SYNTHESIS AND CHARACTERIZATION OF NI DOPED CUO NANOPARTICLES FROM AQUEOUS SOLUTION

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Abstract

In this present work, Nickel doped copper oxide nanoparticles were effectively prepared by simple precipitation method. The applications of Metal oxide nanoparticles contain become gradually more relevant ranging from semiconductor to medical health industries. Ni-doped CuO nanoparticles with doping concentrations ranging from 0.5% were prepared by simple precipitation method. The structural, morphological, compositional and optical properties of Ni-doped CuO nanostructure were analyzed by Fourier transform infrared spectroscopy (FT-IR) Scanning electron microscopy (SEM), Energy dispersive analysis of X-rays (EDAX).

Keywords: X-ray diffraction, hydrothermal, NiCl. Nano structured materials, FT-IR, SEM, EDAX.

1. Introduction

Pure and Ni2+ doped copper oxide (CuO) nanoparticles were synthesized by the Simple solvothermal method. Effect of concentration of the dopant (2.5.57.5 and 10 mole%). The PL results showed that Ni2+ dopant did not give rise to a new PL signal. But it could improve the intensity of PL spectra with an appropriate Ni2+ content. Which was possibly attributed the increase in the content of surface oxygen vacancies and defects after doping Ni2+ [1]. We have synthesized pure and Ni doped CuO nanoparticles using a simple and low cost sol – gel combustion process. The aim of the paper is to evaluate the changes in the structural, morphological and optical properties of CuO nanoparticles brought about through successful doping with Ni as a dopant [2]. The Cu doped NiO (NiO:Cu) nanoparticles were synthesized by co precipitation method using $NiCl_2.6H_2O$,$CuCl_2.2H_2O$ for Ni and Cu sources, respectively. Sodium hydroxide has been used as a precipitator agent [3]. Transition elements (Ni&Cu) doped Zinc Oxide is prepared. All the samples were prepared by chemical co-precipitation method, by using sulfates of metallic precursors. We have doped pure ZnO with Ni and Cu by 3% by weight concentration.[4].we report the effect of doping on the structural and optical properties of CuO nanocrvstals synthesized by the sol-gel method at different doping concentrations of Ni+2 ions . it is observed that the particle size of CuO nanostructures increases while optical band gap decreases as we increase the doping concentration.[5]. Pure Nckel doped ZnO nanoparticles were synthesized by using hydrothermal decomposition and XRD results show information about various crystalline aspects. The FTIR analysis had shown the presence of the chemical groups with every detail and the UV-Visible spectrophotometric analysis showed the optical band gaps. Moreover, the antibacterial study provided the information about the potential of the nanoparticle to inhibit the growth of bacteria that is evident from the inhibition zone [6].

In this report. We have synthesized pure and Ni doped CuO nanoparticles using a simple and low-cost sol-gel combustion process. The aim of this paper is to evaluate the change in the structural, morphological and optical properties

of CuO nanoparticals brought about through successful doping with Ni as a dopant.

2. Experimental Details

The Cuo doped with NiCl2 nanoparticles were synthesized by the following reaction

CuCl2, 8.524g and NaOH, 2g was dissolved in 100 ml of double distilled water and stirred for 2 hrs. At 80°C to obtain a clear solution, the cyclohexane was added into the prepared clear solution and maintained in a beaker. In the meantime, 1.54g of Nickel chloride was dissolved in 20 ml of distilled water and added into the beaker by dropwise under vigorous stirring. The mixture was maintained at the standard temperature. The mixture was centrifuged and washed with ethanol then dried at 700°C using the micro oven. Finally, the green color powder was obtained.

3. Result and Discussion

3.1 Fourier transform Infrared (FT-IR) study

Fourier transform infrared spectroscopy is a technique which is used to examine the vibrational frequencies of bonds in the molecule and to characterize the surface nature of copper oxide nanoparticles. FT-IR spectra of doped Ni nanoparticles were recorded in the range of 4000-400 cm-1 and presented in Fig(). The bands at 3431 cm-1 and 1624 cm-1 respectively correspond to stretching and bending vibrations of O-H mode [7]. The absorption bands at 1401 cm-1correspond to C=O stretching of carboxylate ions [8]. The absorption bands at 1122 cm-1 indicate the existence of carbonates corresponds to C-H stretching mode [9]. The samples show absorption bands at 1106 cm-1 may be attributed to OH bending vibrations Cu-OH [10]. The peaks around at 643-987 cm-1 are associated with the metal – oxygen stretching of CuO[11]. The absorption bands at 455 cm-1 are associated with Ni-O vibration bond [12]. The strong absorption band at 514 cm-1 is related to the vibration of the Cu-O stretching. The obtained value is in good agreement with the published literature [13-15]. The above information confirms the formation of single phase Ni-doped CuO nanoparticles[16.17].

