

The Study of Optical Properties of Thin films $Cd_{1-x}Mg_xS$ Prepared by Chemical Spry Pyrolysis Technique

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Abstract: Thin films of ($Cd_{1-x}Mg_xS$) were deposited on glass substrates at (210) °C by Chemical Spray Pyrolysis (CSP) technique. The absorption coefficient (α) was determined from the absorption and transmission using (uv-vis spectrophotometer) jenway (6405uv- vis) at a normal incident of light in the wave length of range (300-700)nm. Using the relationship $(\alpha h\nu)^2$ against $h\nu$, we find that the films have energy gap between (2.3ev-3ev) at (200) °C and ($\alpha > 10^4 cm^{-1}$) means the direct type of transmission, also we calculate (Refractive index , Extinction coefficient , real Dielectric constant, Imagining Dielectric constant).

Key words: thin film, chemical spry, optical properties

Introduction

Poly-CdS thin film has a band gap of 2.4ev, which causes considerable absorption of the short – wavelength region 1. The physical parameter which influence the efficiency of the photovoltaic devices 2. Theoretical and experimental investigations in the last years show that chalcogenide glassy semiconductors continuous media are formed in a wide variety of basic short rang order structural units (s.u.) 1,2,3. Cadmium sulfide a wide gap (II-VI), semiconductor. CdS is doping by the magnesium thin film solar cell based on CdS layer by chemical bath deposition 4,5 , for instance in this last application the importance of the variation of E_g with (x) lies in the possibility of growing layers of ($Cd_{1-x}Mg_xS$) with different (x) value . In the inter range ($0 \leq x \leq 1$) . this stratified arrange allows a tandem solar cell to absorb a large fraction of the solar spectrum energy6. Chalcogenide semiconductor alloys have applications not only due to their electrical and thermal properties , but also due to their optical properties 7 . Thin film photovoltaic (pv) or (solar cell) are being developed by means of substantially reducing the cost of the (pv) system 8.

Theory

Define absorption coefficient is a ratio decreases in flux energy incident on the unit distance in dimensions diffusion wave in the media and absorption coefficient dependent on photon energy and prepared , the photo energy represent by relationship :

$$E = hf \text{ -----(1)}$$

hf= absorption photon Energy

And the absorption coefficient 9

$$\alpha = 2.303 A/t \text{ -----(2)}$$

t= thickness thin film , A= absorption .

The electrons transformation from valance band to conduction band vertically and without happening any change in value 10 .

$$\Delta \vec{k} = 0$$

The Absorption equation to the transition can be write in the form 11.

$$\alpha hf = A(hf - E_g)^r \text{ -----(3)}$$

(E_g) = optical energy gap , A= constant dependent on the (valance and conduction bands).

. r=1/2. for allowed directed transition

The extinction coefficient (K) is :

$$k = \frac{\alpha \lambda}{4\pi} \text{ -----(4)}$$

The reflective index can be measured from equation :

$$n = \left[\frac{4R}{(R-1)^2} - k^2 \right]^{\frac{1}{2}} + \frac{R+1}{R-1} \text{ -----(5)}$$

Using equation (6) and (7) we obtained the Real and

Imaginary dielectric constant, ϵ_1 and ϵ_2 respectably .

$$\epsilon_1 = n^2 - k^2 \text{ -----(6)}$$

$$\epsilon_2 = 2nk \text{ -----(7)}$$

Materials and Methods

1-Prepared thin film from composition ($Cd(NO_2)4H_2O$) purely of (99%) (BDH) was dissolved in 50ml in water in Wight (3.084g), ($Mg(NO_3)_26H_2O$) purely of 99% (BDH) was dissolved in 50ml in water at Wight (2.564 g) and ($SC(NH_2)_2$) purely of 99% was dissolved in 50ml in water at weight (0.761g) . the molarty solution prepared by the equation:

$$Molarity(M) = \frac{M_s}{V}$$

$$M_s = \frac{W(gm)}{M_{wt} \text{ grams / moles}} \text{ -----(8)}$$

V=volume of the solution ,W=mass of metal (gm) ,(M_s) Number of molar , (M_{wt})molecular Weigh.

