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The Optical Study of Copper Oxides Nanoparticles Synthesis and Characterization

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Abstract:

Copper oxide (CuO) nanoparticles are synthesized by the aqueous preparation method using copper acetate as a precursor and NaOH as a stabilizing agent. This gives a large-scale production of CuO nanoparticles easily. X-ray diffraction pattern (XRD) reveals a single-phase monoclinic structure. Scanning electron microscopy (SEM) showed the rectangular morphology of as-prepared CuO nanoparticles.

Keywords: Nanoparticles, Precipitation, Copper Oxide, Precursor,

Introduction:

The oxides of transition metals are an important class of semiconductors, which have applications in magnetic storage media, solar energy transformation, electronics, and catalysist[1-9]. Among the oxides of transition metals, copper oxide nanoparticles are of special interest because of their efficiency as nanofluids in the heat transfer application. For example, it has been reported that a 4% addition of CuO improves the thermal conductivity of water by 20%[10]. CuO is a semiconducting compound with a narrow bandgap and is used for photoconductive and photothermal applications[11]. However, the reports on the preparation and characterization of nanocrystalline CuO ae\re relatively few to some other transition metal oxides such as zinc oxide, titanium dioxide, tin dioxide, and iron oxide. Some methods for the preparation of nanocrystalline CuO have been reported recently such as the sonochemical method [12], a sol-gel technique[13], a one-step solid-state reaction method at room temperature[14], an electrochemical method[15], thermal decomposition of precursors[16] and co-implantation of metal and oxygen ions[17]and so on. In this paper, we have synthesized CuO nanoparticles by a simple aqueous precipitation method with sizes 5-6 nm. The synthesized nanoparticles were characterized by XRD, FT-IR, UV-Visible Spectroscopy, and SEM.

METHODS AND MATERIALS AND METHODS

2.1 Chemicals :

In this experiment chemicals used are Copper acetate monohydrate $CU(CH_3COO)_2H_2O$ and acetic acid glacial. Deionized water was used throughout the experiment.

2.2 Synthesis :

An aqueous solution of copper acetate (0.02mol) is prepared in a round bottom flask. 1 ml glacial acetic acid is added to the above aqueous solution and heated to 100^oC with constant stirring. About 0.4g of NaOH is added to the above-heated solution till pH reaches 6-7. A large amount of black precipitate is formed immediately. it is centrifuged and washed 3-4 times with deionized water. The obtained precipitate was dried in the air for 24h.

3. Results and Discussion:

3.1 XRD Characterization:

The X-ray diffraction technique is used for the structural/phase analysis of the material under investigation. The pattern of XRD of CuO nanoparticles is shown in the figure. It gives single phases with a monoclinic structure. The intensities and positions of peaks are in good agreement with the reported values (JCPDS file No.05-661)

