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**Research Article**

# Synthesis, And Characterization Of Metal Oxide (Cuo) Nanoparticles By Simple Precipitation Method

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**ABSTRACT**

CuO nanoparticles were synthesized by Simple precipitation method using different precursors Copper Chloride (CuCl2) and Sodium hydroxide (NaOH) post heating comparing between synthesized after calcination. The nanoparticles were characterized by using Fourier Transform Infrared Spectroscopy (FTIR), powder XRD diffraction, scanning electron microscopy (SEM), Energy Dispersive X-ray Analysis (EDX) and Thermo Gravimetric-Differential scanning calorimetry(TG-DSC).The method is simple to synthesis, flexible, easeful, cost-effective, fast and pollution free.

**Keywords:-** Copper Oxide, Nano-Particles, Simple Precipitation Method, FT-IR, SEM, and EDX..

## 1. Introduction

The oxides of transition metals are an important class of p-type semiconductor with application in Magnetic storage media, solar energy conversion, electronics and catalysis [1-8], gas sensor [9], medicine, water purification, pharmaceutical [10] and field emission [10]. Different nanostructures of CuO are synthesized in form of nanowire, nanorod, nanoneedle, nano-flower, and nanoparticle. In the past decades, various methods have been proposed to produce CuO nanoparticles with different sizes and shapes such as thermal oxidation [11], sonochemical [12], combustion [13] and quick-precipitation [14-15].Among these processes, precipitation method is a facile way which attracts considerable interest in industries because of low energy and temperature, inexpensive and cost-effective approach for large-scale production and good yield. In this direction, vapour and liquid phase techniques are the two broad methods for preparing size and shape selective nanoparticles. Liquid phase techniques [16-26]
In the present work, the main objective is to investigate the effect of starting precursors on structural properties of CuO nanostructures synthesized simple precipitation method and annealing process. Copper chloride and Sodium hydroxide were chosen as starting precursors. The as-prepared precipitates were analyzed by scanning electron microscopy, X-ray diffractometer, Fourier Transform Infrared Spectroscopy and Thermo Gravimetric-Differential scanning colorimetric

## 2. Experimental Details

### 2.1 Chemical Reagents

All chemicals used in the experiment were analytic reagent grade. Copper (II) acetate and sodium hydroxide were purchased from Sigma-Aldrich, Germany. Ethanol and Acetone were purchased from Merck Chemicals (India)Pvt. Ltd. Double Deionized water was used throughout the experiment.

### 2.2 Synthesis

Synthesis of CuO nanoparticles using Cupric Chloride (CuCl2) the calculated amount of CuCl2.H2O (8.52g) and NaOH (2 g) were taken in cyclohexane mixture and it was stirred and refluxed for 2hrs.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. The chemical reaction is:
$CuCl_2 + 2NaOH \rightarrow Cu(OH)_2 + 2NaCl$
$Cu(OH)_2$ decomposes into CuO on heating:
$Cu(OH)_2 \rightarrow CuO + H_2O$

## 3. Result and Discussion

### 3.1. FT-IR Spectral analysis

FTIR spectroscopy has been used to identify the functional groups and to determine the molecular structure of the synthesized compound. Functional groups with strong dipole interaction give rise to strong absorption in the IR region. In order to analyze qualitatively the presence of the functional group in Cuo, the FT-IR spectrum was recorded by the KBr pellet technique in the range of 400-4000$cm^{-1}$ (Fig.2).The broad absorption peak at around 3449.42$cm^{-1}$was caused by the water molecules. Weak and broad absorption bands at 3359.46$cm^{-1}$were also absorbed due to the existence of water molecules at 1401.33$cm^{-1}$ C-H stretching vibration (27). The peaks at 1624.60$cm^{-1}$ may be for the Cu-O symmetrical stretching (28). While the very intense peak positional at 1107.38$cm^{-1}$ revealed the presence of (O-H) stretching for alkyl. 987.99$cm^{-1}$ are presents in the spectrum evidence of (O-C-O) tensional tremble respectively. The absorption band at 753.78 and 656.64$cm^{-1}$ were observed from the FTIR spectrum which due to the CuO stretching (29).The peaks in the range of 670-1000$cm^{-1}$ are attributed to C-H bending vibration. There is sharp peak observed at 601.67$cm^{-1}$ in the spectrum CuO nanoparticles which are characteristics of the Cu-O bond formation. Therefore, the metal-oxygen frequencies observed for copper oxide nanoparticles are in close agreement (table2) with that of literature values.

