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# Synthesis and Elastic Study in Cuo:La Nanofluid

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**----------ABSTRACT ----------**
*Copper Oxide is an extensively studied group II-VI semiconductor with optical properties that permits stable emission at room temperature having immense application in sensors, field emission and photonic devices. CuO:La nano materials with an average particle size of 27-33 nm are synthesized by the reaction of copper nitrate in ammonia solution under hydrothermal conditions. XRD, SEM and EDS characterize the samples. The percentage of doping material is confirmed from the EDS spectra. The average crystal size of the prepared CuO nanopowder is determined by XRD. The Ultrasonic velocity and Compressibility have been measured in the CuO:La nanofluid and found 50 $A^0$*

***KEY WORDS:*** *A:Nanofluid B: Copper oxide C:Lanthanum D: Compressibility*

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## I. INTRODUCTION

Copper Oxide is an extensively studied group II-VI semiconductor with optical properties that permits stable emission at room temperature having immense application in sensors, field emission and photonic devices [1-2]. It exhibits a wide variety of morphologies in the nano regime that can be grown by tuning the growth habit of the CuO crystal. Nano CuO can be used as gas sensors, optical switch, and magnetic storage media owing to its photoconductive and photochemical properties[3]. Nanoscaled CuO materials have applications in nanodevices [4]. Furthermore it is a promising semiconductor for solar cell fabrication due to its suitable optical properties. CuO nanoparticles has immense medical applications [5].

## II. EXPERIMENTAL

Synthesis and characterization

CuO nanoparticles are prepared by chemical precipitation route from copper nitrate solution and ammonia. The powdered sample is doped with Lanthanum. The surface topography and microstructure were studied using Field Emission Scanning Electron Microscopy (FESEM). Dispersive X-ray Spectrum Analysis (EDX) was used to determine percentage composition of La in Cu. The compressibility of nanofluid was measured using ultrasonic interferometer.

## III. RESULTS AND DISCUSSIONS

Determination of particle Size from XRD Pattern.

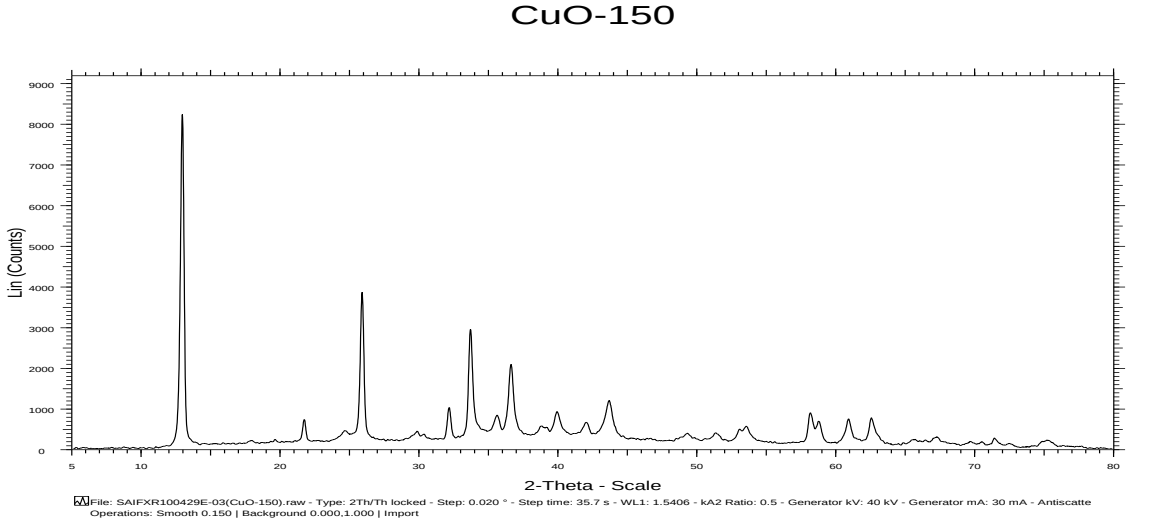
The X-ray diffraction studies were carried out to determine the size and structure of the nanoparticles of CuO.The XRD was compared with JCPDS file No:00-039-1498. The degree of crystallinity of nanoparticles increases with annealing temperature. The percentage of lattice contraction with annealing temperature can also be studied using X-ray diffraction pattern. Particle Size, can be calculated by the formula [6],

Debye- Scherrer's formula $L = K\lambda / \beta \cos\theta$. (1)

K=0.89, $\lambda$ the X-ray wavelength = 0.154095 nm, $\beta$ the full wavelength at half maximum and $\theta$ the half diffraction angle. The crystal size of CuO:La nano particle calculated from FWHM was tabulated in Table 1.