- 2- The glass substrate were cleaned in a hot bath .
- 3- put the glass substrate on the surface of the heater for 20 mints .
- 4- maxing the ratio 1:1 from the solution prepared and put the solution in deposition device .
- 5- start the deposition process in 10 sec spraying and stopping 15 sec .
- 6- after end process deposition the glass left on the heater surface to cooling .

The distance between the surface and nozzle end Pylorysis device (30)cm and the pressure use in the process atomization (6)bar .

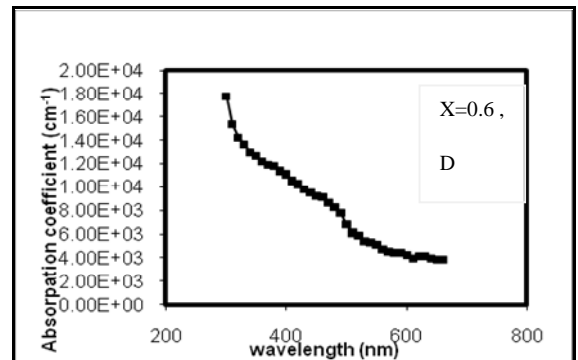
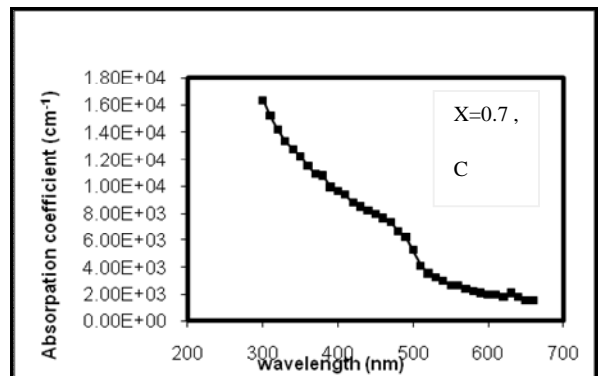
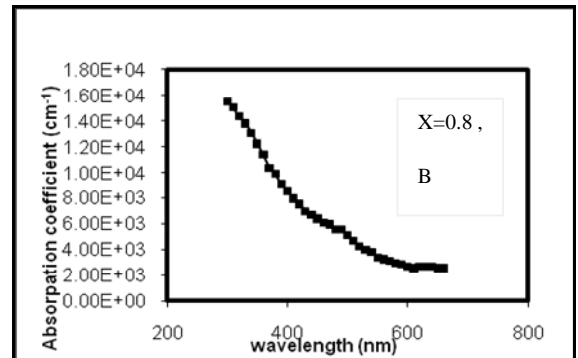
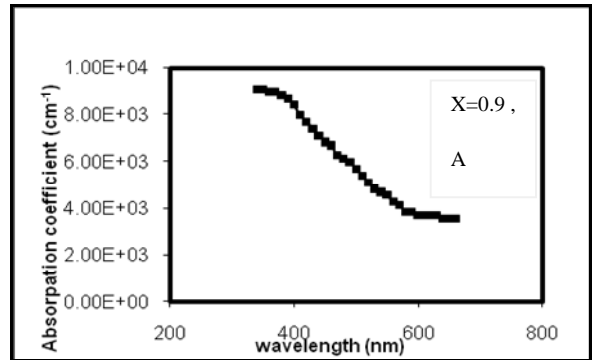
Results and Discussions

