Cdo Doped Cuo Nanostructure For Environment Applications

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ABSTRACT:

The current study focuses on creating pure and CdO doped copper oxide nanostructures(CdO-CuO) using a hydrothermal process, examining the fundamental characteristics of CuO nanostructures, and analysing the photocatalytic behaviour of pure CuO and CdO-CuO samples. SEM-assisted morphological analyses showed that CdO-CuO nano structures. The x-ray diffraction (XRD) pattern confirms the modest variations after CdO doping in peak positions. The photo catalytic performance of the samples examined during the methylene blue (MB) dye degradation indicates that samples perform better.

Keywords: Morophology, CdO-CuO, Methylene blue, Photo catalysis

INTRODUCTION

With the development of the energy crisis and the state of the environment, it is more important than ever to create new energy-harvesting technologies and find innovative solutions to environmental pollution. Since Fujishima and Honda's discovery of water dissociation in 1972, photocatalysis has gained widespread recognition as one of the practical solutions for energy and environmental issues [1-2]. The development and survival of human society are currently being hampered by rising demands related to environmental issues and energy constraint. Advanced technologies have been developed to effectively handle the problems of water shortage as a result of the issue of inorganic and organic pollutants that occur in water from agricultural, household, and industrial activities. Numerous academics and researchers are searching for cutting-edge and potent technologies that may effectively remove pollutants from wastewater in order to address this significant problem [3].

Due to their unique size, physical, and chemical characteristics, as well as their potential applications, nanoscale metal oxide materials have been proposed. Affordability, non-toxicity, and higher efficiency in absorption across a sizable portion of the solar spectrum, cupric oxide (CuO) is one of the benchmark photocatalysts that is most frequently utilised in photodegradation [4-5].

Photocatalysis, according to the International Union of Pure and Applied Chemistry, is "a change in the rate of a chemical reaction or its initiation under the influence of ultraviolet, visible, or infrared

radiation in the presence of a substance—the photocatalyst—that absorbs light and is involved in the chemical transformation of the reaction partner" . Colored dyes, such the often used in the textile sector methylene blue (MB), have a negative impact on the environment and contaminate surface and groundwater resources [6].Organic contaminants can be removed from aquatic habitats in an environmentally acceptable way by using a photocatalyst powered by solar energy.

2 Experiments

2.1 Materials

Materials: Copper acetylacetonate, Sodium hydroxide, cadmium nitrate, distil water, ethanol

2.2 Synthesis of Pure and Cdo doped CuO nanostructure:

Synthesis route from precursors of copper acetylacetonate [$Cu(C_5H_7)_2$ .In the first approach 3-gram copper acetylacetonate and used with 0.3-gram Sodium hydroxide (NaOH) and distilled water as solvent. These solutions will keep in stainless steel autoclaves at temperatures 150 °C, for 10 hours then allow cool to room temperature naturally. Similarly 1gram cadmium nitrate added previous solution for CdO doped CuO sample. A dark precipitate will collect after being filtered and wash with distilled water and absolute ethanol to remove the residue of inorganic/organic impurities. . The final products dried at 60℃ for 20h under ambient air**.**

2.3 Material characterizations

To determine the crystal phase pure and CdO doped CuO photocatalyst powders, X-ray powder diffraction(XRD) analysis was carried out at room temperature) with Cu Kα radiation (λ = 0.15406 nm), over the 2θ collection range of 0–80◦. The FE-SEM (Field Emission Scanning Electron Microscope) images and EDX (Energy-dispersive X-Ray) spectra were obtained from ZEISS-LEO SUPRA-55 and JEOL-JCM-6000 plus,respectively. The UV-Visible investigations of the synthesized photo-catalysts (NPs) were finished on Carry-60 UV/Vis spectrometer.