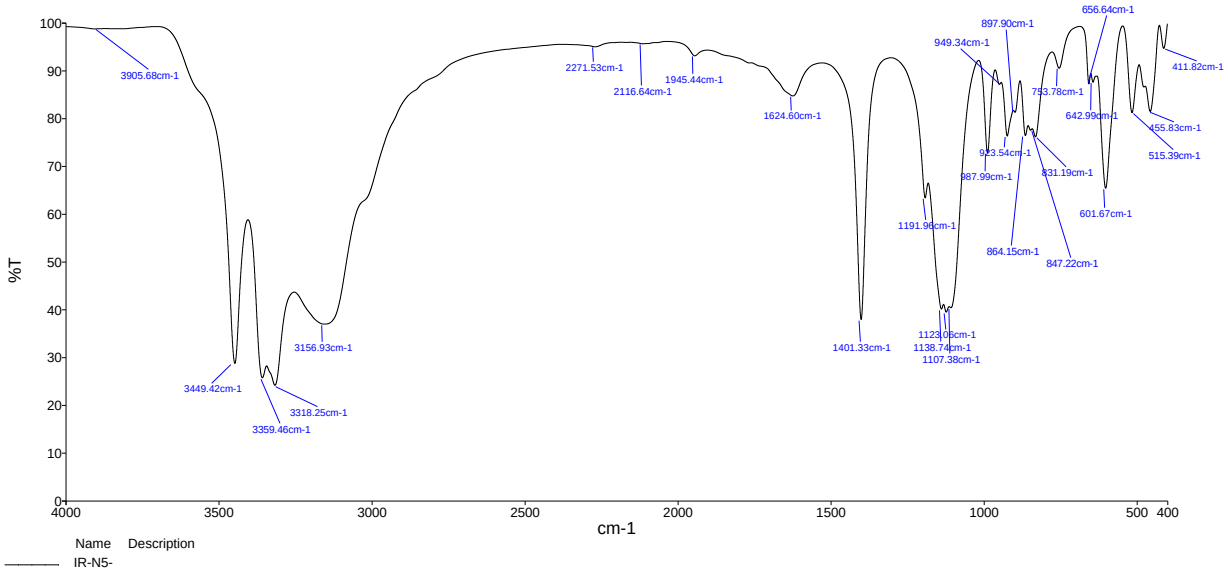



**Figure 2. FT-IR spectrum of CuO nanoparticles**

| Observed Values(Frq $cm^{-1}$) | Reported Values (Frq $cm^{-1}$) | Assignment |
|---|---|---|
| 3449.42 | 3445.89 | broad absorption peak |
| 3359.46 | 3395 | broad absorption peak |
| 1624.60 | 1632.77 | Cu-O symmetrical stretching |
| 1401.33 | 1404 | C-H stretching vibration |
| 1107.38 | 1114 | (O-H) stretching for alkyl |
| 987.99 | 986 | (O-C-O) stretching vibration |
| 753-1000 | 670-1000 | C-H bending vibration |
| 601.67 | 601 | Cu-O bond formation |

