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Effect of *Cd* $(NO3)_2$ *.4H2O* on Some Optical Properties of High Density Polyethylene

دراسة تأثير نترات الكادميوم على بعض الخواص البصرية للبولي اثيلين عالي الكثافة

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ABSTRACT

In the present work , effect of addition *Cd* $(NO3)_2$ *.4H2O* on some optical properties of High Density Polyethylene has been studied . for that purpose , many samples has been prepared by adding *Cd* $(NO3)_2$ *.4H2O* on the High Density Polyethylene by different volume percentages from these salts with polymer and by different thickness .The absorption and transmission spectra has been recorded in the wavelength range (300-1100)nm . The absorption coefficient and energy gap of the indirect, allowed, forbidden transition have been determined.

الخلاصة

في هذا البحث تم دراسة تأثير إضافة نترات الكادميوم على بعض الخواص البصرية للبولي اثيلين عالي الكثافة. ولهذا الغرض تم تحضير نماذج بإضافة نترات الكادميوم إلى البولي اثيلين عالي الكثافة وبنسب حجمية مختلفة من هذه الأملاح مع البوليمر وبسمك مختلف.تم تسجيل طيفي الامتصاص و النفاذية و لمدى الاطوال الموجية (300-1100)nm. و حساب معامل الامتصاص و فجوة الطاقة للانتقال غير المباشر المسموح و الممنوع.

INTRODUCTION

Polymers have traditionally been considered as insulating materials by chemists and physicists alike . A conducting polymer is chewable and desirable . A light weight ready moldable , desirable conductive material has long been recognized as a worthwhile goal to work for[1,2] .Researches, generally, have demonstrated that conductive polymers can be used as energy storage element in: [3,4]

1- Capacitors and Secondary batteries .
2- As semiconductor material in schottky diode.
3- Insulated gate field effect transitions (FET) and light emitting diodes.
4- As conductive layer for electromagnetic shelding (EMI) and electrostatic protection.

In trecent years conjugated conducting polymers have been the main focus of research throughout the world . Since the discovery led by 2000 chemistry Nobel winners, Shirakawa, MacDiarmid and Heeger , the perception that plastic could not conduct electricity has changed Nowadays, conducting polymers also known as conductive plastics are being developed for many uses such as corrosion inhibitors, compact capacitors, antistatic coating, electromagnetic shielding and smart windows; which capable to vary the amount of light to pass[5,6] *Cd* $(NO3)_2$ *.4H2O* material is extensively used because of interesting optical properties (high band gap, transparent to uv-visible light, low refractive index) which are considered for various optical applications such as windows, prism and lenses in the vacuum uv, visible and infrared here desired transmission in the 0.104µm-7µm range[7] . It is also very useful for X-ray nonochromaters and for the study of fundamental propertiesand defect in crystal[8] .

EXPERIMENT

The materials used in the papar is High Density Polyethylene as matrix and *Cd (NO3)$_2$ .4H2O* as a filler The electronic balanced of accuracy 10^{-4} have been used to obtain a weight amount of Cd (NO3)$_2$ .4H2O powder and polymer powder .These mixed by Hand Lay up and the Microscopic Examination used to obtain homogenized mixture .The volume percentages of Cd (NO3)$_2$ .4H2O which equivalent weight percentages are (0 , 19.73 , 35.1) vol%. The Hot Press method is used to press the powder mixture. The mixture of different Cd (NO3)$_2$ .4H2O percentages have been compacted at temperature 110^{o}C under a pressure 100 par for 10 minutes . Its cooled to room temperature , the samples were disc shap of a diameter about 30mm and thickness ranged between (1.85-2.2)mm. The transmission & absorption spectra of HDPE- Cd (NO3)$_2$ .4H2O composites have been recording in the length range (300-1100) nm using double-beam spectrophotometer (UV-210^{o}A shimedza).

RESULTS AND DISCUSSION

The absorption coefficient (α) was calculated in the fundamental absorption region from the following equation[9] :

$$\alpha = 2.303\frac{A}{d} \text{..........................(1)}$$

Where : A absorbance , d the thickness of sample.

Figure (1) shows the relationship between the absorption coefficient and photon energy of the HDPE- *Cd (NO3)$_2$ .4H2O* composites we note the change in the absorption coefficient is small at low energies this is indicates the possibility of electronic transitions is a low. At high energy , the change of absorption coefficient is large this is indicates the high Probability of electronic transitions are the absorption edge of the region [10] . The absorption coefficient helps to conclude the nature of electronic transitions, when the high absorption coefficient values ($\alpha > 10^4 cm^{-1}$) at high energies we expected direct electronic transitions ,and the energy and momentum preserve of the electron and photon(11,12) , when the values of absorption coefficient is low($\alpha < 10^4 cm^{-1}$) at low energies we expected in this case indirect electronic transitions, the momentum of the electron and photon preserves by phonon helps[11] . The results showed that the values of absorption coefficient of the HDPE- Cd (NO3)$_2$ .4H2O composites less than $10^4 cm^{-1}$ which indicates to the indirect electronic transition[13,14]