2.4. Photo-catalytic degradation

The degradation of MB-dye in the presence of sunlight radiations was used to test the photocatalytic capability of pure and CdO doped CuO nanostructures. It was done by using a UV cut-off filter to remove UV light from the sun spectrum. To create an equilibrium between the MB-dye and photo-catalyst, 5 mg of pure and doped were added to a 5-ppm solution of MB-dye, and the two substances were then mixed together in the dark for 60 minutes. In order to analyse the photocatalytic process, the photocatalytic reaction vessel was placed under visible sunlight while being constantly stirred after the dark reaction. The 5 mL suspension was removed from the reaction vessel after 30 minutes and centrifuged for 3 minutes to separate the photocatalyst. The residual MB-concentration dye's was calculated using its absorption spectra around 595 nm. The developed photocatalysts' ability to degrade or decompose was calculated.

Result & Discussions

Fig 1. High Peaks are observed corresponding to planes ($1\bar{1}1$) and (111) for all samples. The films are polycrystalline, all the diffraction peaks belong to the CuO monoclinic tenorite phase that belong to the C2/c space group (JCPDS card, No. 01-080-0076) [7], and there are no other crystalline phases were found in the XRD patterns of pure CuO, after CdO doping the peak intensity decreased.

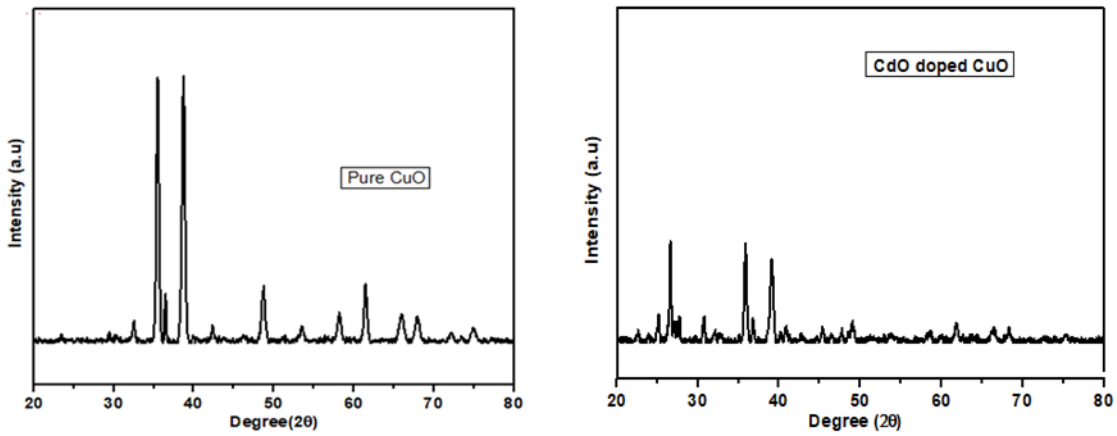

Fig1: X RD patterns of pure and CdO doped CuO.