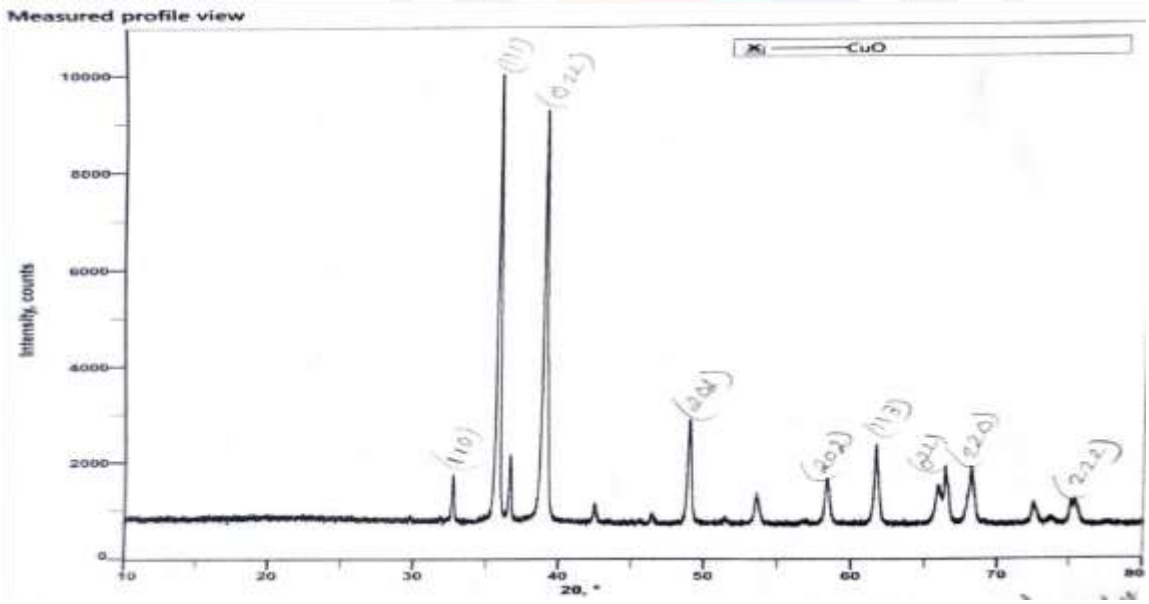

Fig. 1: XRD of CuO nanoparticles

3.2 Fourier Transform Infrared (FT-IR) Characterization: FTIR spectrum of CuO shows peaks 34711.37, 2022.07, 2051.19, 1303.70, 590.20,516.10, 437.20 cm^{-1} revealing the formation of CuO as shown in Figure 2

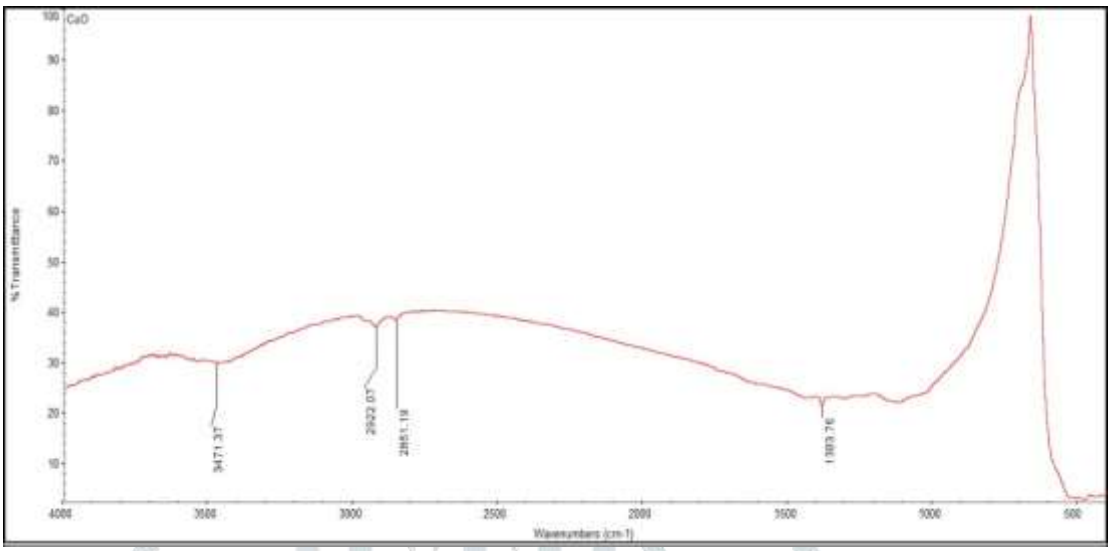

Fig. 2: FT-IR of CuO nanoparticles

3.3 UV-Visible absorption Characterization:

The optical property of polymer composites was studied by an ultraviolet-visible (UV) spectrophotometer. It refers to absorption spectroscopy in the ultraviolet-visible spectral region which uses light in the visible adjacent ranges. The UV spectrum of the CuO nanoparticles showed two absorptions at 220 and 430nm.

