

Contents list available at **IJND**
International Journal of Nano Dimension

Journal homepage: www.IJND.ir

Short Communication

Tetranuclear Copper (II) schiff base complexes as new precursor for synthesis of CuO nanoparticles by solid-state thermal decomposition

ABSTRACT

A. A. Dehno Khalaji*
F. Malekan

*Department of Chemistry, Faculty
of Science, Golestan University,
Gorgan, Iran.*

Received 03 July 2013

Accepted 14 October 2013

In this paper, we used tetranuclear copper (II) Schiff base complexes, $[\text{Cu}_4(\mu\text{-sal}_2\text{hn})(\mu\text{-N}_3)_2(\text{N}_3)_2]$ (**1**) and $[\text{Cu}_4(\mu\text{-salophen})(\mu_{1,1}\text{-N}_3)_2(\text{N}_3)_2]$ (**2**), as new precursor in solid-state thermal decomposition for the synthesis of CuO nanoparticles. The crystallinity, purity and morphology of the CuO nanoparticles were characterized by Fourier transform infrared (FT-IR), X-ray diffraction (XRD) and scanning electron microscopy (SEM).

Keywords: *Tetranuclear; Schiff base; nanoparticles; XRD; SEM.*

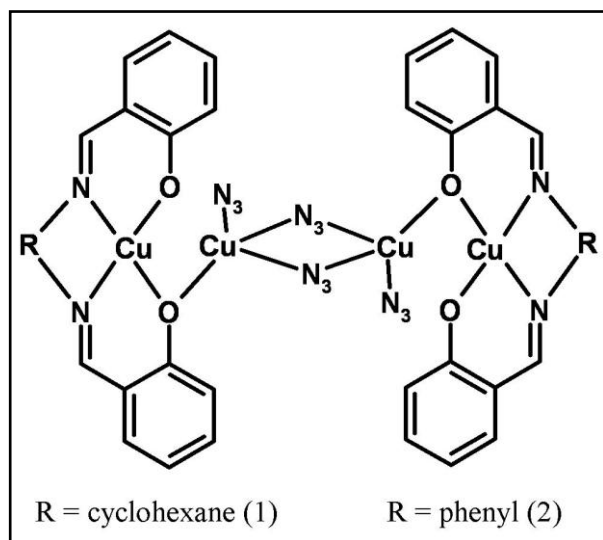
INTRODUCTION

Copper (II) oxide nanoparticles have been of considerable interest due to the role of CuO in antibacterial activity [1], electrocatalytic application [2] and interaction with amino acids [3]. There are several methods to prepare CuO nanoparticles, such as electrochemical reduction [1], hydrothermal and alcohothermal reaction [2, 3], solid-state thermal decomposition [4], microwave irradiation [5] and etc. [6-12]. Currently, the solid-state thermal decomposition of Schiff base complexes as new precursors is being used more and more [13-15], and as compared to conventional methods, it is much faster, economical and cleaner. Although CuO can be prepared using a number of methods [1-12], it still remains a major challenge to develop a facile, inexpensive and nontoxic route for the synthesis of CuO [16].

In this study, we decided to use simple, low-cost, green and reproducible process for the preparation of CuO nanoparticles from tetranuclear copper (II) Schiff base complexes as new precursors (Scheme 1).

* Corresponding author:

Aliakbar Dehno Khalaji
Department of Chemistry, Faculty
of Science, Golestan University,
Gorgan, Iran.
Tel +98 171 2245882
Fax +98 171 2245882
Email alidkhalaji@yahoo.com



Scheme. 1. Chemical structure of Cu (II) Schiff base complexes

EXPERIMENTAL

Materials and characterization

All reagents and solvents for synthesis and analysis were commercially available and used as received without further purifications. Fourier Transform Infrared spectra were recorded as a KBr disk on a FT-IR Perkin–Elmer spectrophotometer. X-ray powder diffraction (XRD) pattern of the complex was recorded on a Bruker AXS diffractometer D8 ADVANCE with Cu-K α radiation with nickel beta filter in the range $2\theta = 10^\circ$ – 80° . Scanning electron microscopy (SEM) images were obtained on Philips XL-30ESEM. Tetranuclear copper (II) Schiff base complexes were prepared by the some procedure [17, 18].

Preparation of CuO nanoparticles

The complexes were loaded in to a crucible and then were placed in oven and heated at a rate of $10^\circ\text{C}/\text{min}$ in air. Nanoparticles of CuO were synthesized at 500°C after 3 h, washed with ethanol and dried at room temperature. The synthesized CuO nanoparticles were characterized by FT-IR, XRD and SEM.