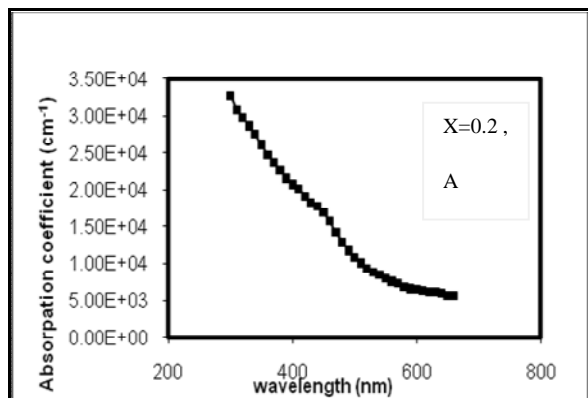
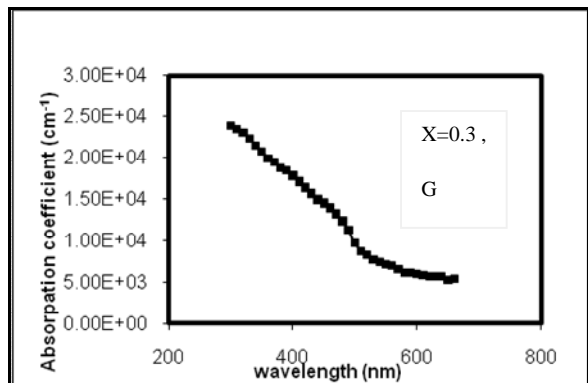
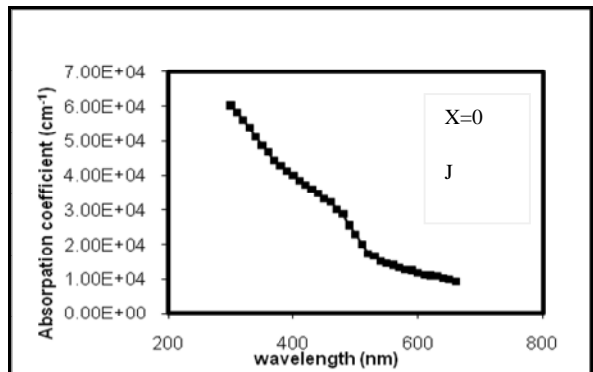
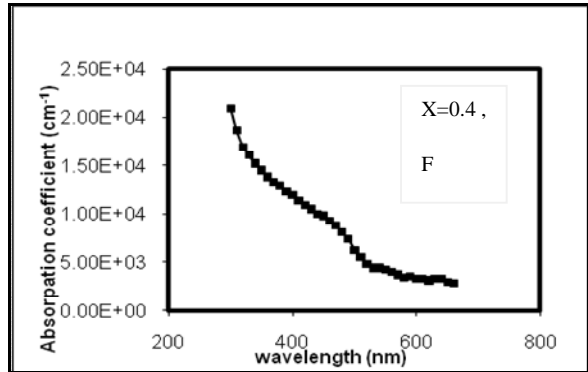
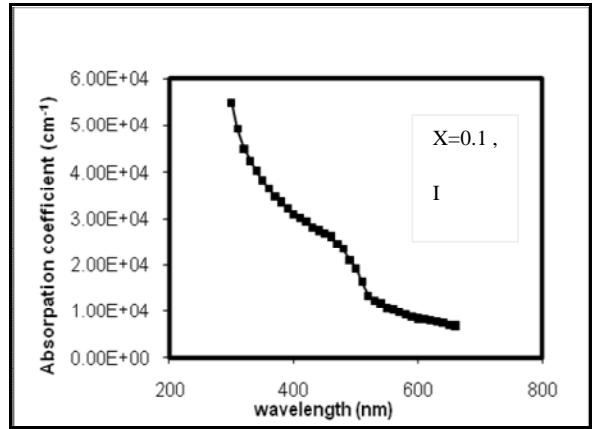
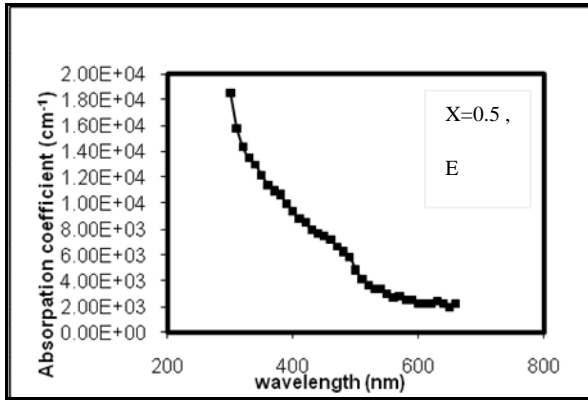
The optical properties of thin films ($Cd_{1-x}Mg_xS$) which are prepared by chemical spray pyrolysis With different value of (x) descried in table (1-1) .

