Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Archives of Physics Research, 2014, 5 (4):30-33
(http://scholarsresearchlibrary.com/archive.html)

Scholars Research Library
ISSN : 0976-0970
CODEN (USA): APRRC7

The structural and compositional studies of copper oxide thin film

Mohd. Khizar[2], Chishty S.Q.[1*], Afzal Hussain[3] and Mazhar Farooqui[4]

[1]*Department of Physics, Dr.Rafiq Zakaria College for women, Aurangabad M.S.India.*
[2]*Department of Physics, Kohinoor College of arts and science, Khultabad. M.S.India.*
[3]*Department of Physics, Arkay College of engineering and Technology, Bodhan Nizamabad,Telangana India*
[4]*Department of chemistry, Dr.Rafiq Zakaria College for women, Aurangabad M.S.India.*

ABSTRACT

Thin film of CuO has been deposited on a glass substrate by chemical bath deposition method. The CuO thin films are found to be uniform, smooth, and well adherent to the substrate. The films are characterized for their optical characteristics. Structural study through XRD spectrum showed that CuO films are crystalline nature. Compositional analysis by EDAX, the composition and chemical constituents of the film is estimated and is tachometric Surface morphology study through SEM photographs gave the surface nature which was uniform and smooth.

Key words: Chemical bath deposition , thin films , XRD Spectrum.

INTRODUCTION

Ultra thin layers of material deposited on another material are of immense importance for the present day science and technology. The fabrication of integrated circuits consists of deposition and selective removal of series of thin films. Thin film micro electronics and optoelectronics are among the strongest technological drivers of our economy, a fact manifested by the explosive growth in communications and information processing, storage and display applications. Technologies have fertilized expanding thin film uses in diverse areas e.g.:- coating of all kinds, bio-technology and the generation and conservation of energy. Thin film applications are issues rooted in material science and engineering. Involvement with thin films dates to the metal ages of antiquity [1]. Many magnificent examples of statuary, royal crowns, coffin cases that have survive intact attest to the level of skill achieved. It is no wonder that when British gold beaters were called upon to provide the first metal specimens to be observed in the transmission electron microscope.

The study of the material in thin film form has solved a number of fundamental problems, which could be solved by materials in the bulk form. The applications of thin films are numerous. Thin film conductors, resistors, capacitors, electrical contacts, and thin film insulator are some of the electrical applications [1-3].

MATERIALS AND METHODS

In this study, the Cu_2O thin films were prepared using the chemical bath deposition technique. The following constitutes the chemical bath system for optimum deposition: 30ml of 0.1M copper nitrate [Cu(NO3)2], 30ml of 0.1M Hydrazine (NH2NH2), and 6.5ml of 1M triethanolamine (TEA) which is the complexing agent[4].

Solutions for the deposition bath were made in 50ml beakers and 76mm x 26mm x 1mm commercial–quality glass microscope slides were used as the substrate. Before use, these glass slides were soaked in a solution of nitric acid and hydrochloric acid and then washed thoroughly with detergent and rinsed in distilled water. After transferring the solution to a beaker, the substrate was suspended vertically in the solution with the aid of a beaker cover. The addition of the 1M TEA to $CU(NO_3)_2$ solution resulted in a deep blue solution. The further addition of NH_2NH_2 to the solution resulted in a hissing sound which signaled the release of nitrogen gas and a rapid change in color, first to light blue and then to light yellow, reddish brown, and, finally, blue. The optimum growth period is in the range of 4-5 hours. The film deposited is either pure yellow or reddish brown but gradually turns yellow with time.

$$Cu(NO_3)_2 + TEA \leftrightarrow [Cu\ (TEA)]_2+ + 2NO^{-3}$$
$$[Cu\ (TEA)]^{2+} \leftrightarrow Cu_2+ + TEA$$
$$NH_2NH_2 + 2NO^{-3} + 6^{e-} \leftrightarrow 2H_2O + 2N_2 + 4O^{2-}$$
$$8Cu_2+ + 4O^{2-} + 8e_- \leftrightarrow 4Cu_2O$$

The results obtained from XRD, SEM, EDAX, Optical studies are discussed below.

