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Structural and Morphological Properties of CuSe Thin Films Prepared By Spray Pyrolysis Technique

Meshram R.S.[1]*,
[1]Dept. of Physics, N.H.College, Bramhapuri,Dist- Chandrapur, India

***Corresponding Author Email:- meshramratan@gmail.com**

Abstract : Copper selenide (CuSe) thin films have been deposited by spraying a mixture of aqueous solutions of copper chloride hydrate ($CuCl_2 \cdot 2H\ O$) and selenourea on to glass substrate by using chemical spray pyrolysis technique at 300°C temperature.The films were characterized by using X-ray diffraction technique (XRD) , FESEM and EDS .The structural studies indicates that CuSe thin film is nano-crystalline in nature with a hexagonal structure having preferred orientation along (102) plane and some peaks are also present (006), (104) (108), and (112). The as –synthesized films were homogeneous and highly crystallized .The structural compositional analysis reveal that the products were the pure phase of CuSe with corresponding atomic ratios .The film with surface morphology showed that the deposited film has well defined morphology. The crystalline size was found to be in the range of 32-39 nm .The FESEM study reveals that the grains are uniform with uneven spherically shaped and spread over the entire surface of the substrate

IndexTerms **–CuSe Thin Films, Spray Pyrolysis, Structural, Morphological, EDS Properties.**

INTRODUCTION

Copper selenide (CuSe) is a metal chalcogenide p- type semiconducting material, which has electrical and optical properties suitable for opto electronic device applications [1-2]. Moreover, different crystalline phases have been reported with orthorhombic structure [3], cubic, hexagonal [4], and tetragonal [5], depending on the stoichiometry and the growth methods [6]. Several researchers have been performed in the past to study the fabrication and characterization of CuSe thin films because of possible its application in solar cell technology [7-8]. Various methods so far adopted for the preparation of copper chalcopyrite thin films include chemical bath deposition [9],selenization [10-11],sputtering [12],electrochemical deposition[13],galvanic synthesis [14],co-deposition [15] ,evaporation[16] ,electrodeposition [17-18] ,solvothermal method [19],MOCVD [20] and spray pyrolysis method presents some noticeable advantages , such as : a wide possibility of varying the film properties by changing the composition of the starting solution (introduction of dopants and change the film microstructure) and low cost when large –scale production is needed [21]. CuSe thin films are p-type semitransparent highly conducting semiconductors [22] that found numerous applications in devices such as thin film solar cells, photodetectors, superionic materials, optical filters [23-25]. Structural properties have been determined using X-ray diffraction. The crystalline size was estimated for the deposited films .Surface morphology with film composition was analyzed by FESEM and EDS [26].

METHOD.

Copper selenide thin films were deposited onto glass substrates by a spray pyrolysis method at 300°C substrate temperatures. Aqueous solutions of copper chloride hydrate ($CuCl_2 \cdot 2H\ O$) and selenourea were utilized as starting materials. Microslides glasses were used as substrates. A spray rate of 4ml/minute was kept constant throughout the experiment. The distance between the nozzle and the substrate was 28 cm. The as deposited thin films of copper selenide were characterized for structural, morphological, compositional, measurements [27].

RESULT AND DISCUSSION

X-ray diffraction pattern of copper selenide thin film at 300°C temperature was recorded by varying diffraction angle (2θ) from 10 to 90 degree [28]. Fig.(1) shows the X-ray diffraction pattern indicated that the deposited film possess polycrystalline in nature with hexagonal structure [29] .X-ray diffraction pattern reveal that the film of copper selenide deposited by spray pyrolysis technique is polycrystalline in nature. It was observed that reflections peaks are (102), (006), (104) (108), and (112) for CuSe thin film [21]. Crystalline size was estimated by using Scherrer's formula given by the equation

$$D=k.\lambda/\beta.Cos\theta$$

Where k is constant, λ is wavelength of X-rays , β is the full width at half of the peak maximum in radian and θ is Bragg's angle. The crystalline size was estimated for the (006) reflection. The crystalline size for copper selenide thin film was found to be in the range 32-39nm [27]. Fig. (2) Shows FESEM image of as-deposited copper selenide thin film. From FESEM image we can said that the film surfaces are homogeneous, smooth and well covered [8] .Fig. (3) Shows image of as deposited copper selenide thin film. The chemical composition of CuSe thin film was characterized by using EDS.The measurements of EDS supply more accurate information for evaluating the purity and composition of CuSe thin film. As shown in Fig.(3) , all peaks are related to the Cu and Se elements of the CuSe thin film. The peaks of other impurities are not observed in the EDS pattern of CuSe thin film [30].The atomic molar ratio (Cu: Se) is found to be 74:26

