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STUDY OF THE OPTICAL PROPERTIES OF $Sn_{1-x}S_x$ THIN FILMS.

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ABSTRACT

Thin film of tin sulfide (SnS) is deposited on to glass substrates using chemical spry pyorlysis thin films. The solution prepared by 0.2 M and used temperature at 350 C° and the distance between the nozzle and glasses substrate 35cm . obtained The optical constant such as (refractive index n and Extinction coefficient κ) of the deposition films were obtained from the analysis of the experimental recorded transmittance spectral data. The optical band gap of SnS films calculate from $(\alpha hv)^{\frac{1}{2}}(ev/cm)^{\frac{1}{2}}$. photon energy curve. The energy gap was found to be in the range 1.4eV to 1.85 eV.

Introduction:

SnS is one of the Tin chalcogenide layered semiconductor in group IV-VI. The p(type) conductivity [1-7], n (type) conductivity[1-3] depending of the concentration of tin and it my also change it's type of conduction from p to n type conduction in accordance with treatment temperature [8.9].

Different values of energy gap have been obtained [1,2,4] for SnS ranging from 1 to(2.33)ev depending of the resulting structure obtained by different techniques and the occurring type of electron transition. The requirement imposed on films used as a light absorber are (1) the must have an energy gap of about 1.5eV with indirect allowed transition and (2) a high absorption coefficient $>10^4\ cm^{-1}$, because SnS crystallizes in orthorhombic structure it can be use in n-p homojunction [8,9]. Semiconducting metal chalcogenides are used as sensor polarize thermoelectric cooling materials [10].

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Among many semiconductor metal chalcogenides tin sulfide have attracted extensive is interest du to it's photoconductivity properties for solar energy conversion Tin sulfide exists in variety of phases such as SnS, $Sn_2S_3, Sn_3S_4 and SnS_2$ du to characteristics of tin and sulfur [11].

The quality and properties of the films depends largely on substrate temperature, precursor solution concentration atomization type and substrate [12]. One such material is tin sulfide SnS, which was some desirable properties for photovoltaic application [13].

The application of thin films is widespread the methods employed for thin film deposition can be divided into two groups based on the nature of the deposition process viz . ,physical or chemical . the physical include physical vapor deposition (PVD) , laser ablation , molecular beam epitaxy and sputtering . the chemical method comprise gas – phase deposition method and solution techniques [14].

Spry pyrolysis has been used for several decades in the glass industry and in solar cell production [14]. SnS films are highly suitable for many application in a number of solid state devices. such as photovoltaic [15]. Photoelcrochemical (pec) [16], photoconduction cell [17] and intercalation battery system [18]. In addition , SnS thin films have photoelectric conversion efficiently (24%) [19] for the fabrication of heterojunction solar cell .tin sulfide

(SnS) is one of the promising materials for low cost thin film solar cell technology , because of it's optimum energy band and high fundamental absorption coefficient [20].

Experimental:

in the present work $Sn_{1-x}S_x$ with x=(0.1,0.2,0.3,0.4,0.5) thin film were prepared by chemical spry pyrolysis on the microscope glass substrate place directly above the heater , at distance 35cm with atomization nozzle kept at temperature 350 C°. with varying value (x) to compounds $Sn_{1-x}S_x$

The glass substrate were cleaned . Tin sulfide thin film a precursor solution is prepared by dissolving the salts of stannous chloride (Sn Cl 2HO) and Thiourea (CS(NH) of 0.2M . deionised water . few drops (0.5 ml) of concentrated HCl is added to get clear solution . solution is sprayed for 5 sec and left off for15 the thin films were prepared at 350C on clean substrate . Optical absorbance and transmission measurements of the films were study using spectrophotometer (UV-Vis-spectrophotometer) JENWAY (64050UV/Vis)

RESEALUT AND DISCUSSION

The absorption coefficient, α, was calculated from the Lambert law as α=(2.303 A) / t . [21] where 'A' is the optical absorption and 't' is the film thickness. the spectra behavior of the absorption coefficient as a function of energy, hv, is shown in figure (1) height absorption coefficient, > $10^4 cm^{-1}$, above the fundamental absorption edge.