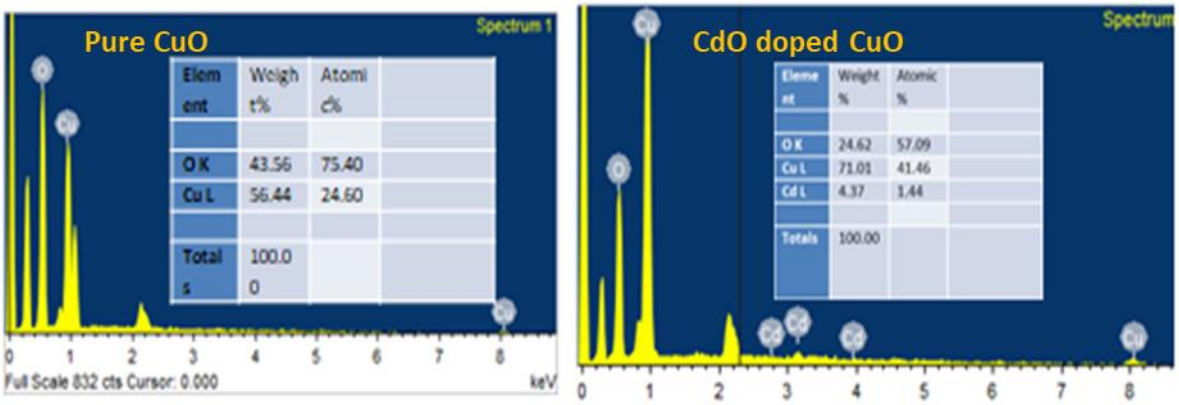

Fig 2. EDS of pure CuO and CdO doped CuO.

Figure 2 shows the energy dispersive X-ray spectrum of pure and CdO doped CuO. The peaks of copper, cadmium and oxygen belonging to the pure and CdO doped CuO can be clearly observed in the spectrum, which is evidenced.

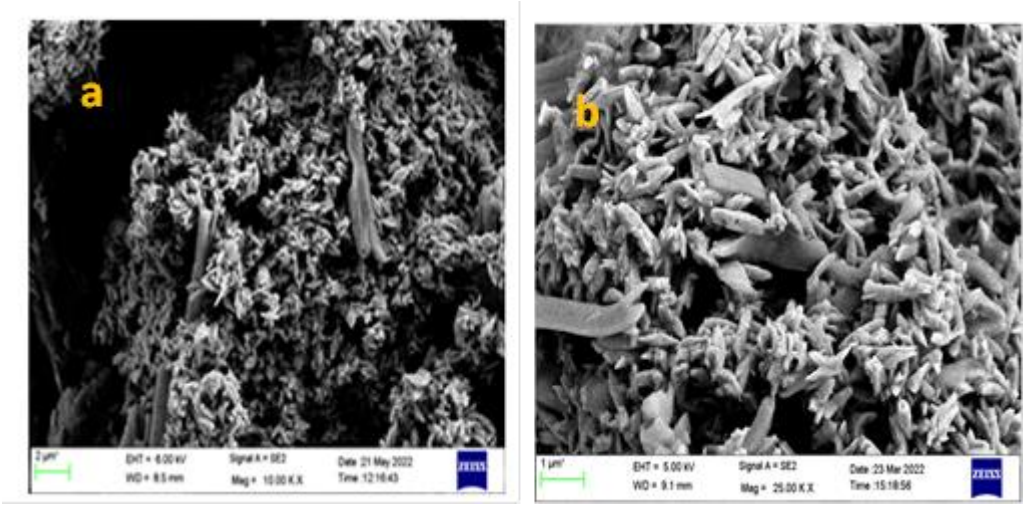

Fig. 3 SEM images of (a) pure (b) CdO doped CuO nano structures.

Figure 3 displays the SEM images of the pure and CdO doped CuO nanostructures. The images depict that CdO dopant clearly influences the morphological changes of CuO. The flakes-shaped nanostructures were changed after CdO doping.

The photocatalytic mechanism of the synthesized CdO-CuO nanostructure by hydrothermal method were analyzed from the photodegradation of MB under solar light irradiation. The photocatalytic degradation of pure and CdO doped CuO nanostructure were studied. From the reaction, it is examined that the hydroxyl radical (.OH), superoxide radical (O_2) are foremost dependable species for the photodegradation performance of the MB dye molecule [8-12].The photocatalytic absorbance spectrum of pure and CdO doped CuO nanostructure under natural sunlight is shown in Fig. 4. By using CdO-CuO photocatalyst, the absorbance of the dye solution reduced with the rise in the time of irradiation. The degradation percentage of MB dye reached 76 in 90 min. The unique charge separation and surface morphology influence the degradation efficiency of CdO doped CuO nanostructures.