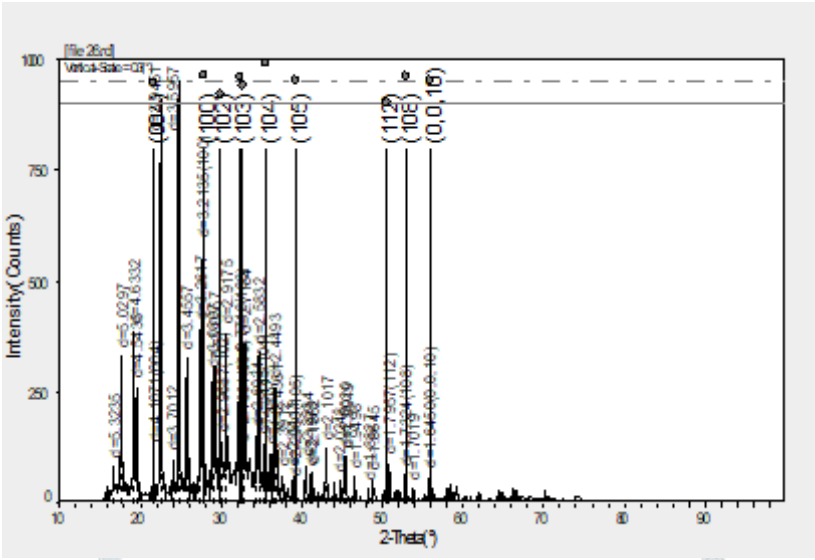

Figure 1. XRD Pattern of CuSe Thin Film

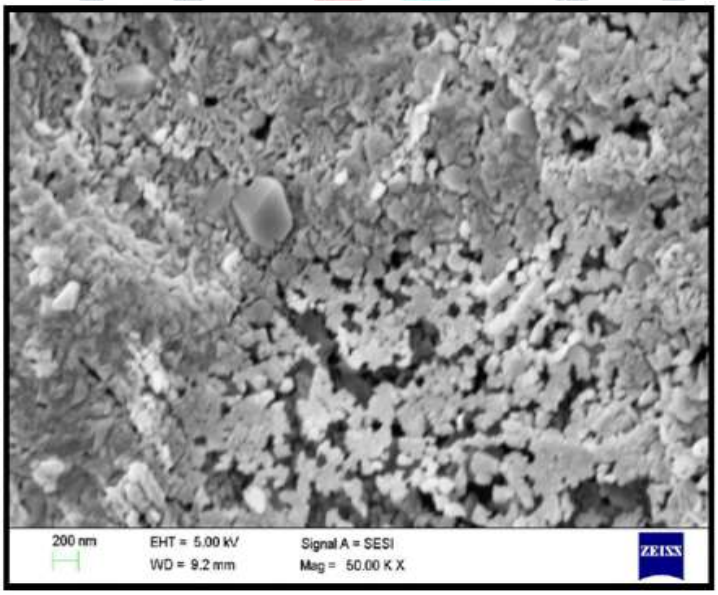

Figure 2. FESEM Image of CuSe Thin Film

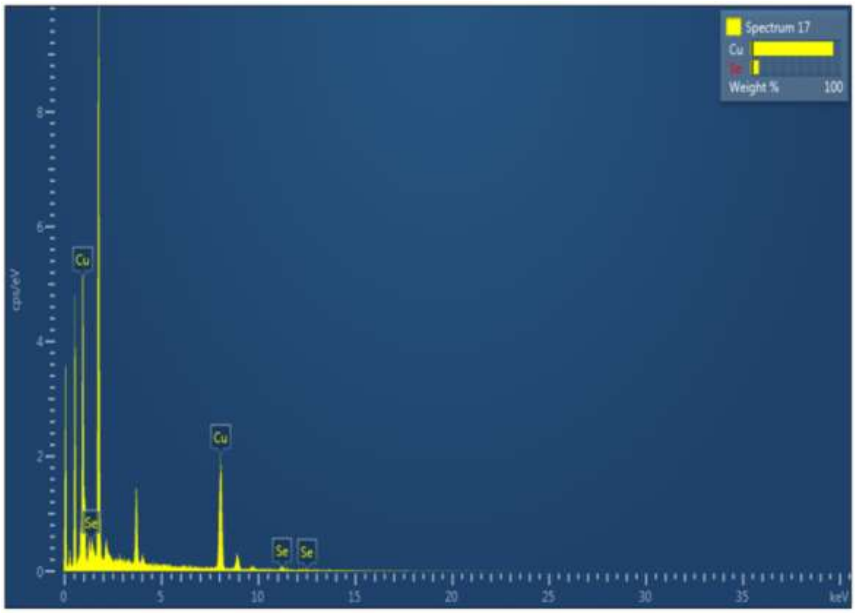

Figure 3. EDS Spectra Of CuSe Thin Film

CONCLUSION-.Copper selenide thin films have been successfully deposited using the simple and inexpensive spray Pyrolysis technique.XRD study reveals the polycrystalline nature of the films with hexagonal. The crystalline size was found to be 32-39nm.Scanning electron microscopy studies reveal smooth, uniform surface. EDS analysis confirms the ratio of Cu and Se and confirms the formation of CuSe phase.

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