fig.1. These results confirms the nanorod formation as the nanorod were clearly visible in Fig.1-a and Fig1-b for temperature 300'c and 550'c respectively. SEM results also confirm the increase in particle size with increase in heat treatment temperature. As the average size was found to be ranging between 40-160nm for the temperature ranging from 300-750'c respectively.SEM results also confirms the agglomeration phenomena in the samples prepared without the use of surfactant(Triton X100) so no further investigation has been done. This result also successfully confirms the particle size lowering effect of surfactant used as reported [10].

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