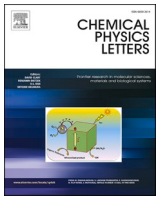
Chemical Physics Letters 808 (2022) 140122

Contents lists available at ScienceDirect

Chemical Physics Letters

journal homepage: www.elsevier.com/locate/cplett



Research paper

Formation of CuO nanostructures via chemical route for biomedical applications

Sneha R. Bhosale [a], Sharvari A. Ghatage [a], Pranali N. Wahane [a], Rakhee R. Bhosale [b], Kishor S. Jagadhane [a], Devashree N. Patil [c], Prashant V. Anbhule [a,*]

[a] Medicinal Chemistry Research Laboratory, Department of Chemistry, Shivaji University Kolhapur 416004, India
[b] Analytical Chemistry and Material Science Research Laboratory, Department of Chemistry, Shivaji University Kolhapur 416004, India
[c] Department of Biotechnology, Shivaji University Kolhapur 416004, India

ARTICLE INFO

Keywords:
CuO nanostructure
Co-precipitation
Particle size
Surface area
Antimicrobial study

ABSTRACT

In this report, we have successfully prepared the CuO nanostructure by simple and cost-effective co-precipitation method by varying the concentration of precursor's solution. The variation of concentration and its effect on the physico-chemical properties of the CuO nanostructure was investigated and discussed in detail. The structural, surface morphological, elemental composition, particle size with zeta potential, optical properties and surface area of the CuO nanostructures were characterized by X-ray diffraction (XRD), Fourier transform infrared analysis (FT-IR), Scanning electron microscopy (SEM), Energy dispersive X-ray analysis (EDAX), Dynamic light scattering (DLS), UV–Visible spectroscopy and BET analysis respectively. The XRD confirms the phase formation of the pure CuO and observed the monoclinic crystal structure of CuO nanostructure. Also, the surface morphology was studied by using SEM and it showed the petals like morphology and change in the aspect ratio of the nanostructure was observed when the concentration of precursors solution was altered. The surface area and porosity of the CuO nanostructures have been carried out and it reveals a more porous structure. Furthermore, the nanostructures are utilized for study of the antimicrobial properties. It is observed that CuO nanostructures shows enhanced antimicrobial properties towards *B. subtilis*, *E.coli* and *E. faecalis* and *S. aureus* bacteria. Also, we have studied the antifungal activity tested against *C. albicans*. Therefore, CuO nanostructures can be used as an ingredient for dermatological applications in creams, lotions, ointments, or other biomedical applications for human beings.

1. Introduction

In this era, nanostructures have enabled the homogenization of a wide range of specialties in the biological, pharmaceutical, and environmental fields. To name a few several nanomaterials are used in a variety of biomedical sectors, including drug delivery, diagnostics, medicine, antimicrobial, antifungal and therapies [1,2]. Because of their small dimensions and high biocompatibility, nanomaterials are beneficial in this area. As a consequence nanotechnology frequently employs nanomaterials in a variety of biomedical applications. One of the most significant basic investigations in nanoscience and technology is determining the antioxidant and antimicrobial activities of nanomaterials [3]. Improving antimicrobial activities and adaptability of materials is especially crucial to avoid hematolysis, allergic reaction, inflammation, and other unpleasant reactions whether prolonged or temporary, localized or universal [4,5].

In recent years, the preparation of metal oxide nanoparticles with tailored morphology has attracted much interest because of its unique features and applications [6]. Among the inorganic metals, copper is soft, bendable, and malleable with high electrical and thermal conductivities. CuO is a p-type semiconductor with band gap of 1.2 eV [7]. CuO is easily available with low cost as compared to equivalent metals such as platinum, gold, and silver nanoparticles [8,9]. Copper oxide nanoparticles show remarkable physico-chemical features as well as optical, magnetic properties,catalytic, high aspect ratio to volume ratio, and biocidal qualities [10–13]. CuO synthesis can be carried out by a variety of fabrication approaches including, sol–gel method, microemulsion, gas-phase oxidation, coprecipitation, hydrothermal and chemical bath deposition method [14–18]. Cu^{2+} ions produced from CuO nanoparticles exhibit antimicrobial potential. Cu was considered to be a great

* Corresponding author.
E-mail address: pva_chem@unishivaji.ac.in (P.V. Anbhule).

https://doi.org/10.1016/j.cplett.2022.140122
Received 26 July 2022; Received in revised form 6 October 2022; Accepted 10 October 2022
Available online 22 October 2022