RESULTS AND DISCUSSION

A strong absorption band at 565 and 542 cm^{-1} in the FT-IR spectra of CuO nanoparticles

assigned to the vibrations of the Cu-O stretching functional group [2]. This band, and the absence of stretching vibrations of CH, C=N and other groups of the ligand in the FT-IR spectra confirmed the prepared of CuO nanoparticles [2].

Figure 1a and b shows the XRD patterns for the CuO nanoparticles obtained from solid-state thermal decomposition of tetranuclear copper (II) Schiff base complexes 1 and 2. All of the diffraction peaks can be clearly indexed to the monoclinic structured CuO. No other impurities were detected by XRD analysis, indicating the high phase purity of the CuO nanoparticles [2].

The detailed morphology and structure of CuO nanoparticles were future characterized by SEM. Figure 2a and b shows SEM images of CuO nanoparticles. Figure 2b show these nanoparticles have irregular shape and their distribution is not uniform. The nanoparticles are stable in air and did not convert into any other compounds.

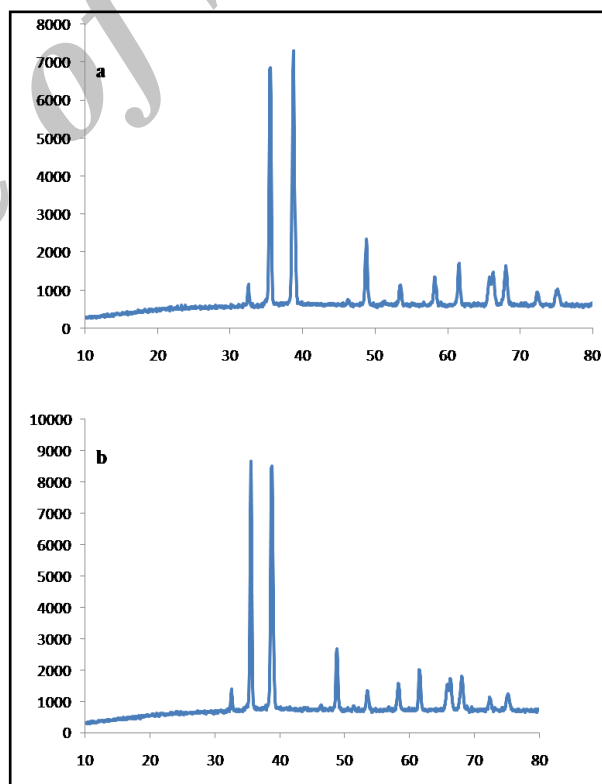


Fig. 1. XRD patterns of the as-prepared CuO nanoparticles from (a) and (b)

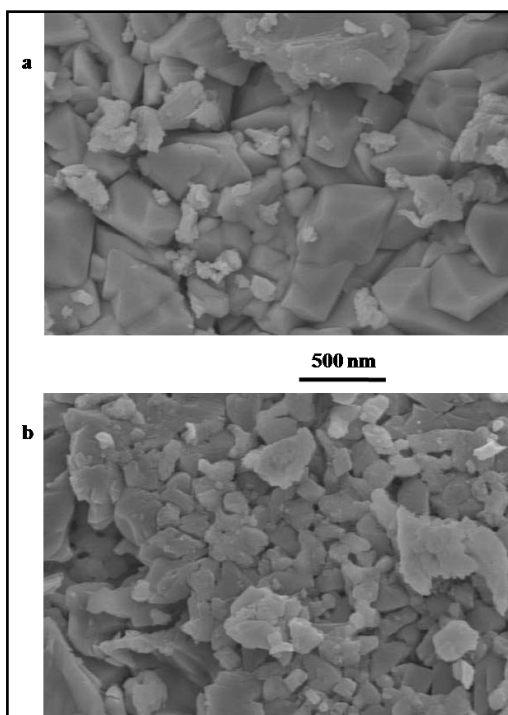


Fig. 2. SEM images of the as-prepared CuO nanoparticles from 1 (a) and 2 (b)

CONCLUSIONS

In summary, we have successfully prepared CuO nanoparticles by solid-state thermal decomposition of tetranuclear copper (II) Schiff base complexes. The as-prepared CuO nanoparticles exhibit irregular in size and shape. In addition, this method is simple, facile, inexpensive, nontoxic and safe to use, can be applied as a general method for the preparation of other transition metal oxide nanoparticles.

ACKNOWLEDGEMENTS

We are grateful to the Golestan University for partial support of this work.

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