Optical transmittance of the films was used estimate the band gap energy . the absorption can be calculated using the relation [3,18]

$$(\alpha h\nu)^n = A(h\nu - E_g)$$

Where A is a constant (slope), E_g is the band gap energy and n characterizes the transition process (n takes the value 2 and 1/2 for allowed and indirect allowed transitions , respectively . from the calculated values of the absorption coefficient a plot has been drawn with

$(\alpha h\nu)^2$, and hv . α is the optical absorption coefficient of the material and hv is the photon energy .[18] form figures (2) show us that the energy gap values around 1.4 eV to 1.85 eV. This value is similar study to [3,13] Inertia coefficient was calculated from equation [22]

$$\alpha=4\pi k/\lambda$$

and the following forms (3) change the values of k with λ where start decreasing with increasing wavelength, starting from the wavelength (400nm) is that the coefficient of inertia in this region, a region that is changing where the photon has enough energy to transfer an electron from the valence band to conduction band in directly. The value coefficient of inertia increase when increase the quantity the Thiourea .

Calculated the optical refractive index n using equation through [23]

$$n = \left(\frac{4R}{(R-1)^2} - K^2\right)^{1/2} - \frac{R+1}{R-1}.$$

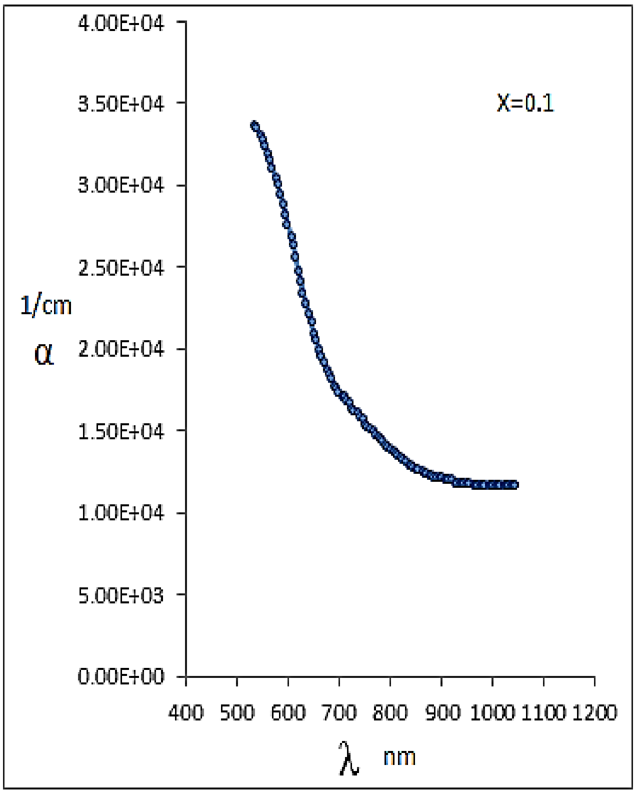
R=1-T-A where T=Transmittance , R=Reflection , A= absorption.

the following forms (4) shows us that the behavior of the refractive index (n) with wavelength (λ) that is observed value n stated from 650nm - 875nm weave length.

The band gap energy increases with increasing sulfur content in the composite piece is due to enter the element sulfur negative ions to the crystal structure of the tin component to replace the element cations . poor crystallinity of the films may also lead to higher optical band gap [13].

All the deposited SnS films have shown height absorption coefficient,, > $10^4 cm^{-1}$, above the fundamental absorption edge [13,22], indicating that these films are adequate to be used as absorber layer in thin film solar cell [3]. The value of inertia coefficient increase when increase the quantity the Thiourea .

