Study the structure and morphology of the compound $(ZnO)_{0.8}(CuO)_{0.2}$ by using nano materials.

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Abstract

Recent nanotechnological advances suggest that metal oxide nanoparticles (NPs) have been expected to be used in various fields. ZnO ,CuO nano powders have been characterized by X-Ray Diffraction. Was used this nanomaterial to Prepare compacted-materials of $(ZnO)_x(CuO)_{1-x}$, by using powder metallurgy with weight ratio (x=0.8). The particle size calculations were done using XRD Scherer's formula (46.218 nm). The structure and surface morphology of the compound were examined by means of X-Ray Diffraction and scanning electron microscopic (SEM). XRD is an easy tool to determine the size and the shape of the unit cell for any compound .Composite nanostructures of these two oxides (CuO/ZnO) may pave the way for various new applications.

Keywords: powder metallurgy, $(ZnO)_x(CuO)_{1-x}$, nano powders.

دراسة التركيب والتشكيل الداخلي للمركب $(ZnO)_{0.8}(CuO)_{0.2}$ باستخدام مواد نانوية

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الملخص

تشير التطورات الأخيرة إن تقنيات النانو واكاسيد المعادن النانوية من المتوقع إن تستخدم بمجالات عديدة. مساحيق النانو لاوكسيد $(ZnO)_x(CuO)_{1-x}$ الزنك وأوكسيد النحاس ميزت بواسطة حيود الأشعة السينية . تم استخدام مواد نانو لتحضير المركب .وقد تم حساب حجم الجسيمة باستخدام معادلة شيرر (46,218 نانو متر) . (x=0.8)بواسطة تقنية تعدين المساحيق بنسب تم فحص التركيب والتشكيل الخارجي للمركب بواسطة جهاز حيود الأشعة السينية والمجهر الالكتروني الماسح . مركبات النانو لهذه الاكاسيد (اوكسيد الزنك واوكسيد النحاس) قد تمهد الطريق لمختلف التطبيقات الجديدة .

الكلمات الدالة: المساحيق النانوية , $(ZnO)_x(CuO)_{1-x}$تعدين المساحيق

Introduction

Metal oxides are of interest to many scientific and technological disciplines. In particular, nanostructures of these materials have attracted considerable interest as they exhibit materials properties that differ strongly from those of the bulk phases. These particle size effects enable tailoring the materials to a wide range of applications including magnetic ferrofluids, electronics and catalysis [1]. Cupric oxide (CuO) is an important transition metal oxide with a narrow bandgap (Eg=1·2 eV) and forms the basis of several high temperature superconductors and giant magnetoresistance materials [2]. This material has a great potential for different technological applications such as gas sensors, magnetic phase transitions, catalysts, and superconductors [3]. The oxides of transition metals are an important class of semiconductors, which have applications in magnetic storage media, solar energy transformation, electronics and catalysis. Among the oxides of transition metals, CuO has attracted much attention because it is the basis of several high-Tc superconductors [4]. Zinc oxide is an important basic material due to its low cost, large band gap (3.37 eV), large exciton binding energy (60 MeV),and luminescent properties [5]. It is widely used in many applications, such as catalyst, gas sensor, filtering materials for ultraviolet light, microbe resistant defence clothing [6]. And also as antimicrobial and retanning agent [7]. XRD study is most important tool used in nano materials science. A discussion about simple and low cost preparation of nano powder and its X-ray diffractional (XRD) studies are presented in this

study. XRD is an easy tool to determine the size and the shape of the unit cell for any compound [8].

Experimental

Nano ZnO and nano CuO powders were prepared by precipitation method. The powders used to prepare $(ZnO)_x(CuO)_{1-x}$ compact, by using powder metallurgy with weight ratio (x= 0.8), are mixed to obtain a uniform distribution of the components. These are mixed using a variable speed electric mixer for(2 hours) for the purpose of obtaining a homogeneous mixture and the non-agglomerated mixtures are then dried in an oven at (80 °C) for (2 hours). A mold is designed for the manufacture of samples in the form of pellet in diameter (9mm) and thickness (5mm) and the weight of the sample is (1.3 g). It uses hydraulic press with a pressure of (500-700) psi, and the diameter of the mold used (1cm) with a high of (3cm). The specimens were sintered at (1000°C) for (4 h), and then cooled in the furnace to room temperature. The morphology, crystal structure and crystallinity of the nanostructures were monitored by using scanning electron microscope (SEM), and x-ray diffraction.