Table (1-1) show the value (x)

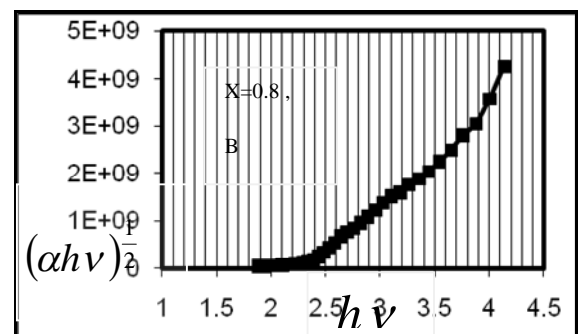
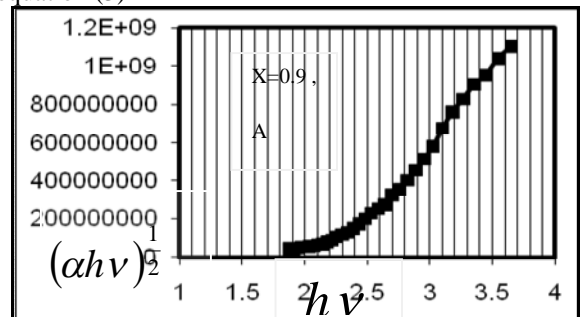
Name of the sample	Cd_{1-x}	Mg_x	E_g
A	0.9	0	2.3
B	0.8	0.1	2.45
C	0.7	0.2	2.6
D	0.6	0.3	2.7
E	0.5	0.4	2.75
F	0.4	0.5	2.8
G	0.4	0.6	2.83
H	0.3	0.7	2.85
I	0.2	0.8	2.9
J	0.1	0.9	3

