IRRADIATION EFFECT IN CdSe THIN FILMS

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Abstract

Cadmium selenide thin films of thickness 200 nm were thermally deposited by vacuum evaporation method at room temperature on glass ground. The effects of irradiated time on the structure and optical characteristic of these films were studied. The films are hexagonal structure confirmed by XRD analysis. XRD pattern of the irradiated film at 72 hour shows an improvement of crystallinity. The optical measurements of CdSe films were carried out in the wavelengths range from 300-900 nm. The transmitance spectra shows that irradiated samples are less transmittance than non – irradiated one. The increase in irradiated time leads to a decreases in energy band gaps from 2.49 eV to 2.33 eV.

Keywords: Structure characteristic, Optical characteristic, irradiation, thin films, CdSe

تاثيرالتشعيع على اغشية CdSe الرقيقة

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الخلاصة

رسبت الاغشية الرقيقة لسيلينايد الكادميوم ذات السمك 200 nm حراريا باستخدام طريقة التبخير بالفراغ عند درجة حرارة الغرفة على ارضيات من الزجاج. درس تاثير زمن التشعيع على الخواص التركيبية والبصرية لهذة الاغشية. تم التاكد من تركيب الاغشية السداسي بتحليل XRD. بين مخطط XRD للغشاء الملدن عند 72 ساعة تطورات في التبلور. الصفات البصرية لاغشية CdSe سجلت بواسطة مطياف UV– . بين طيف النفاذية ان النماذج المشععه

اقل نفاذية من الغير مشععة. زيادة زمن التشغيغ قاد الى تناقص فجوة الطاقة من 4.49 eV الى 2.33 eV.

الكلمات المفتاحية: الصفات التركيبية، الصفات البصرية، التشعيع، الاغشية الرقيقة، سيلينايدالكادميوم

Introduction

The attention on the physical characteristic of the CdSe thin films rise because of their importance application in the fabrication optical fibres, solar energy collectors, optical instruments, and low cost solar cells, sensor and laser materials [1-5]. Several methods are available for depositing CdSe thin films such as, electron beam deposition[6], chemical bath deposition[7], spray pyrolysis [8], among these techniques thermal evaporation is suitable technique for preparing uniform and adherent films[9].

In the present study, we report the influence of irradiated times on the characteristic of CdSe films. It is well known fact that when gamma radiation interacts with the material, it can excite electrons of the target atom. When these electrons de-excite, the energy is transferred to the lattice through electron – photon interaction. In this way the amplitude of lattice vibrations increases which leads to improvement in crystallinity and the structure of the material [10].

Experimental work

CdSe films were deposit by vacuum evaporation method on to glass ground. Molybdenum boat was used to evaporate CdSe powder. Film substrate was fixed at 18 cm from molybdenum boat. The temperature of the film substrate was at room temperature. After preparation, the samples irradiated at various irradiated time (24, 28, and 72) hour. The structure properties of the as- deposited and irradiated films were investigated using XRD. Optical characterization behaviors were carried out by UV-spectrometer In the wave length (400-900) nm.

Resulet and discussion

To determane the crystal structure of as- prepared and irradiated films, X-ray diffraction (XRD) drawings were using. (XRD) emerge that

the preparing films are polycrystalline and possess a hexagonal structure. Fig. 1 shows XRD pattern of as- deposited and irradiated CdSe thin films at various times (24, 48 and 72) hour. The XRD peaks agree well with the corresponding JCPDS X-ray powder file data [11]. All CdSe thin films show highest intense reflection peak corresponding to (002) plan and low intense peak corresponding to (103) plane were identified for CdSe. As the dose time increases there is a sharp increase in the intensity of the (002) while intensity of (103) peak was unchanged with the increase of the irradiated times.