All the value n almost 2.5 that is mean it's Almost up to the value of chalcopyrite.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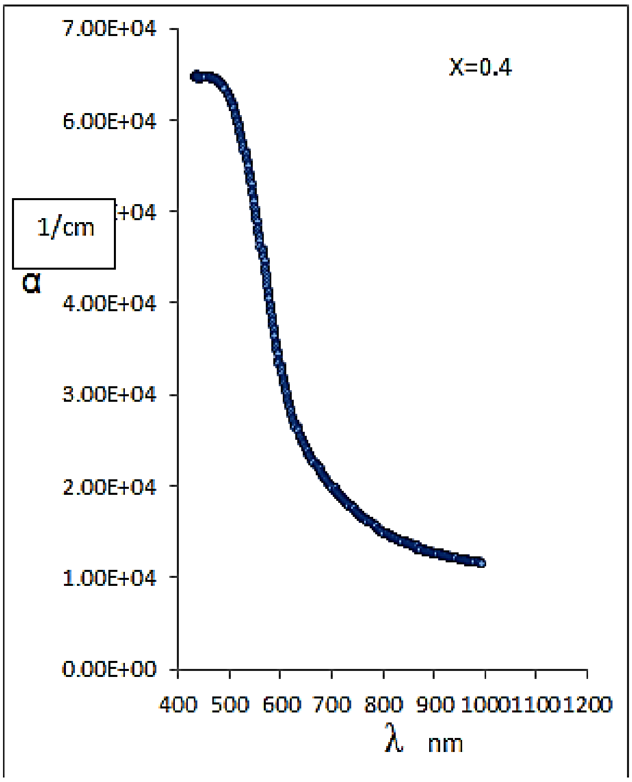
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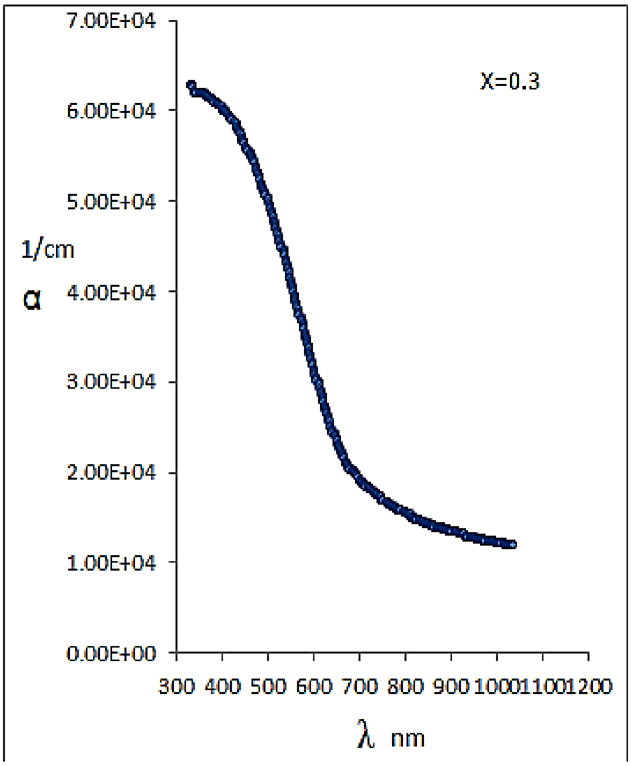