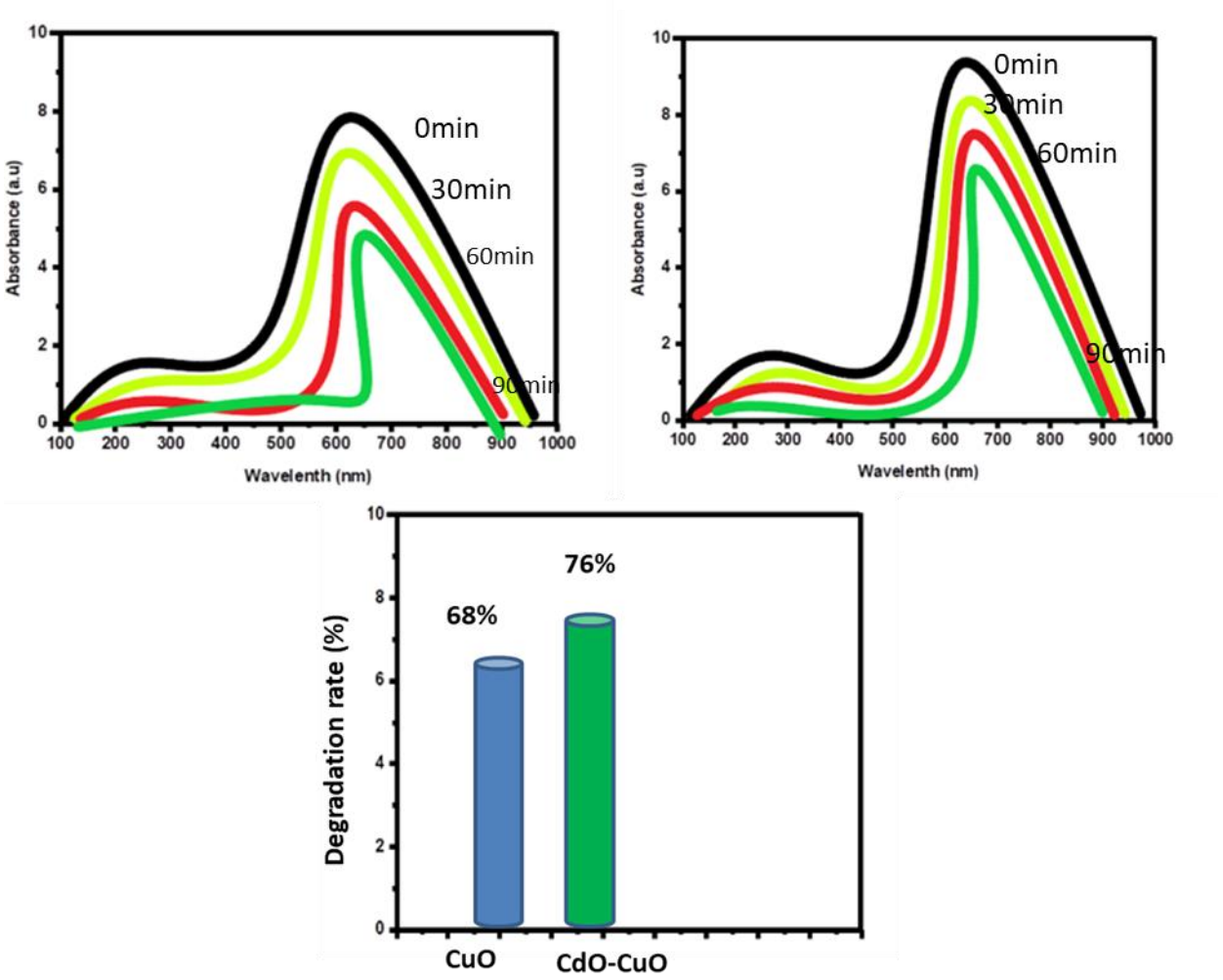

Fig. 4 Photocatalytic absorbance spectra of MB in the presence of prepared pure and CdO doped CuO and Eficiency degradation.

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