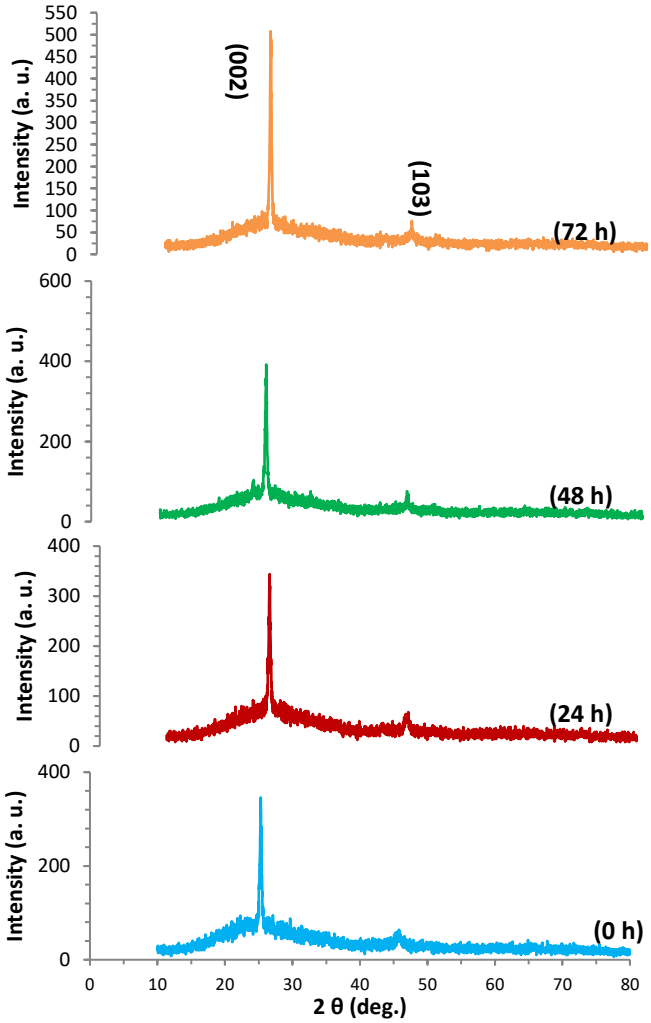

Figure (1) XRD patterns of as-prepared and irradiated CdSe thin films at different times (24, 48 and 72) hour.

The crystallite (D) of CdSe films are estimated by using Scherrer's formula [12].

$$D = \frac{0.94\,\lambda}{\beta \cos\theta} \quad \text{---------- (1)}$$

Where D is the crystallite size, λ is the wavelength of the x-ray used; β is the full width at half maximum (FWHM) and θ is the Bragg's angle of reflection.

From Table.1, it was appear that the crystallite size of the CdSe films corresponding to (002) increase with the increasing of irradiation times that indicates the improvement in crystallinity of the material. This is may be due to fragmentation caused by strain develop during irradiation [13].

The strain (ε) and the dislocation density (δ) of the films can calculate by taken the following formulas, [14, 15] see Table 1:

$$\varepsilon = \frac{\beta \cos(\theta)}{4} \quad \text{---------- (2)}$$

$$\delta = \frac{1}{D^2} \quad \text{---------- (3)}$$

The data of the Table 1 show that it was observed that the dislocation density and strain deceases with increase of irradiated films which indicate better lattice arrangement.

Table1. The structural parameters of CdSe thin films and Irradiation time

irradiation Time (hour)	2θ (deg.)	FWHM (deg.)	Lattice spacing d (Å)	(hkl) Plane	Crystallite size D (Å)	Strain (ε)x10^{-4} (line^{-2} m^{-2})	Dislocation density (δ)x10^{15} (line m^{-2})
0	25.327	0.2834	3.513	002	243.537	14.865	1.686
	45.820	0.24	1.978	103	265.075	13.658	1.423
24	25.333	0.324	3.512	002	262.629	13.785	1.449
	45.610	0.24	1.987	103	375.243	9.648	0.710
48	25.400	0.3188	3.503	002	266.940	13.562	1.403
	45.831	0.3767	1.978	103	239.279	15.130	1.746
72	25.326	0.3494	3.513	002	300.254	12.057	1.109
	45.850	0.34	1.977	103	375.568	9.639	0.708

Optical transmission spectra or UV-Spectrophotometer Analysis

The optical transmittance spectra for CdSe films before and after irradiation are shown in Figure (2). Irradiated samples shows less transmittance than non-irradiated one, this reduction in transmittance slightly increase with increase in irradiation times. This may be due to the decrease of surface roughness and growing in crystallinity of the CdSe films after irradiation.