*3.2 XRD pattern of CuO:La at various temperatures*

**Figs.1-2** The XRD pattern of CuO: La nanoparticle at 150$^{o}$C and 200$^{o}$C



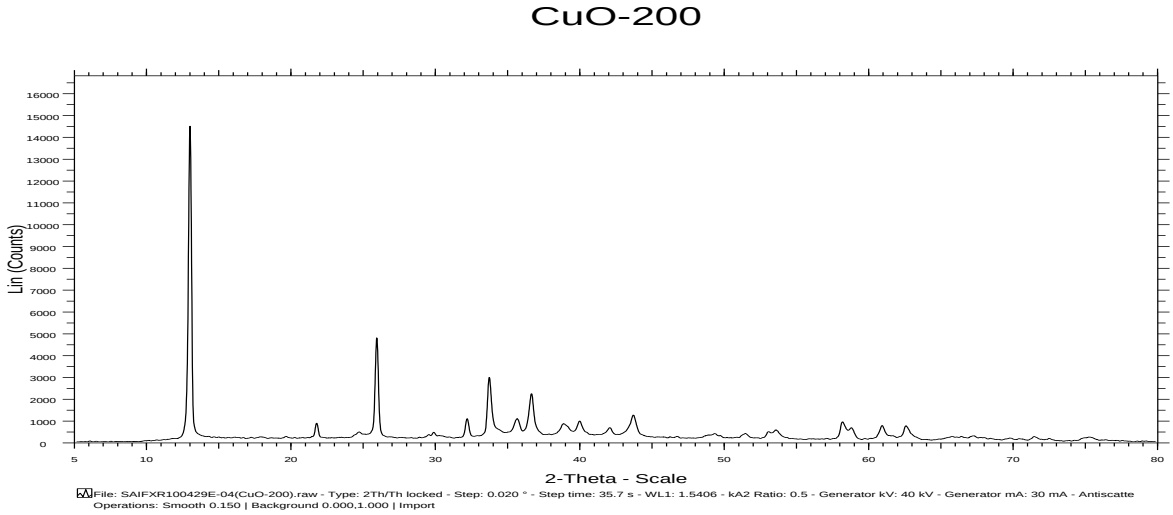
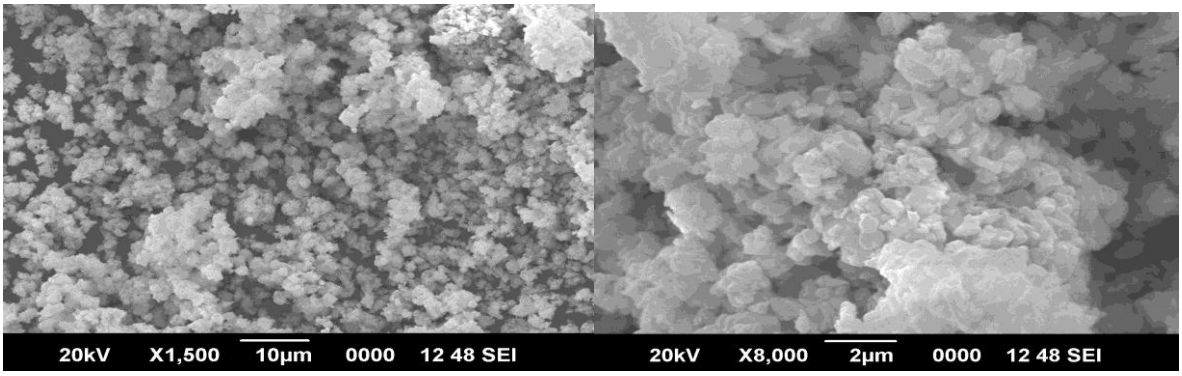