2.1. Thickness of the thin film

Thickness of the Copper oxide (CuO) thin film deposited by chemical bath deposition technique is measured by using the refractive index and wavelength[5]. The thickness of the thin film is calculated by the equation

$$t = \frac{\lambda_1 \lambda_2}{2(\lambda_1 n_2 - \lambda_2 n_1)}$$

Where n_1 and n_2 are the refractive indices corresponding to wavelength λ_1 and λ_2. The thickness of the film was found to be 392 nm.

2.2. Thin film structural studies

The copper oxide thin film prepared by chemical path deposition[6] at room temperature on a glass substrate was carried out using X-ray diffractometer.

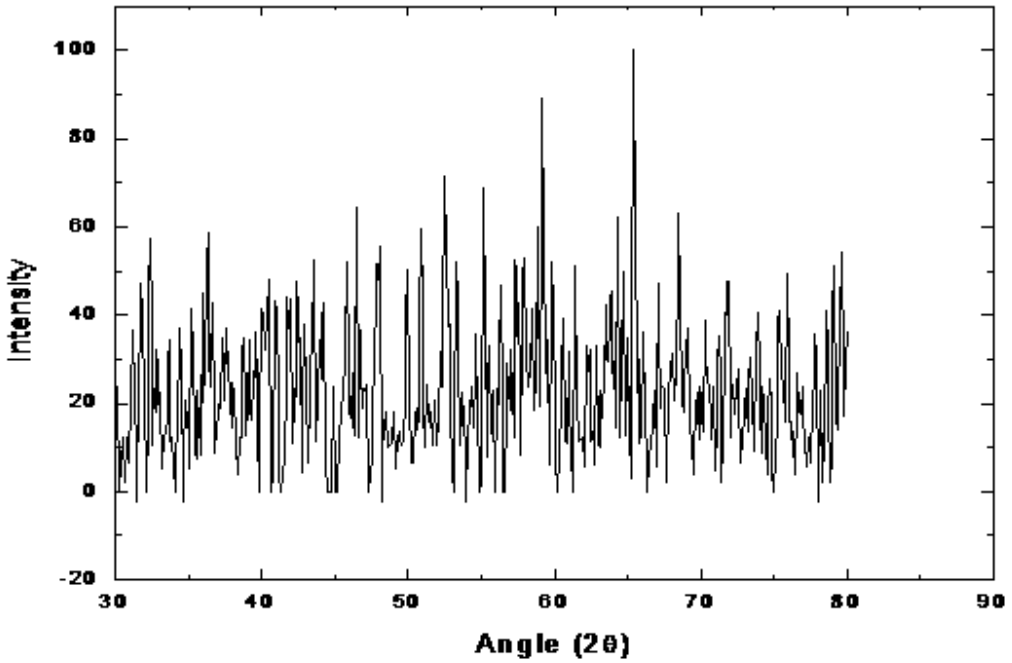


Fig . 1: XRD pattern of CuO thin film on glass substrate

From the Diffract gram, it observed that the thin film is in crystalline in nature. The crystalline nature of the film may be improved further by increasing the substrate annealing temperature[7].

Figure 1 shows the XRD pattern of the copper oxide thin film on glass substrate in the range of 2θ angle between 30° and 90°.

2.3. The elemental composition of the thin film and analysis

The elemental composition of the thin film and analysis had been subjected to EDAX analysis.

Figure 2 shows the EDAX spectrum of Copper oxide (CuO) thin film deposited at 30°. It shows the deposited film is having Na, O, Si elements[8]. The evaluated atomic percentage of Na=10.6, O = 28.09 Cu= 29.07 and Si = 40.86 respectively. Where, the element Silicon is due to the composition of the substrate[9].