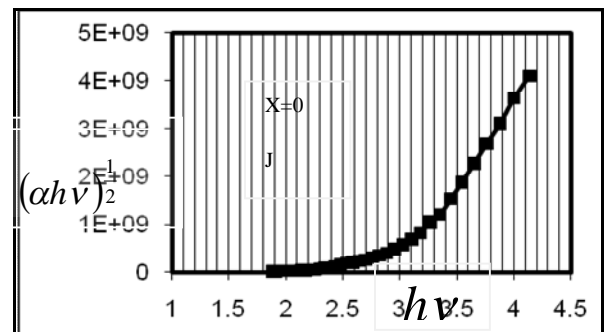
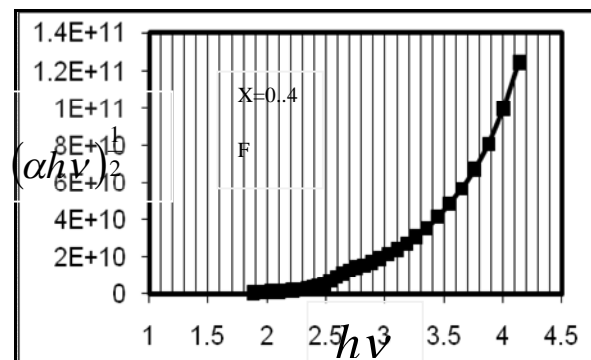
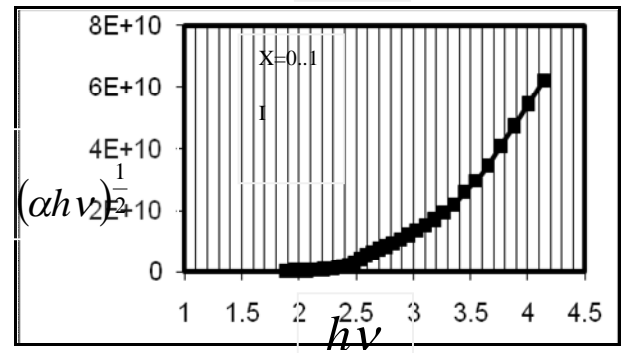
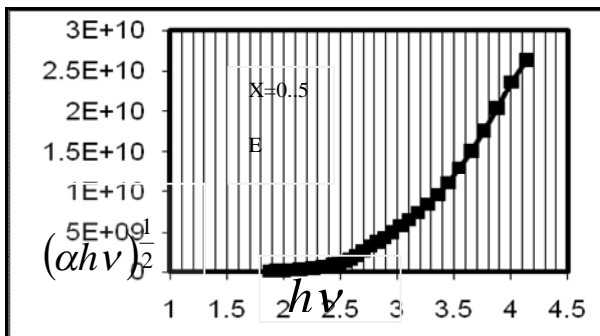
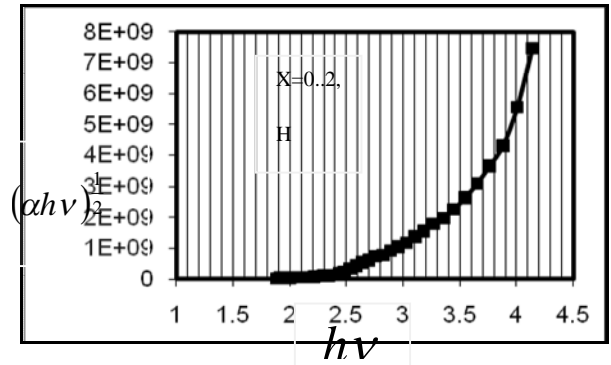
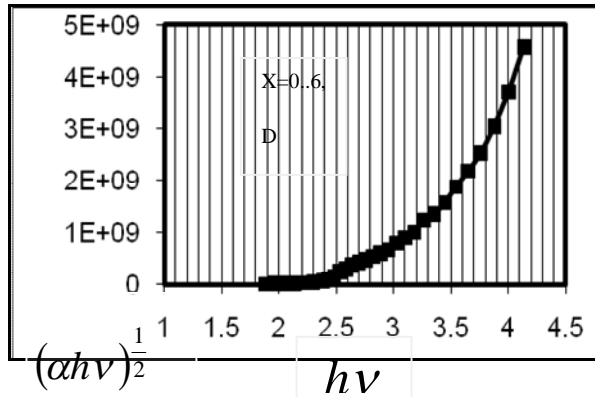
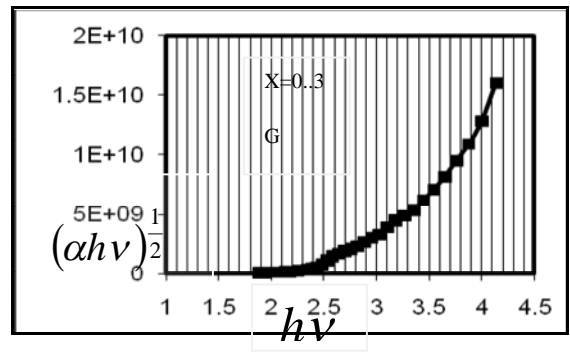
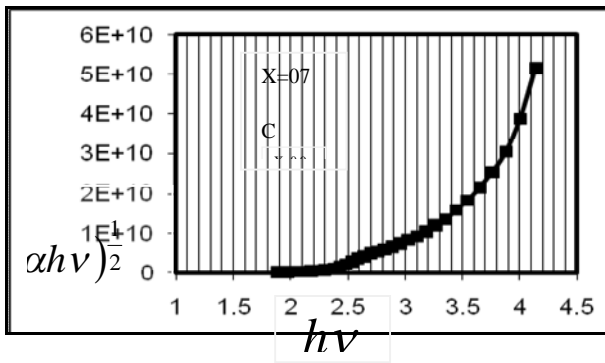
The absorption spectrum of the thin films were measure using the (UV-VIS Spectrophotometer).Use equation (2) were Calculate, the value of the absorption coefficient in order of $10^4 cm^{-1}$ as shown in figures (1) Show the value of α as a function of wavelength for different value of (x) .