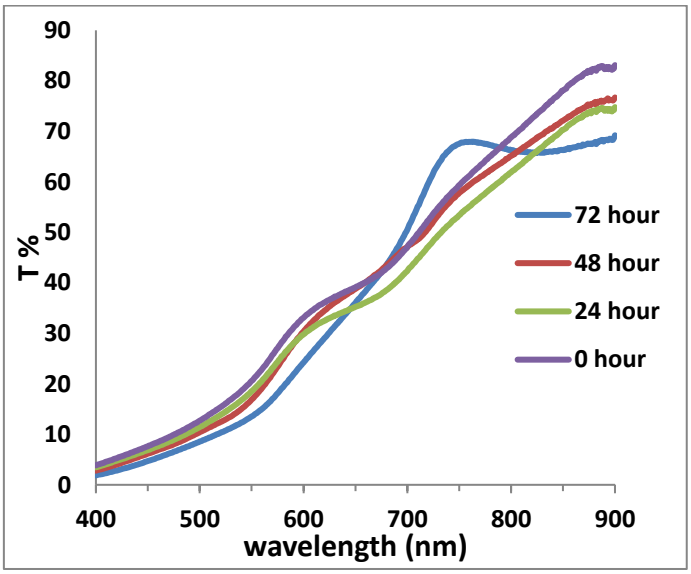

Figure (2) Transmittance spectra of as-deposited and irradiated CdSe thin films at different times (24, 48 and 72) hour.

Figure (3) shows $(\alpha h\upsilon)^2$ against photon energy for as-deposited and irradiated films at different times. It was observed that band gap energy decrease from 2.49 eV to 2.33 eV with increase of irradiated time as shown in Table (2). This is due to improvement in the films crystallinity attributed to increase in grain size [6] as supported by the XRD studies.

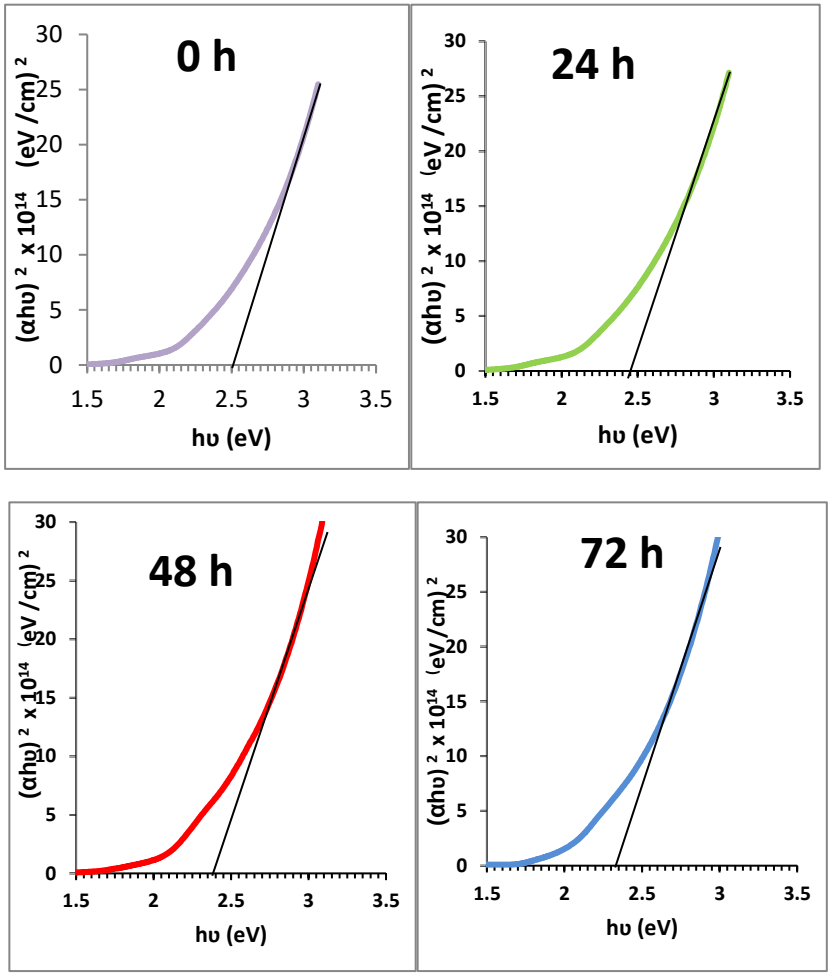

Figure (3) $(\alpha h\upsilon)^2$ versus photon energy of CdSe as-prepared and irradiated times.