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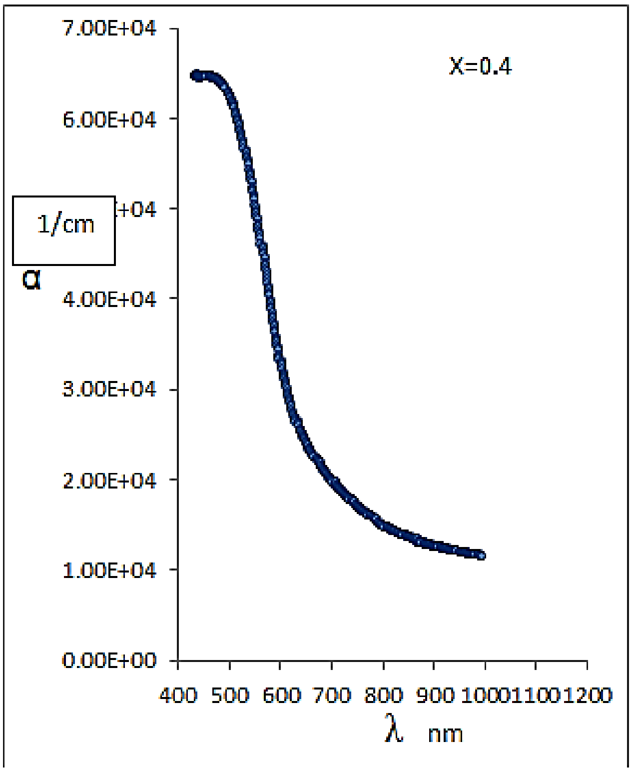
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X=0.4
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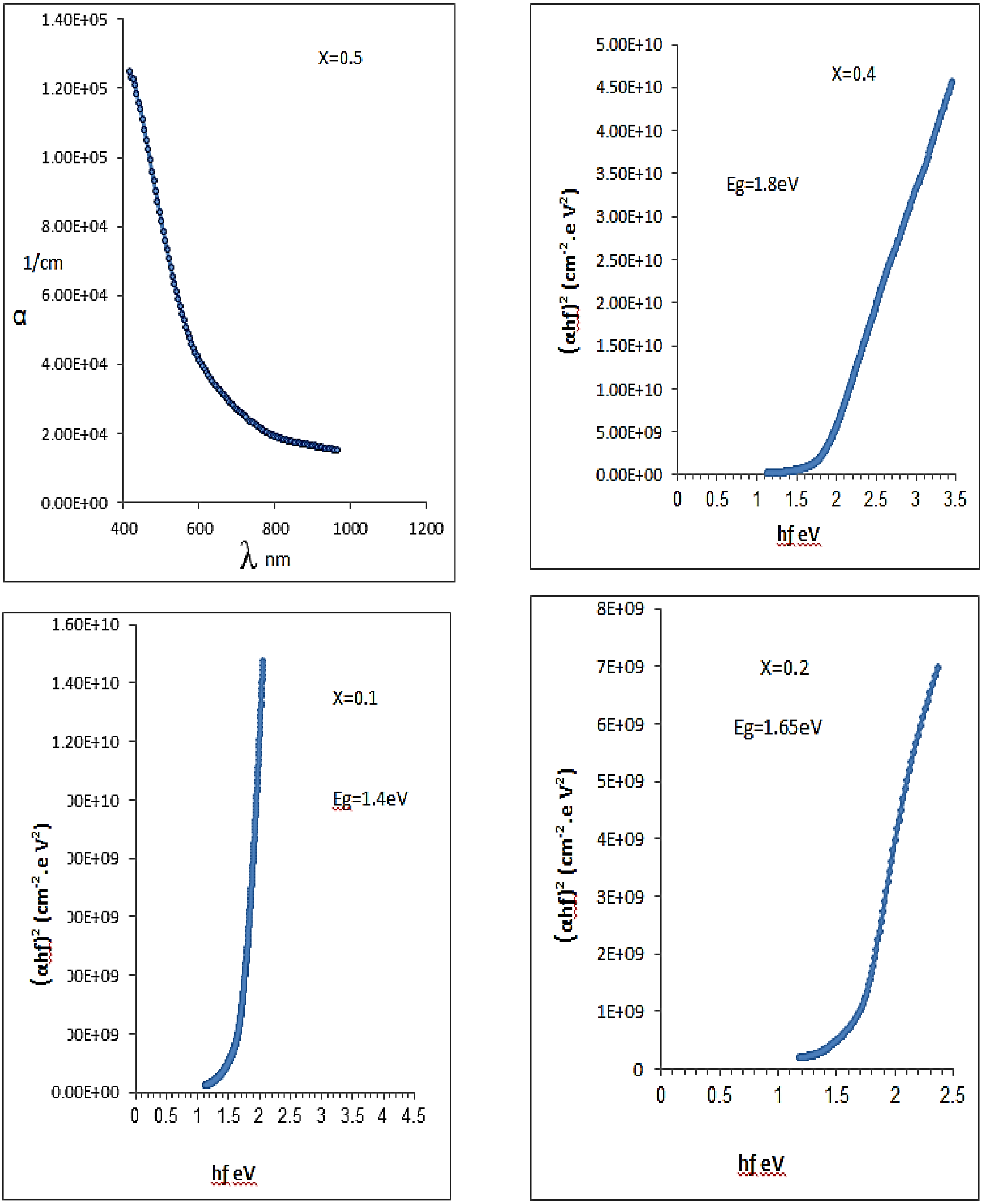

