

FACILE SYNTHESIS AND CHARACTERIZATION OF COPPER OXIDE (CuO) NANOPARTICLES VIA SOL-GEL METHOD

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Abstract:

Metal and metal oxide particles are very importance because of their prominence in different fields of applications in Science and Technology. In this present paper work Copper Oxide (CuO) Nanoparticles are synthesized by Sol-Gel technique in ethanol media. Copper Chloride (CuCl₂) was used to prepare Copper Oxide Nanoparticles. The synthesized nanoparticles are characterized by using X-ray powder diffractometry (XRD) to find the crystallinity, UV- visible spectra and Scanning Electron Microscope (SEM). The XRD data reveals that the prepared CuO-nanoparticles are pure, crystalline and nano-sized. The SEM image suggested that CuO nanoparticles are like rice grains or needle shape and there is a tendency of agglomerations. UV-visible spectra gives the band gap of nanoparticle CuO which is 3.43 eV after calculation. Nanoparticles shows the interaction between Copper and Oxygen. This method is more economical, convenient, easy and effective in comparison to other known methods of synthesis of nano-materials.

Keywords: Copper Oxide Nanoparticles; Chemical Precipitation; Nanotechnology; Sol-Gel; X-ray Diffraction; SEM.

Introduction:

Over the last decade, transition metals and metal oxide are numerous applications in different fields. Nowadays metal oxide nanomaterials have attracted researchers due to their unique physical and chemical properties that makes them technologically very important in numerous fields [1, 2]. Copper Oxide (CuO) is one of useful metal oxide which has numerous applications in range fields. Copper oxide nanoparticles have a great efficiency as Nanofluids in heat transfer applications. Some Scientist has been reported that by just 4% addition of CuO increases the thermal conductivity of water by 20% [3]. Copper Oxide has a semiconducting compound with a narrow band gap. It has used for photoconductive and photothermal applications. Copper oxide nanoparticles has various applications such as gas sensors, magnetic storage media, batteries, semiconductors, solar energy transformation and field emission...etc [4,5]. The numerous methods are used to prepare copper oxide nanoparticles, including solid state reaction, sol-gel, sonochemical preparation, microwave irradiation, alkoxidebased synthesis and thermal decomposition [6,7]. In the present work, for the synthesis of nano particles of copper oxide sol-gel method was used as it was more economical, faster and easier.

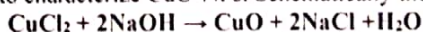
Experimental

Materials.

Analytical Reagent (AR) grade chemicals such as Copper chloride (II) CuCl₂, Sodium hydroxide NaOH, Acetone and Ethanol C₂H₅OH were used as starting material for the synthesis of CuO. These chemical were purchased from Merck with purity 99.9%. These chemicals were used as purchased without further treatment in this study.

Synthesis of CuO

For synthesis of CuO-NPs, at first 6.0 g of copper (II) chloride dehydrate was dissolved in 320 ml of Ethanol and 3.6 g of sodium hydroxide pellet were dissolved in 100 ml ethanol separately. Drop wise addition of sodium hydroxide solution to copper (II) chloride dehydrate solution was carried out with constant stirring at room temperature. The color of the solution was turned from green to bluish green and finally to black as the reaction proceeded. The black precipitate was copper hydroxide. The precipitate was filtered by a centrifuge (Eppendorf Refrigerated Centrifuge Model 5702R, Germany). Then washed with ethanol and deionized water to remove the sodium chloride salt solution. After that, the precipitate was dried at about 50°C in the dryer. The dried sample was annealed at temperature 100°C to obtain crystalline CuO-NPs. Then the annealed sample was grinded to get the powdered nanoparticles. The powder sample was used to characterize CuO-NPs. Schematically the chemical reaction can be represented as:



Characterization Techniques

The prepared sample of copper oxide nano particle was characterized by XRD i.e. X-ray diffraction technique The crystalline structure,