Observed Values(Frq cm^{-1})	Reported Values (Frq cm^{-1})	Assignment
3449.09	3431	O-H stretching vibrations
1624.65	1627	O-H bending vibrations
1401.37	1406	C=O stretching of carboxylate
1122.96	1117	C-H stretching vibration
1106.81	1109	OH bending vibrations
643.88 - 987.75	588 – 1020	metal – oxygen stretching of CuO
514.62	525	Cu-O stretching vibration
455.88	454	Ni-O vibration bond

Table 2. Assignment of FT-IR absorption bands in the spectra of CuO

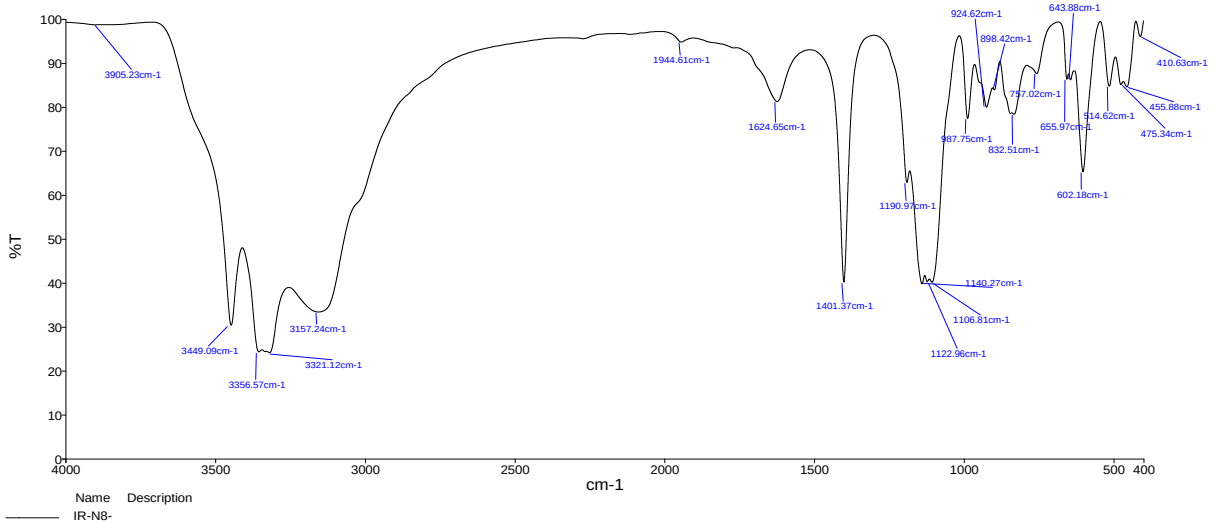

Figure 2. FT-IR spectrum of Ni & CuO nanoparticles

3.2. Scanning electron microscopy (SEM) Analysis

The morphology of the prepared nanoparticles was examined using SEM.The surface morphology of the copper oxide nanoparticles.SEM image shows individual copper oxide nanoparticles as well as a number of aggregates. The SEM images show most of the nanoparticles are spherical shape particles of the prepared CuO nanoparticles as shown in fig (2).