Fig. (1) represent absorption coefficient with different value (x)

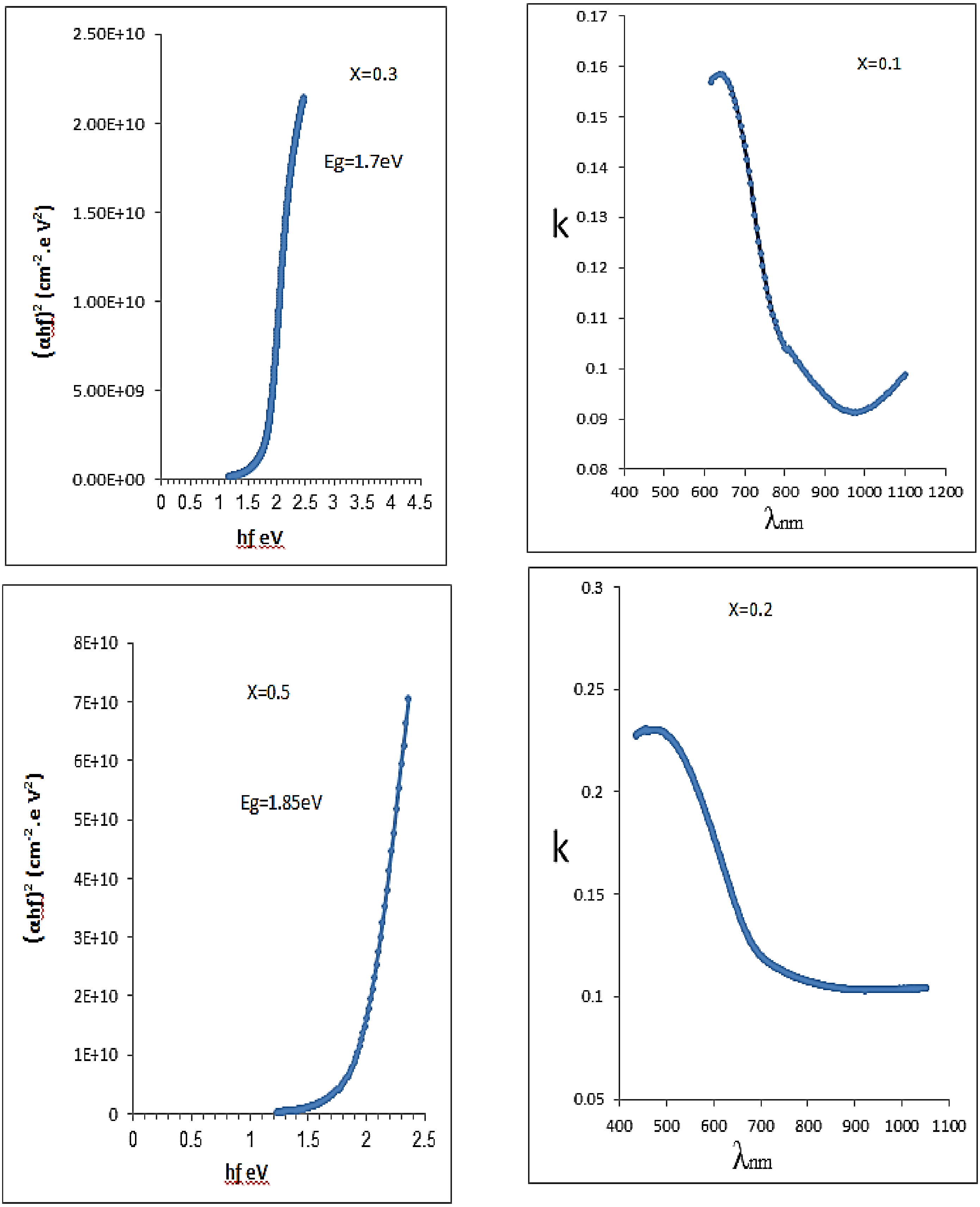

Fig. (2) represent band gap with different value (x)