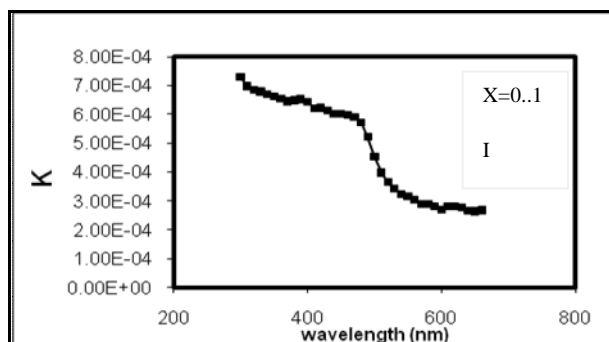
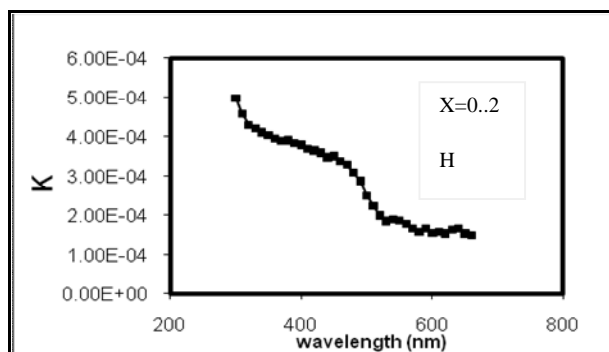
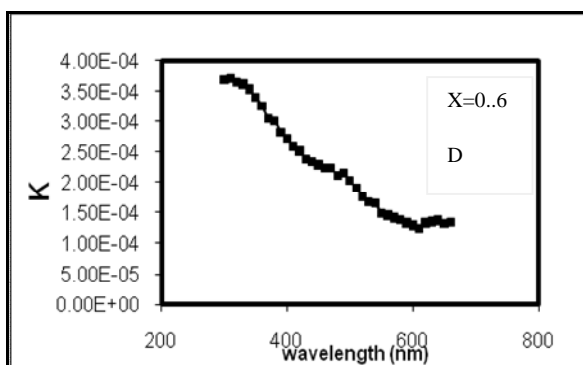
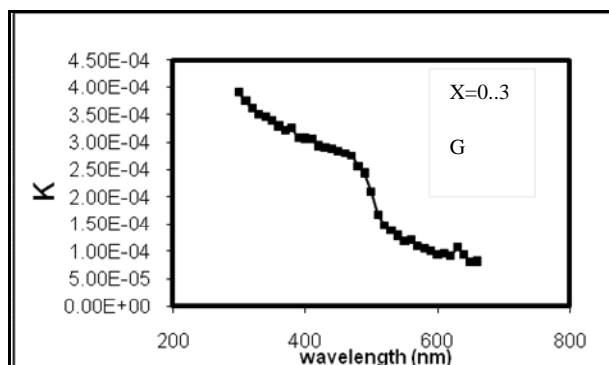
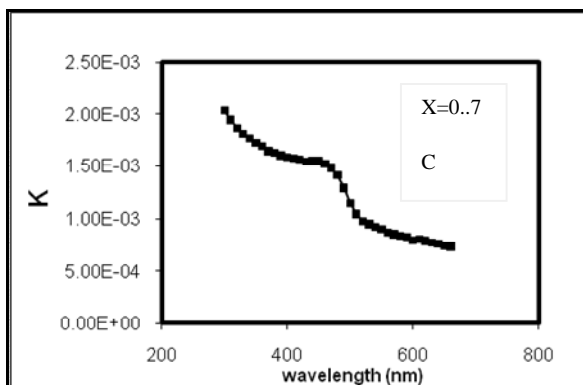
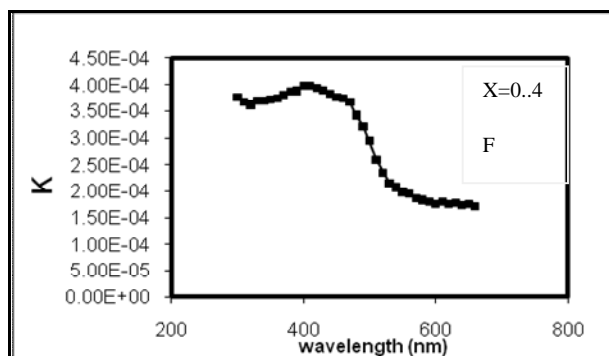
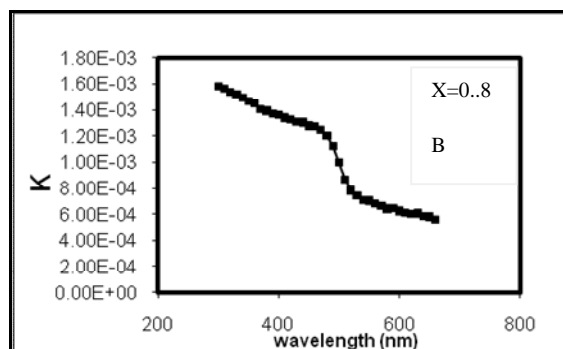
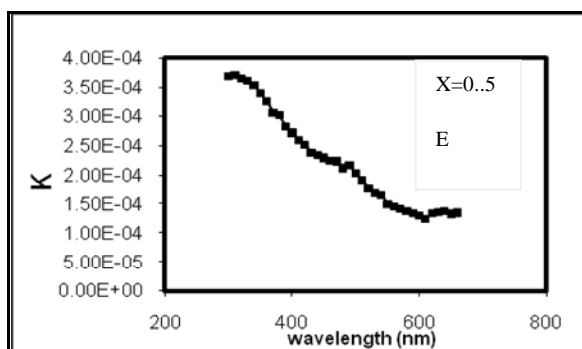
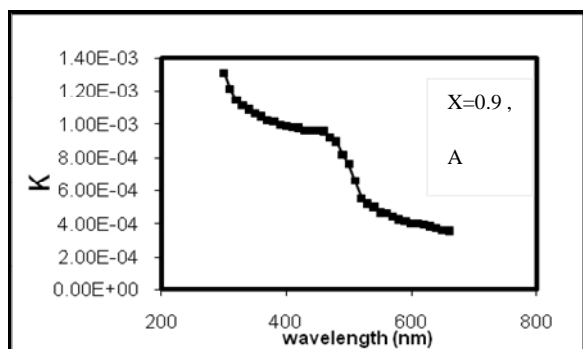


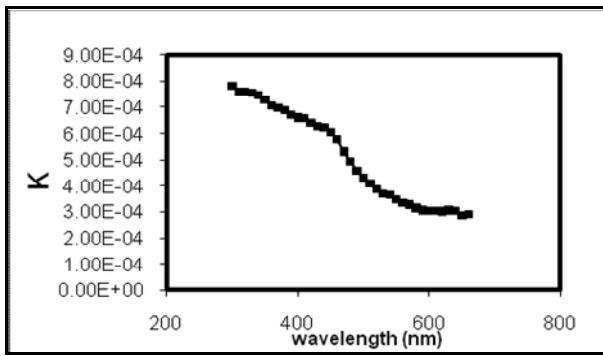
As shown in figures [(2), show as function photon energy ,the energy gap increased when there is increased ratio of magnesium that calculated by use equation (3)





The extinction coefficient (k) calculated by using equation (4) which shown in figure[3]. The value (k) decreased with increased wavelength ($350\text{nm} \leq \text{wavelength}$)





As shown in figure [4], the reflection index calculate by equation (5) where the value n with λ . The absorption value n decreased with increased wavelength value to all thin films.

