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Synthesis and Characterization of CuO Nanoparticles Prepared with Coffee Extract and To Study Its Electrical Conductivity

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ABSTRACT

Oxides of copper have unique semiconducting and optical properties. Very few reports are available on the synthesis of copper oxide nanoparticles using plant extract. CuO Nanoparticles have tremendous applications due to their semiconducting nature. It can be prepared by different methods. In this work CuO nanoparticles were synthesis with coffee bean extract and also used to study its electrical conductivity by Four probe method. The prepared CuO nanoparticles were characterised by uv-visible spectra and XRD.

I. INTRODUCTION

The Particle of size between 1 to 100 nm are called as nanoparticles. The nanomaterials have unique properties in comparison with the same materials in the bulk form. The shape of the nanoparticle is also equally important to control its different properties. The copper oxide nanoparticle is one of the most important metal oxides which has attracted in recent years. Cupric oxide and cuprous oxide are two important oxide compounds of copper. The main features of CuO nanoparticles are due to its low cost and its easily availability. It has good electrical and optical properties. It is nontoxic and easily obtain by oxidation of copper. Nanoparticles are synthesis by different methods such as sol gel technique, thermal decomposition, sonochemical process, rapid precipitation, spin coating solid state reaction, solvothermal process and microwave irradiation. Now a day's eco-friendly methods such as biosynthesis are used to obtained nanoparticles. This method is reliable and cost effective.

The CuO nanoparticles have many applications in solar cell technology, storage media, drug delivery medicine, lithium-ion batteries, gas sensors, fuel cells, formation of FET and they also show the catalyst properties. The synthesized nanoparticles can also be used to form nanocomposite, nanowire, nanotube and Nano film. One of the important applications of CuO nanoparticles is its semiconducting properties.

II. METHODS AND MATERIAL

In 100 ml distilled water add 9 gm of coffee powder. Heat this up to one hour in a burner flame. Cool this solution and filter with the filter paper. Now take 12.05 gm of Cu (NO3)2 :6H2O and dissolve it in a 50 ml of distilled water with continuous stirring up to 3 hours at 283oC. After this add coffee extract drop by drop. The colour of solution changes from blue to black. The obtain precipitate wash with distilled water, filter and dried. The particles obtained kept in a muffle furnace for 6 hours at 450oC.

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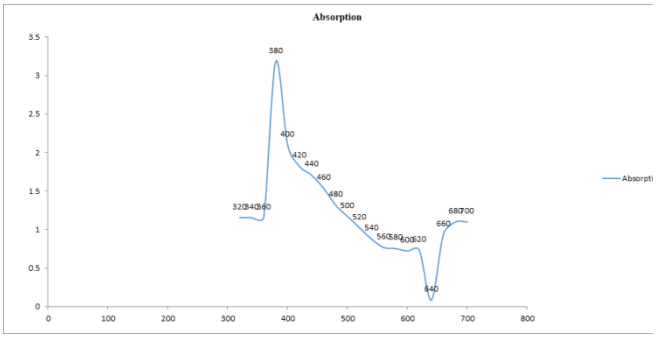
Particles disperse by using ultra sonicator having frequency of 20 kHz for 11 minute and 4 second pulse. The Titanium horn is used in sonicator.

Electrical conductivity by Four Probe Method:

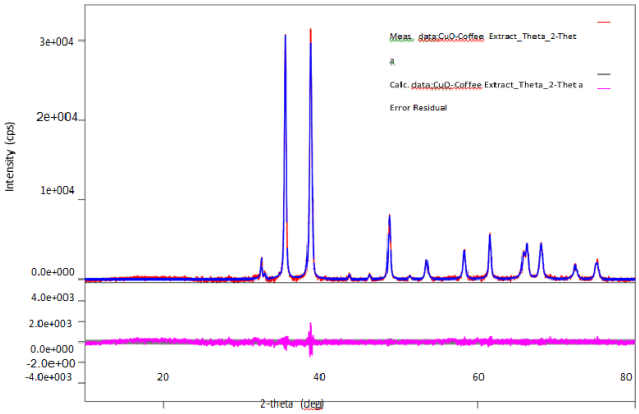
This method permits measurements of resistivity in samples having a wide variety of shapes, including the resistivity of small volumes within bigger pieces of semiconductor. In this manner the resistivity of CuO nanomaterials is measured by making pallets of the CuO powder. the four-probe set-up used in this work for electrical study. In this setup, four sharp probes placed on a flat surface of the material to be measured, current is pass through the two outer electrodes, and the floating potential is measured across the inner pair. To prevent minority carrier injection and make good contacts, the surface on which the probes rest, maybe mechanically lapped.

III. RESULTS AND DISCUSSION

1) **UV-Visible Spectra:** The characteristics uv-visible spectra of biosynthesised CuO nanoparticles is as shown in fig 1. The wavelength vs Absorption graph of CuO nanoparticles shows that the maximum absorption occurs at 380 nm in uv-visible spectra. This attributed to the formation of cupric oxide CuO nanoparticles.



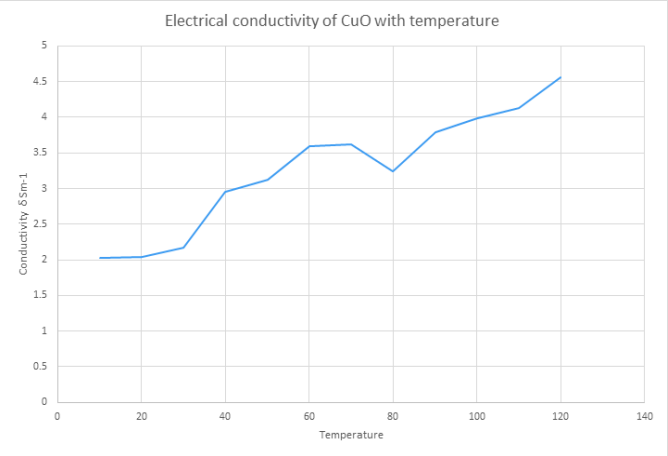
2) **XRD:** The X-ray diffraction pattern of synthesised CuO particles is carried out for 2 theta values. The XRD pattern is as shown in fig 2. The peaks for 2 theta values are obtained at 32 to 78 as shown in figure. The peaks obtained are match with the JCPDS data card no.86-1268. This shows the presence of CuO nanoparticles.



3) **Sonication:** - The process in which Ultrasonic wave are immerge in the liquid mixture of given sample for the separation of the nanoparticles. The frequencies (>20 kHz) are usually used, leading to the process also being known as ultra-sonication. The figure of sonication perform are as shown in fig.

Take a small beaker of glass in which dissolve the given sample (CuO nanoparticle) in sufficient amount of water. We apply the ultrasonic wave of frequency 50Hz for 11 minutes (pulse time is 4 second) to the given solution further start sonication. After some time, the whole particles of given sample are separate. After that by drying these mixtures we get fine powder of given sample.

4) **Electrical Conductivity of CuO nanoparticles with respect to temperature by Four Probe Method-** The electrical conductivity of material was measure by four probe method. By keeping constant current (I=3mA) and varying temperature, S=0.2cm (Distance between two probes) and W=0.92 cm (Thickness of materials). Figure depict that the conductivity rises linearly with temperature which shows the semiconducting nature of the material.



IV. ACKNOWLEDGEMENT

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V. CONCLUSION

Present research has resulted in several novel and significant findings by getting knowledge of the CuO nanoparticles as well as materials literature. This report was mainly devoted on synthesis of CuO nanoparticles by green synthesis method and to study its electrical properties by Four probe method. The obtained nanoparticles were used for characterizations.

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