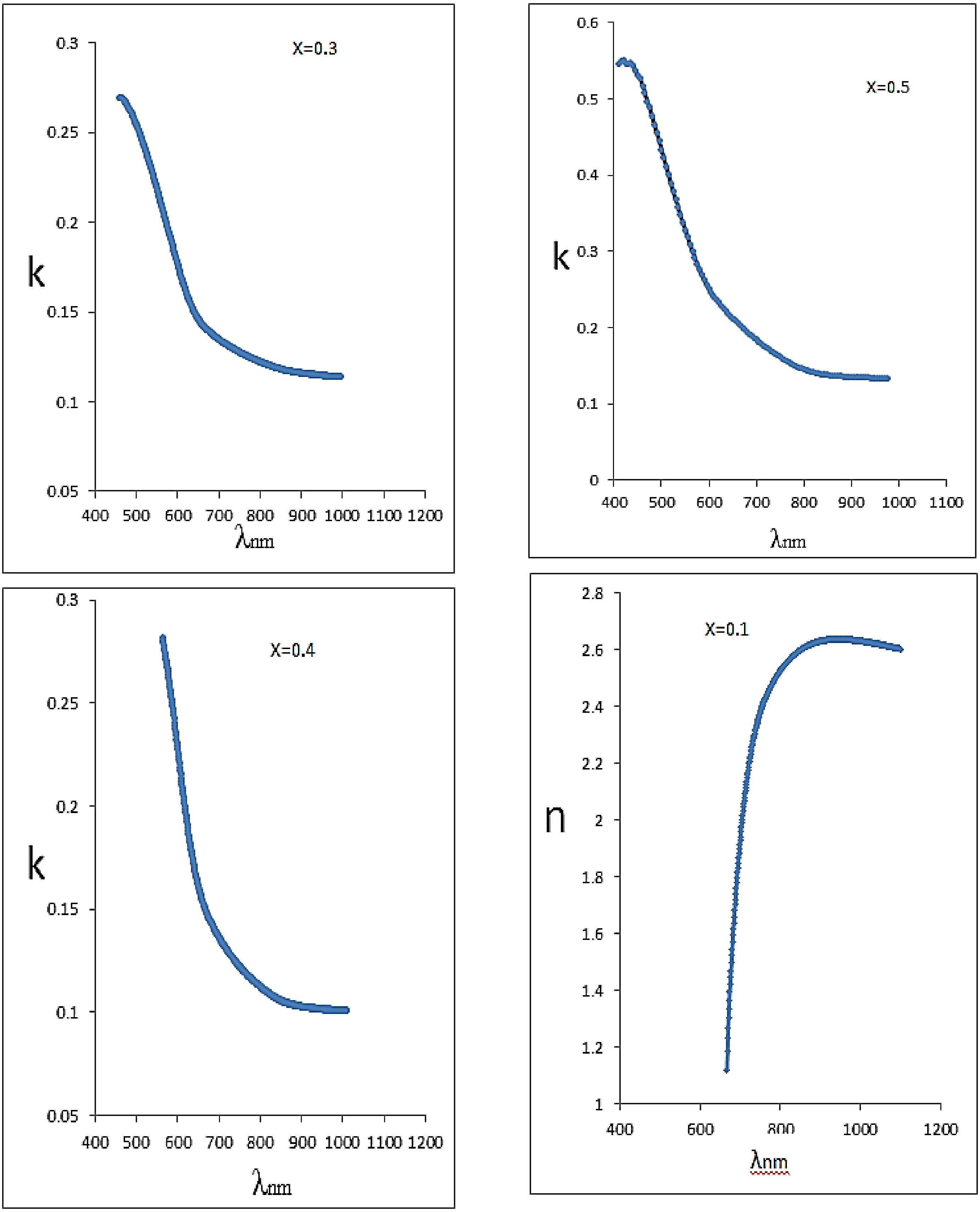

Fig. (3) represent Inertia coefficient with different value (x)