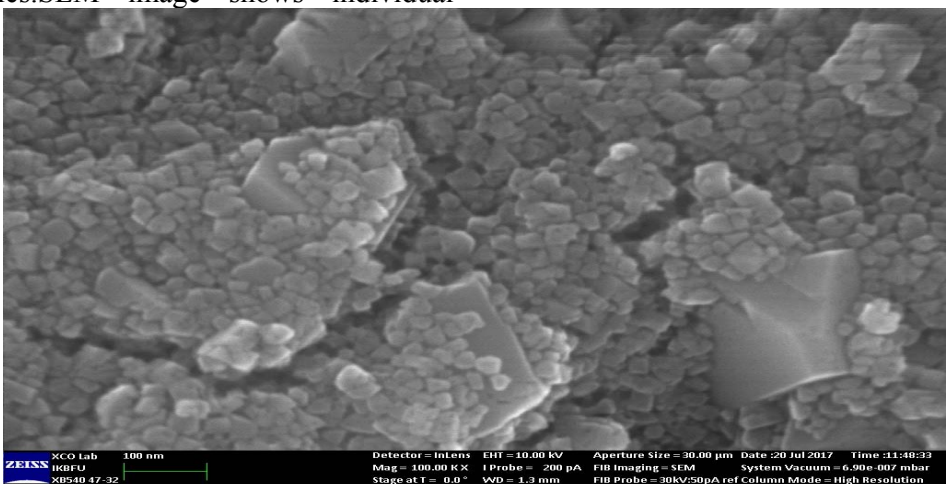

Figure 2: SEM image of Ni & CuO nanoparticles

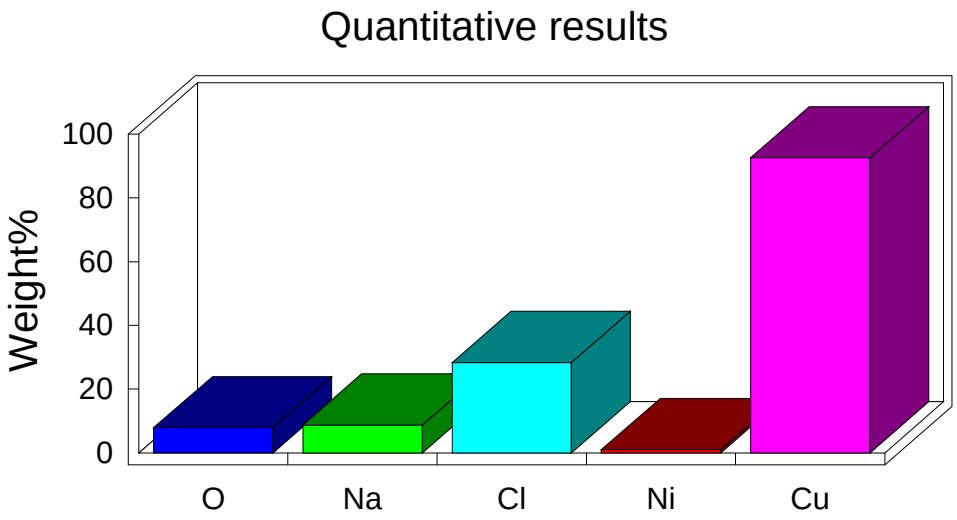

Figure 3: corresponding EDX results of Ni & CuO nanostructures

3.3 Energy dispersive X-ray Diffractive (EDX) analysis

The EDAX profile of prepared Ni-doped Cu nanoparticles is shown in the figure. It is evident from the EDAX spectra, no other elemental peaks other than Ni, O, Cl, and Cu are observed.Besides the EDX spectrum of the samples shows that Cu peak intensity increase as doping concentration level decrease the presence of dopant was confirmed by EDAX spectrum. The quantitative results of Ni-doped Cuo. The quantitative results show the presence of the quantitative results show the presence of 92.54% Cu, 1.06% Ni, and Na 8.64% and 7.88% oxygen and hence indicate the purity of CuO nanoparticles. It is also evident to notice that the prepared Ni-doped CuO compositions are pure and free of elemental impurities.

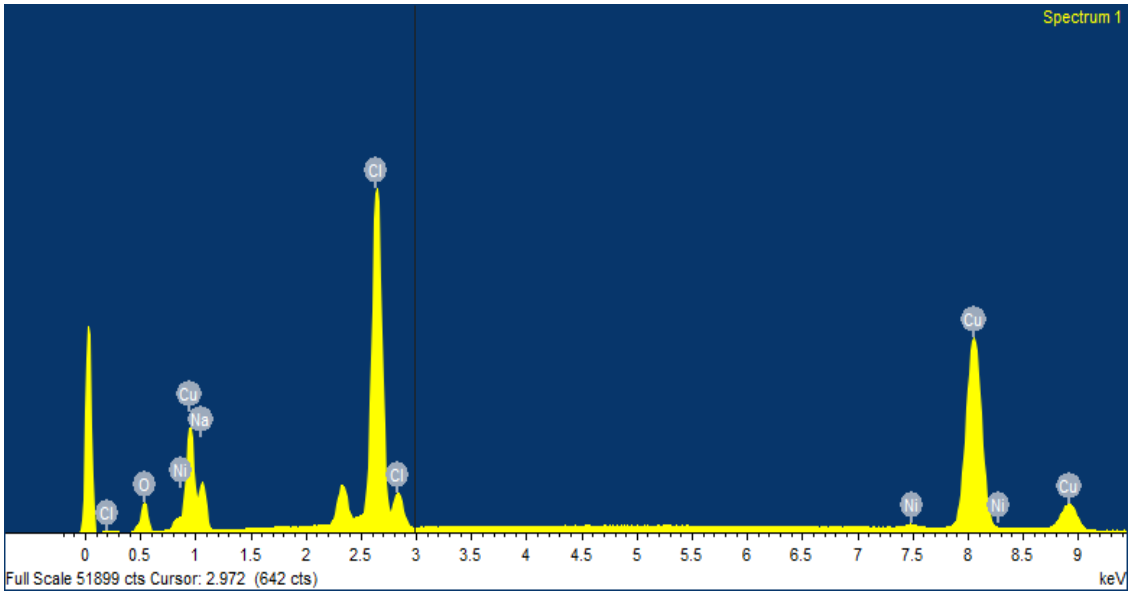

Figure 4: corresponding EDX results of Ni &CuO nanostructures

Element	weight	Atomic
O K	7.88	15.67
Na K	8.64	11.95
C l K	28.40	25.48
Ni K	1.06	0.57
Cu K	92.54	46.32

Table 2: EDX Spectrum and elemental values of the Surface

4. Conclusion

Ni-doped CuO nanoparticles were prepared by simple and low-cost sol-gel combustion process method. We report on the product of Ni doping on the structural, morphological, compositional and optical properties of CuO nanoparticles. The as the synthesis materials were confirmed by EDAX analysis. The FT-IR spectrum confirmed form of Ni: CuO nanoparticles. SEM image confirms that Ni-doped CuO nanoparticles contain spherical shape in nanoscale.

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