Table 2 Values of optical band gap energy for different irradiated times

irradiated time (hour)	E_g (eV)
0	2.49
24	2.45
48	2.39
72	2.33

Conclusion

Structure and optical properties for CdSe thin films were studied with variation in irradiated time. X- ray was shown that there is a change in the crystallite size of the material. The reduction in band gap of CdSe thin films with the increase of irradiated times investigated.

Reference

1. T. Logu, K.S., P. Soundarrajan, and K. Sethuraman, Hydrophilic CdSe Thin Films by Low Cost Spray Pyrolysis Technique and Annealing Effects. Electron. Mater. Lett., 0000. **0**: p. 1-7.
2. L. Ion, S.A., M. Popescu, F. Scarlat, F. Sava, F. Ionescu, STRUCTURE AND ELECTRICAL PROPERTIES OF ELECTRON IRRADIATED CdSe THIN FILMS. Journal of Optoelectronics and Advanced Materials, **6**(2004) 113-119.
3. S.Mahajan, M.R., R. B. Dubey and Jagrati Mahajan, CHARACTERISTICS AND PROPERTIES OF CDSE QUANTUM DOTS. International Journal of Latest Research in Science and Technology, **2**(1)(2013) 457-459.
4. Ekpunobi, N.A.O.a.A.J., Influence of thickness on the structural and optical properties of cadmium selenide thin films. Advances in Applied Science Research, **3**(2012) 1244-1249.
5. shabir ahmed , m.g., shama islam , , study of effect of solar light irradiation on structural , optical and electrical properties of CdSe thin films. international journal of physics and astronomy, **2**(2014) 79-92.
6. A.D. Pogrebnjak, N.Y. Jamil, S.N. Abdulla, A.M. Muhammed, The Effect of γ-irradiation on the Structural and Physical Properties of CdSe Thin Films. PROCEEDINGS OF THE INTERNATIONAL CONFERENCE NANOMATERIALS: APPLICATIONS AND PROPERTIES, **2(**2013) 3pp.
7. M. P. Deshpande, N.G., Sandip V. Bhatt, Pallavi Sakariya, S. H. Chaki, Spectroscopy and structural study on CdSe thin films deposited by chemical bath deposition. Advanced Materials Letters, (2013) 1-12.

8. K. Subba Ramaiah, Y.K.S., S.J. Chang, F.S. Juang, K. Ohdaira, Y. Shiraki, H.P. Liu, I.G. Chend, A.K. Bhatnagar, Characterization of Cu doped CdSe thin films grown by vacuum evaporation. Journal of Crystal Growth, **224(**2001) 74-82.
9. Cristian Baban, G.I.R., On the structural and optical characteristics of CdSe thin films. Applied Surface Science, **211(**2003) 6-12.
10. K.M.Abhirami, R.S., K.Asokan, Structure, Optical and electrical properties of gamma irradiated SnO thin films. Radiation PhysicsandChemistry, **91**(2013) 35-39.
11. Powder diffraction data file, joint committe of powder diffraction standered 1984: International center for diffraction data, USA card No. 23.
12. M.Zulfequar, K.A.a., Study of effect solar light irradiation on structural, optical and electrical properties of CdSe thin films. International journal of physics and astronomy, **2**(2014) 79-92.
13. K. Sarmah, R.S., H.L.Das, stractural characterization of thermally evaporated CdSe thin films. Chalcogenide letters **5**(2008) 153-163.
14. P.A.Chate, D.J.S., P.P.Hankare, Electrical and crystallographic properties of nanocrystalline$CdSe_{0.5}S_{0.5}$ composite thin films deposited by dip method. J.Mater.Sci.Mater.Electron, **22(**2011) 111-115.
15. A.A.Yadav, E.U.M., photoelectrochemical performances of n-$CdS_{1-x}Se_x$ thin films prepared by spray pyrolysis technique Sol. Energy **84(**2010) 1445-1452.