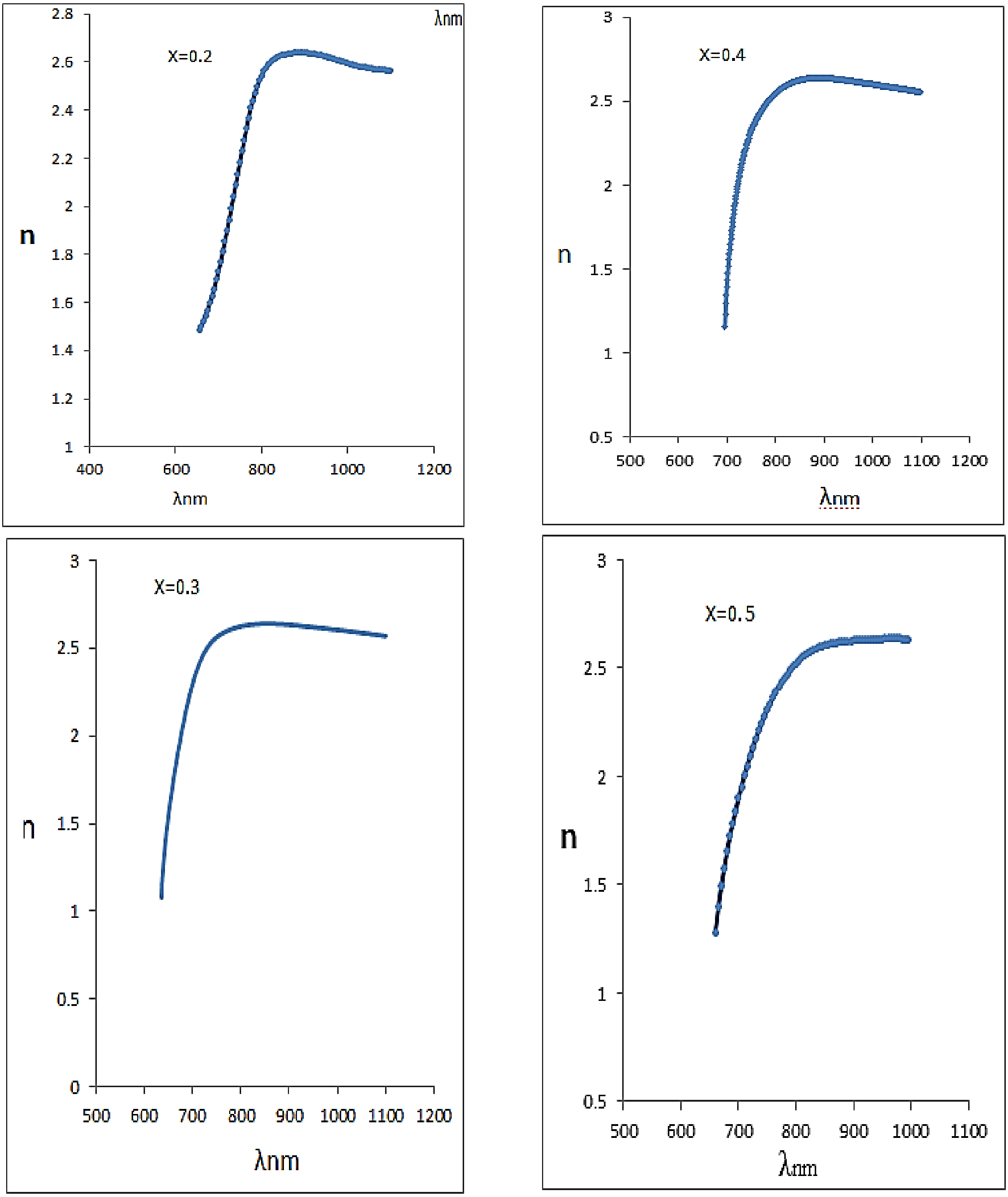

Fig. (4) represent the optical refractive index with different value (x)

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دراسة الخصائص البصرية للغشاء الرقيق $Sn_{1-x}S_x$

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الخلاصة

حضر غشاء SnS على الزجاج بطريقة الرش الكيميائي الحراري . المحلول المحضر في التجربة بمعيارية 0.2 مولا ري . بدرجة حرارة القاعدة 350 درجة مئوية . والمسافة بين نوزل الرش والقاعدة 35cm . و من خلال الفحوصات البصرية للغشاء المحضر تم حساب الثوابت البصرية (معامل الانكسار n ومعامل الخمود k) . ومن خلال البيانات العملية لطيف الشعاع الممتص وجد ان فجوة الطاقة المحضرة تتراوح بين 1.4-1.85 ev .