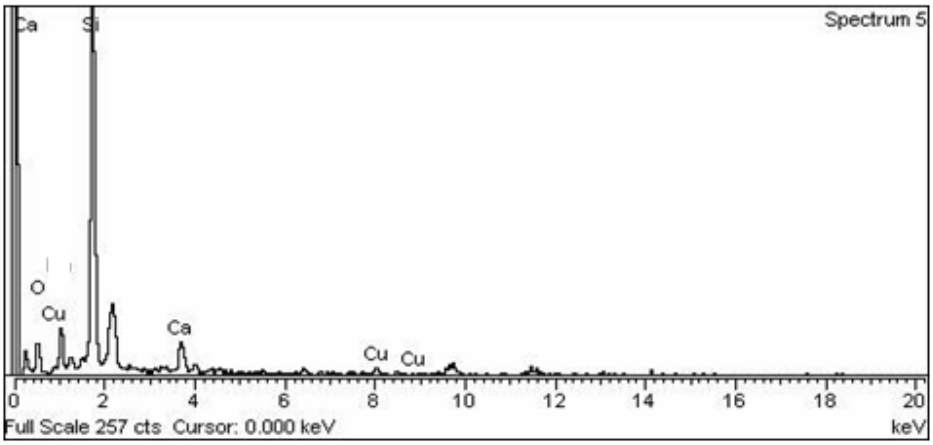
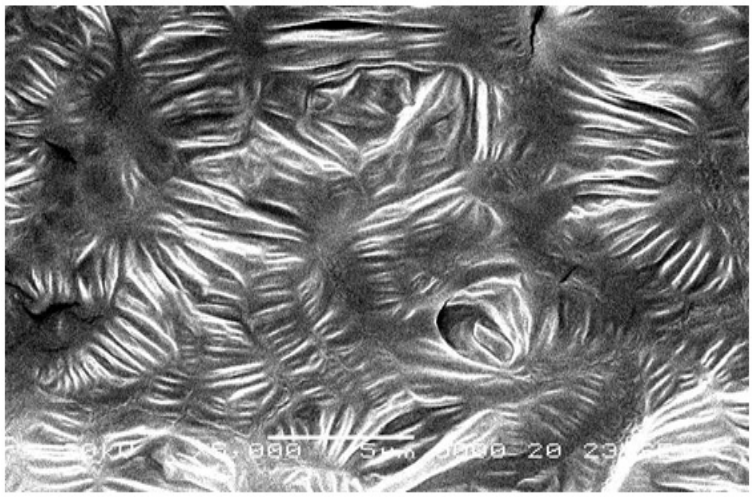


Fig . 2. EDAX Spectrum of CuO thin film deposited on glass substrate

2.4. Study of CuO surface morphology

The scanning electron microscopic image of CuO thin film deposited at room temperautre is shown in figure 3. It shows smooth uniform surface The SEM studies were carried out to study the morphology of the deposited film[10]. The SEM photograph provides the nature of the surface that is uniformity, smoothness and cracks. The photographs are taken with the magnification of 10000X[11].



.

Fig. 3: SEM image of CuO thin film at room temperature

CONCLUSION

Thin film CuO were developed on glass substrate . The PH values are kept high . The parameters like Temperature , reaction time , and reactant concentrations play an important role during deposition . These parameters were changed so as to form metal compound films of better quality for each combination of reactant . Reaction time for the film formation was nearly six hours. When this time is extended to nine hours or so thickness and adhesion problems arises. Figure 3 shows SEM image of the film deposited on glass plate is fairly uniform. X-ray diffraction (XRD) is a powerful technique for determination of crystal structure and lattice parameters. The EDAX Spectrum of thin film deposited at 30° shows the deposited film is having Na, O, Si elements the element Silicon is due to the composition of the substrate.

REFERENCES

[1] *Milton Ohring, The material science of Thin* films, (**1999**) .
[2] A. Goswami , *Thin film fundamentals*,**1998** 211 11.
[3] A.R. West,'Solid State Chemistry' John willey & Sons, Singapore, (**2003**)
[4] Gan Z.H, Yu G.Q, Tay B.K, Tan C.M, Zhao Z.W and Fu Y.Q, *Journal of Physics*, **2004 37**, 85.
[5] Chaffar Akkari F, Kanzari M And Rezig B, *Material on semiconductors* (**2002**).
[6] M. T. S. Nair, Laura Guerrero, Olga L. Arenas, *Solar energy materials* (**1999**).
[7] Shigehito Deki, Kensuke Akamatsu, Tetsuya Yano, Minoru Mizuhata and Akihiko Kajinami, *Applied physics*, **2007** 40, 54.
[8] Philippe Poizot, Chen-Jen Hung, Maxim P. Nikiforov, Eric W. Bohannan, and Jay A.Switzer, *Solid state letters*, **2003** 6, 25.
[9] F. Silvain, J. L. Bobet and J. M. Heintz, *Applied science and manufacturing*, **2002** 33
[10] Jorge Medina-Valtierra, Sergio Calixto and Facundo Ruiz, *Engineering chemistry*, **2004** 58 61.
[11] Rupa R. Pai, Teny Theresa John, M. Lakshmi, K. P. Vijayakumar and C. Sudha Kartha, *Conductivity studies* **2005**, 208, 212.