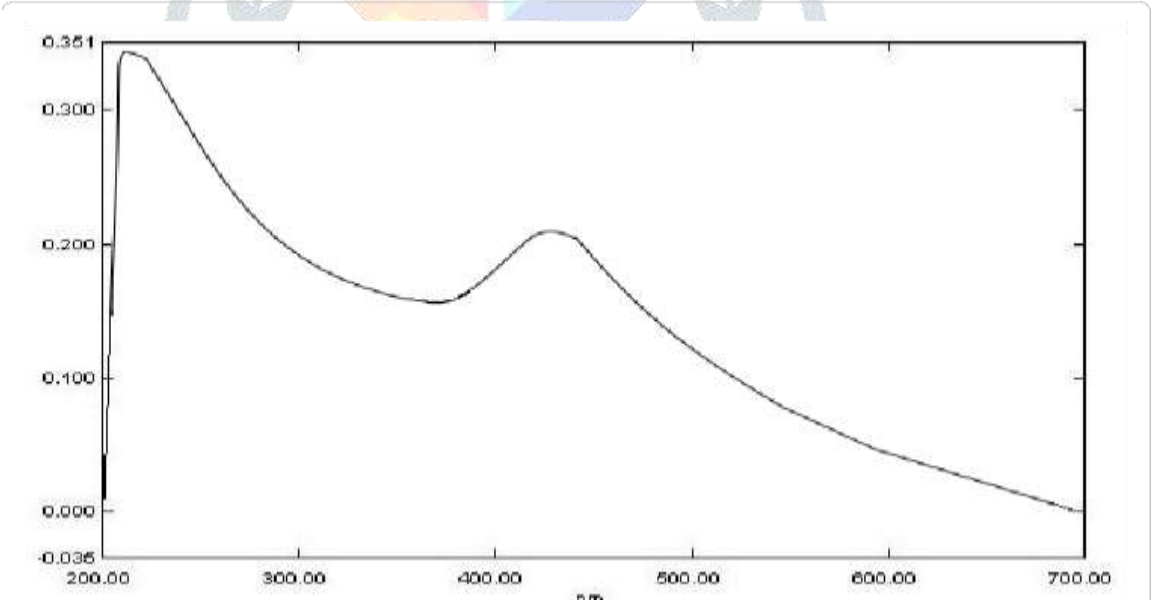

Fig. 3: UV-Visible of CuO nanoparticles

3.4 Scanning electron microscopy (SEM) Characterization:

Figure 4 shows the SEM images of the prepared CuO nanoparticle's surface morphology. it shows that the CuO nanoparticle shapes are rectangular observed.

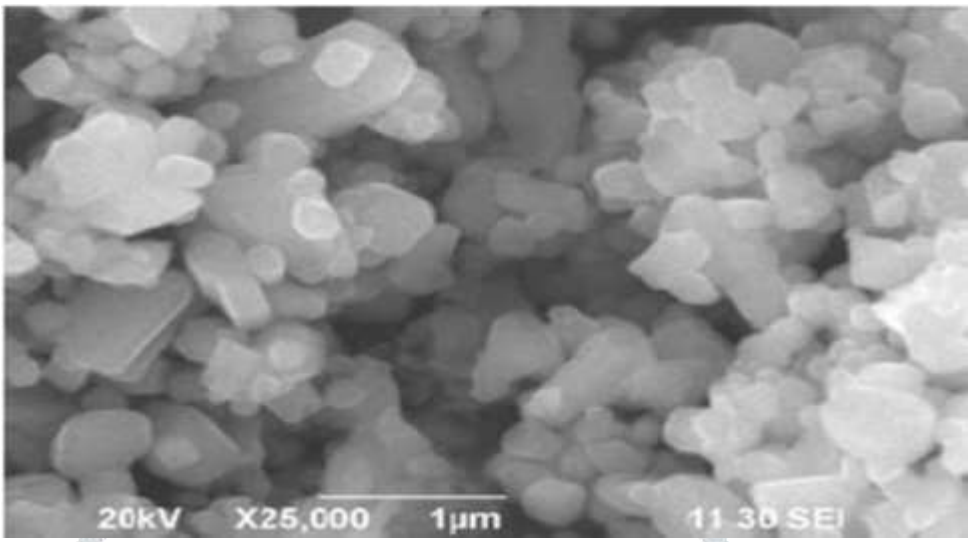

Fig..4: SEM Images of CuO nanoparticles

Conclusion:

It is found that the study of CuO characterization of FTIR spectrum of CuO shows peaks 34711.37, 2022.07, 2051.19, 1303.70, 590.20,516.10, 437.20 cm^{-1} revealed the formation of CuO, The UV spectrum of the CuO nanoparticles showed two absorptions at 220 and 430nm, the XRD pattern of CuO shows the monoclinic structure and SEM images show rectangular rod shapes within 1 $\mu\mu$m.

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