ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

DESCRIPTION OF IRON SELENIDE THIN FILMS DEVELOPED BY CHEMICAL METHOD AT ROOM TEMPERATURE

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Abstract

Nanostructured materials have indeed become a very active research field in the areas of solid state physics, solid state chemistry, solid state ionics, material engineering and biotechnology. Iron selenide thin films have been set down onto glass substrates by the chemical deposition techniques. To obtain good quality FeSe thin films, preparative conditions such as concentration of cationic and anionic precursors, adsorption and rinsing time durations etc are optimized. Structural characterization of iron selenide thin films was carried out by means of X-ray diffraction. The morphological characterization of FeSe thin film was carried out using scanning electron microscopy. The semiconducting behavior of FeSe thin films has been studied by using two probe method of electrical resistivity.

1. Introduction

In recent years, thin film science has grown world-wide into a major research area. The major exploitation of thin film science is still in the field of microelectronics. However, there are growing applications in other areas like thin films for optical and magnetic devices, electrochemistry, protective and decorative coatings and catalysis [1-3]. Several methods have been attempted to prepare the iron selenide thin films: molecular beam epitaxy [4], milling pure elemental powders of iron and selenium [5], and selenisation of evaporated iron thin films [6]. In this paper, we describe an inexpensive, non-toxic, and easy to operate method to prepare FeSe thin films by chemical bath deposited method on glass substrates

2. X-ray diffraction

X-ray diffraction (XRD) studies were carried out in order to determine the crystalline nature of the deposited films. The inter-planar spacing'd' was calculated using the relation,

$$D_{hkl} = (\lambda/2)\,\mathrm{Sin}\theta \qquad (1)$$

Figure 1 shows the x-ray diffraction pattern of FeSe thin film deposited on glass substrate at room temperature. XRD pattern revealed that the deposited material has polycrystalline nature having hexagonal structure. The diffraction peaks of FeSe are found at 2θ values of 28.40 corresponding to the lattice plane (100). The swelling observed in the XRD pattern is due glass substrate. The average crystallite size of the deposited material is determined by using Debye-Scherer's formula,

$$d = \frac{0.9\,\lambda}{\beta \mathrm{Cos}\,\theta} \qquad (2)$$

Where β is full width at half maximum of the peak in radians, λ is the wavelength of CuKα radiation (λ=1.54 A^0), θ is the Bragg diffraction angle at peak position in degrees. The size of the crystallinites is found to be in the range of 50-100 nm.

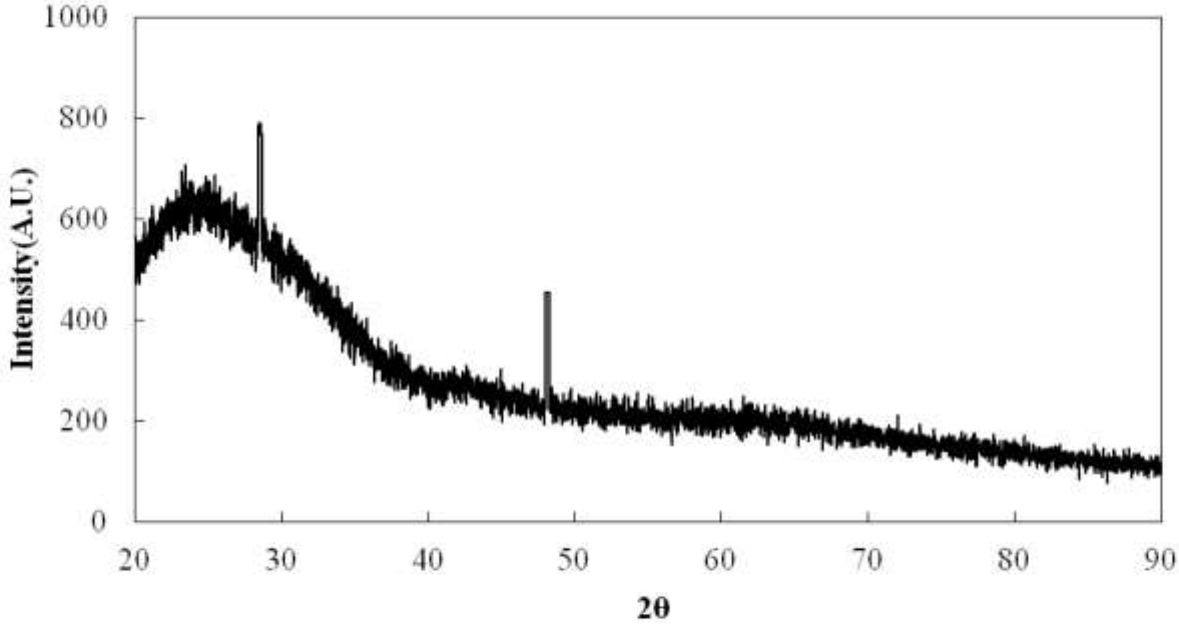
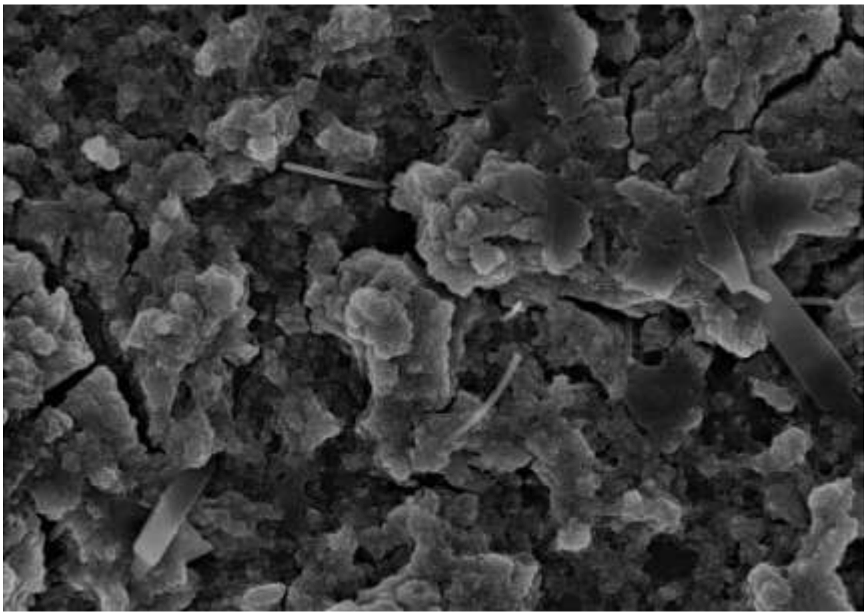


Figure 1 : x-ray diffraction pattern of FeSe thin film deposited on glass substrate

3. Morphological

Figure 2 shows, the SEM image of as deposited FeSe thin film on to the glass substrate. From SEM, it is observed that as-deposited FeSe film is uneven uniform and some part of the film is porous.



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The type of electrical conductivity exhibited by FeSe thin film was determined by thermo-emf measurement. The temperature difference applied across the film causes the transport of carriers from the hot end to the cold end and thus creates an electric field, which gives the thermal voltage. This thermally generated voltage is directly proportional to the temperature difference created across the semiconductor. It was found that the polarity of thermo-emf for nanocrystalline FeSe thin film was in favor of p-type conductivity

4. Conclusions

In conclusion, FeSe thin films were successfully synthesized at room temperature by CBD method on the glass substrate. Studies with XRD and SEM techniques confirmed nanocrystallinity with micro porous morphology and high resistivity of p-type FeSe. Such porous surface-morphology is useful in many optoelectronic applications.

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