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

### 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 (3).

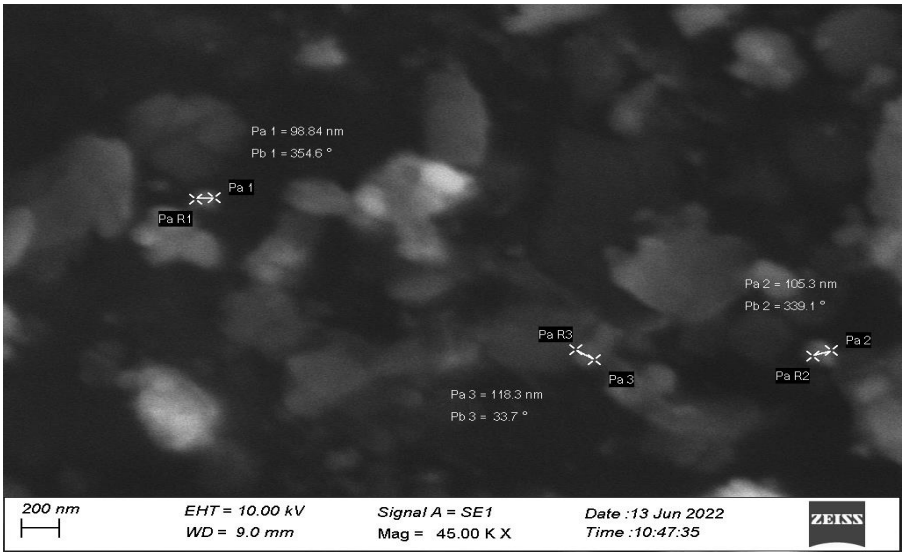



**Figure 3. SEM image of CuO nanoparticles**

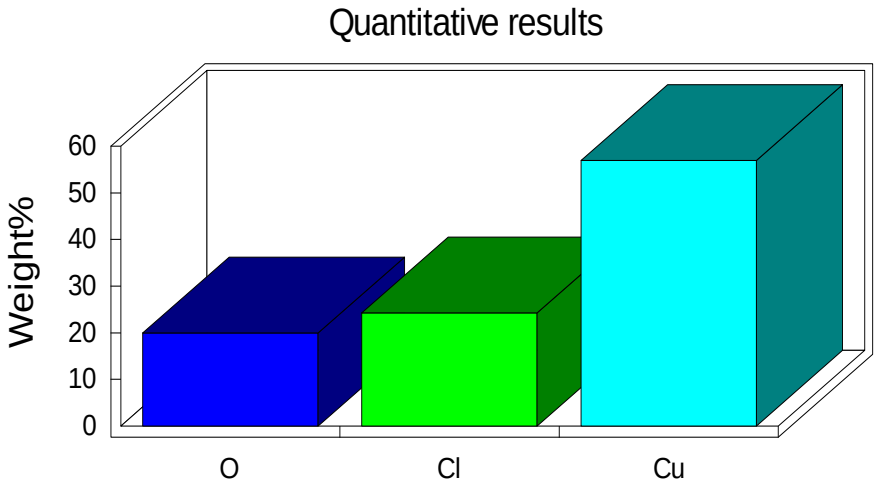
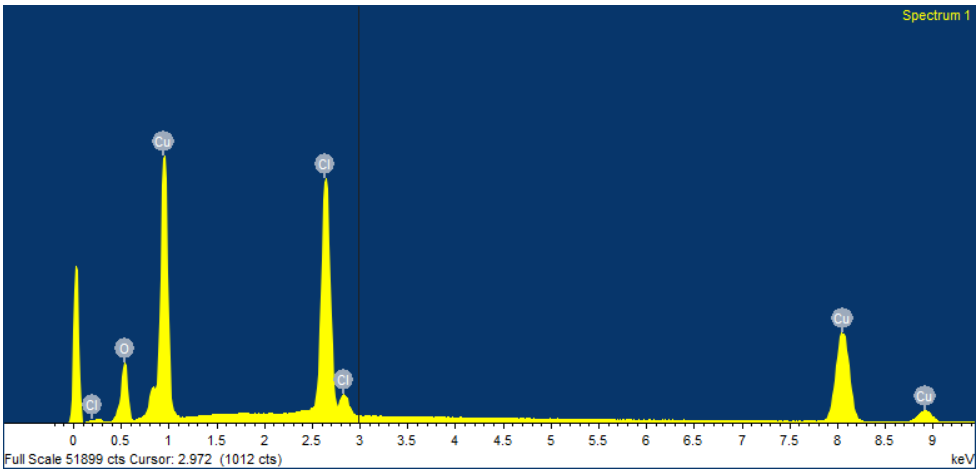



**Figure 4: corresponding EDX results of CuO nanostructures**

### 3.3. Energy dispersive X-ray Diffractive (EDX) analysis

The Energy Dispersive X-ray diffractive study was accepted out for the synthesized CuO nanoparticles to identify the elemental composition.EDX verify the presence of copper and oxygen signals of copper oxide nanoparticles as shown table 3. In figure (4) shows the quantitative results of pure CuO nanoparticles. The quantitative results show the presence of the nanoparticles yielded 56.93% copper and 19.98% of oxygen which proves that the created nanoparticle is in its highest purified from.




**Fig(5) EDX analysis of synthesized CuO nanoparticles**

| Element | Weight % | Atomic % |
|---|---|---|
| O K | 19.98 | 44.13 |
| Cl K | 24.29 | 24.21 |
| Cu K | 56.93 | 31.66 |

**Table 3: EDX Spectrum and elemental values of the Surface**

## 4. Conclusion

The Copper oxide nanoparticles were effectively synthesized by simple precipitation method. The FT-IR spectra confirmed the presence of metal oxide nanoparticles. The SEM image confirmed by the spherical shape and size 100 nm. The elemental quantitative analysis of EDX spectrum confirms the presence of 56.93% copper and 19.98% of oxygen in (CuO) metal oxide nanoparticles.

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