The X-ray diffraction pattern were recorded using XRD-6000 with CuKα (λ=1.5406A°) that have an accelerating voltage of (220/50)HZ which is produced by SHIMADZU company, and the scanning electron microscope used in imaging the nanoparticles was a VEGA//EasyProbe which is a favorable combination of a scanning electron microscope and a fully integrated energy dispersive X- ray microanalyser produced by TESCAN, s.r.o., Libušina trída 21.

Results and discussion

1- x-ray diffraction

X-Ray diffraction (XRD) has been performed for the identification of the crystal structure and growth orientation of the nanostructures. The crystal structure obtained was investigated by XRD. All diffraction data are in good agreement with JCPDS files No.39-

0400, No.26-0571, No.05-0661,and No.0831. Figure (1) shows the XRD pattern of CuO/ZnO composite nanostructure. Both ZnO and CuO peaks appears in the pattern which confirms the presence of both materials. The peak at 2θ value of (39.3°) belongs to the monoclinic CuO while the peak at 2θ value of (34.8°) is related to the ZnO wurtzite structure. The XRD pattern of the synthesized is shown in Figure (1).

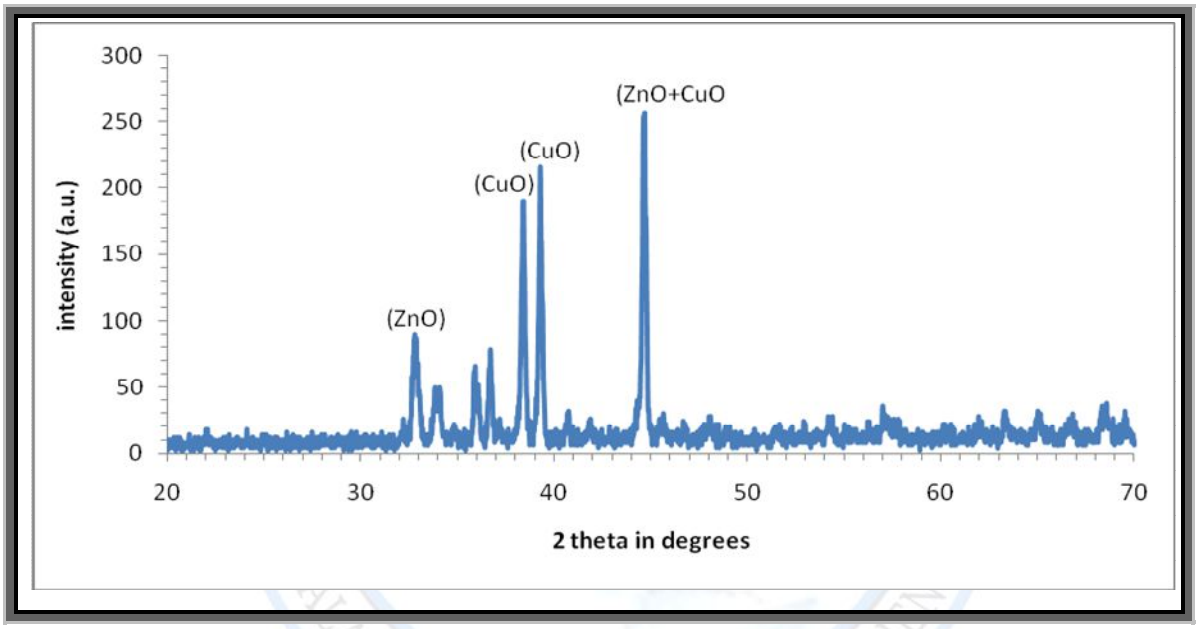

Figure 1. XRD pattern of $(ZnO)_x(CuO)_{1-x}$ sample

The growth procedure of the ZnO and CuO nanostructures are described in this work. The high temperature sintering bath deposition method was chosen for the growth of ZnO, CuO and their composite nanostructures. After the growth, diverse characterization techniques were used to probe the morphology and structural aspects of the as grown nanomaterials. The detailed analysis of the XRD and the assignments of various reflections are given in Table (1).