**Table :1**. Particle size measurements of CuO:La from XRD data

| Temp | FWHM | β x10-3 | 2θ | θ | Particle size (L) Nm |
|---|---|---|---|---|---|
| 150 | 0.295 | 5.14 | 12.892 | 6.446 | 27 |
| 200 | 0.24 | 4.18 | 12.948 | 6.474 | 33 |

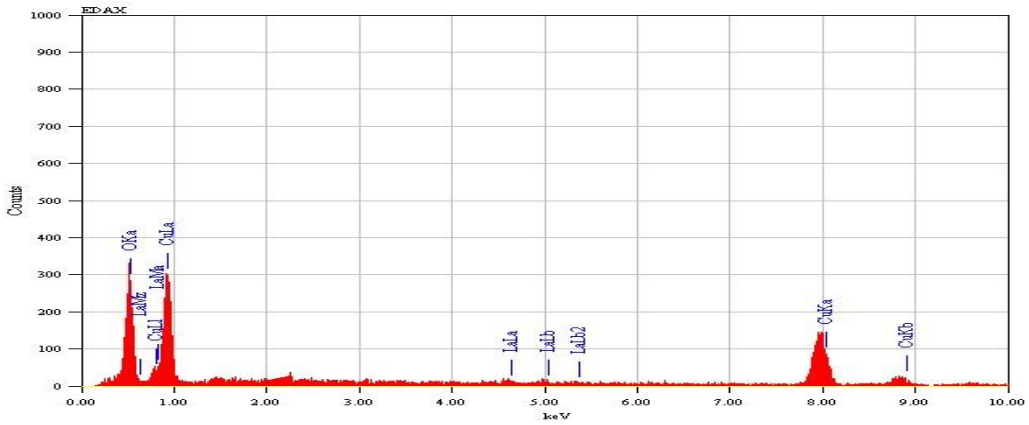
*3.3 .Scanning Electron Microscopy (SEM***)** The SEM image of CuO:La nanoparticle under high magnification is shown below.

**Fig 3.** SEM of CuO:La Nanoparticle




*Energy Dispersive Spectrum Analysis (EDS)*
EDAX or EDS of CuO:La nanoparticle is plotted using the recorder and the EDAX data is found as CuO 98.18 % and La 1.82 %

**Fig. 4.** EDS spectra of CuO:La nanoparticle




*Compressibility measurements using ultrasonics*

Ultrasonic waves of known frequency (*f*) are produced by a quartz crystal fixed at the bottom of the cell of ultrasonic interferometer (Mittel Ent. Delhi). The wavelength of ultrasonic waves of frequency 2MHz is found out and tabulated in the table 2. Density of CuO nanofluid, $\rho = 1.201\times10^3$ Kg/m$^{3.}$ Compressibility was measured using the formula $\beta = 1/\rho v^2$ [7]. It was measured to be 50 $A^{0.}$

**Table 2**. Compressiblity measurement of CuO;La nanofluid using ultrasonics

| Fluid | Readings | λ/2 | Mean λ/2 | V=f λ m/s | Compressibility $\beta = 1/\rho v^2$ $A^0$units |
|---|---|---|---|---|---|
| CuO:La nanofluid | 7.715<br>7.807<br>7.905<br>8.017 | 0.092<br>0.098<br>0.112 | 0.1006 | 402.4 | 50 |

## IV. CONCLUSION

The size and crystal structure of CuO doped with lanthanum was studied using XRD. The XRD results indicated that the particle size of nano CuO doped with lanthanum is much small as compared to that of pure CuO and decreases with lanthanum loading.ie,. *27-33 nm.* From XRD results it is clear that as temperature increases , particle size also increases.The SEM spectra was used to characterize the nano particle . From the EDAX analysis , the percentage of mass of elements are obtained . The ultrasonic velocity measured [7] by using ultrasonic interferometer in the CuO;La nano fluid to be 402 m/s and the compressibility was estimated as 50 $A^o$.

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