Table 1: Strongest three peaks of fig.1

No.	Peak No.	2 Theta (deg)	d(A°)	FWHM (deg)
1	21	44.6726	2.02688	0.19010
2	15	39.3203	2.28956	0.17630
3	13	38.4252	2.34081	0.19300

Particle Size Calculation from x-ray diffraction

From this study, considering the peak at degrees, average particle size has been estimated by using Debye-Scherrer formula [9, 10]

$D = 0.9\lambda / \beta \cos \theta$ …… (1)

Where λ is the wavelength of X-ray (0.15406 nm). β is FWHM (full width at half maximum). θ is the diffraction angle. For sample sintering at 1000°C:

$D = 0.9\lambda / \beta \cos \theta$ …… (1)

= 46.218 nm

2- Scanning electron microscope

The morphology of the final products was determined by scanning electron microscopy (SEM).The particle morphology of the prepared ceramic materials were studied by using SEM images. Some particle agglomerates shows the SEM images of the as synthesized $(ZnO)_x(CuO)_{1-x}$ sample at low and high magnification with less than (100 nm) diameter as was previously obtained. These micrographs shows clearly that the network formation and agglomeration of the $(ZnO)_x(CuO)_{1-x}$ sample has taken place. We Show the irregular flower-like structures. Figure (2) shows SEM image of $(ZnO)_x(CuO)_{1-x}$ with flower nanoparticle shape formation.

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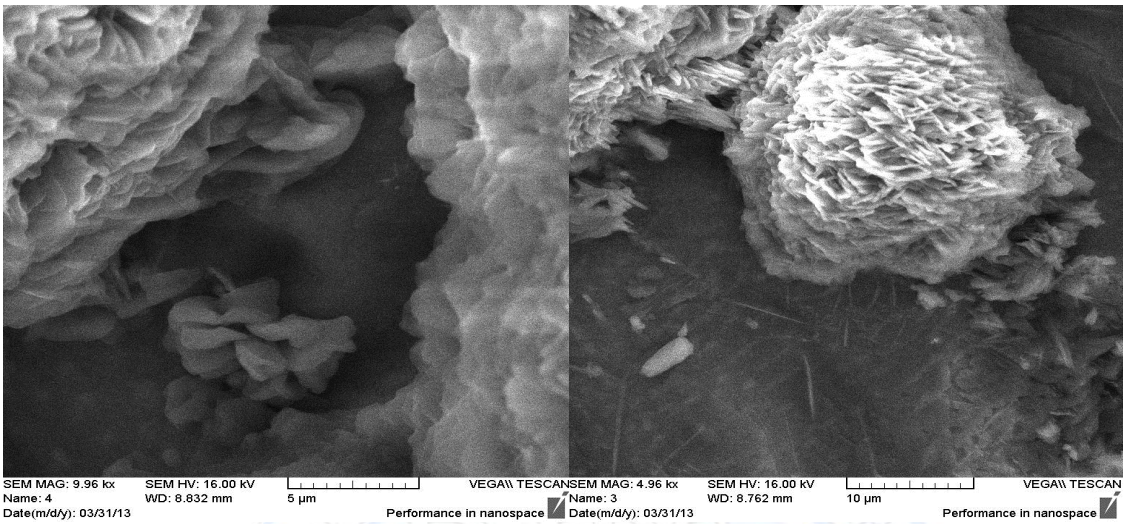

Figure 2. SEM images of $(ZnO)_x(CuO)_{1-x}$ sample

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