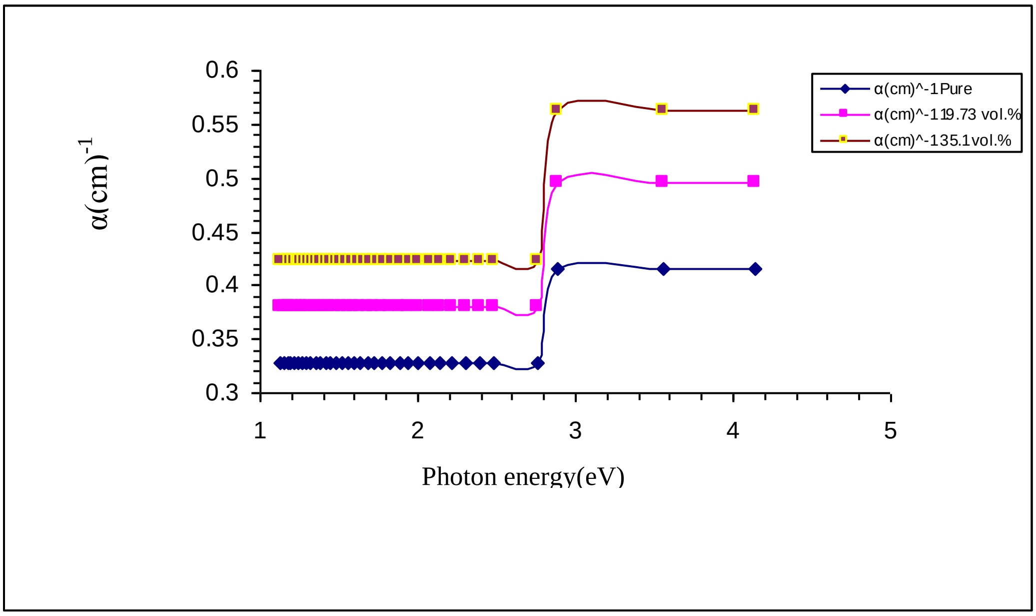

Figure -1: the relationship between the absorption coefficient and photon energy of the HDPE- Cd (NO3)$_2$ .4H2O composites

The forbidden energy gap of indirect transition both allowed, forbidden calculated according to the relationship[12] :

$$\alpha h\nu = A(h\nu - E_g)^m \text{........................}(2)$$

Where : hv the energy of photon , A proportionality constant, Eg forbidden energy gap of the indirect transition.

If the value of (m=2) indicates ton allowed indirect transition . when the value (m=3) indicates to forbidden indirect transition. Figure (2) shows the relationship between $(\alpha h\nu)^{1/2}$ $(cm^{-1}.eV)^{1/2}$ and the photon energy of pure polymer (HDPE) , with take over

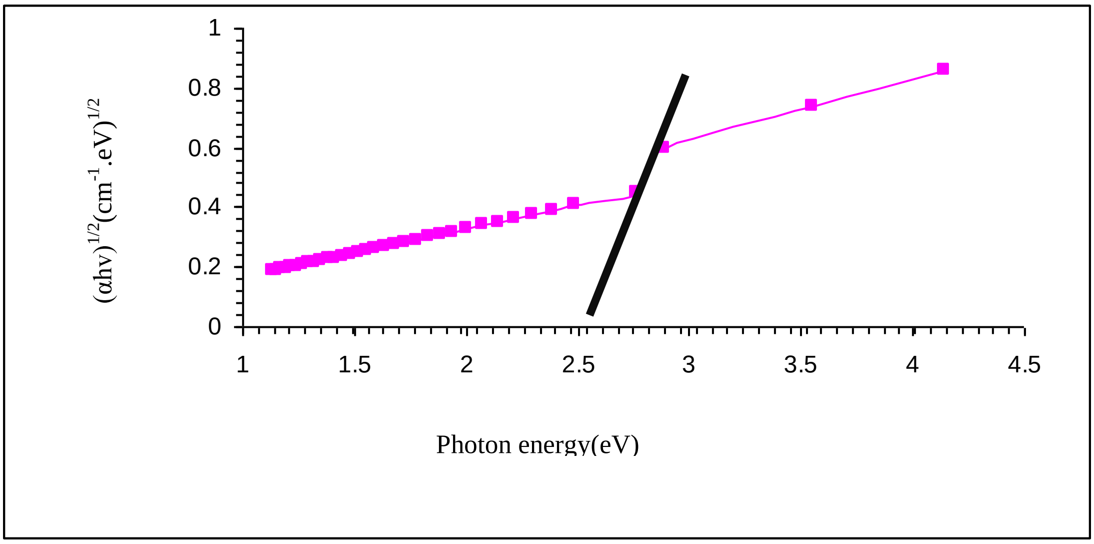

Figure -2: the relationship between $(\alpha h\nu)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of pure polymer (HDPE).

Part of the straight cut oriented axis at the point $(\alpha h\nu)^{1/2}=0$ will get the value of forbidden energy gap of the allowed indirect transition , which equal (2.64eV).Figure (3) and figure (4) represents the same relationship but to the polymer filled with *Cd* $(NO3)_2$ *.4H2O* with volume percentages of *Cd* $(NO3)_2$ *.4H2O* are(19.73 , 35.1) vol% ,the same way we can be

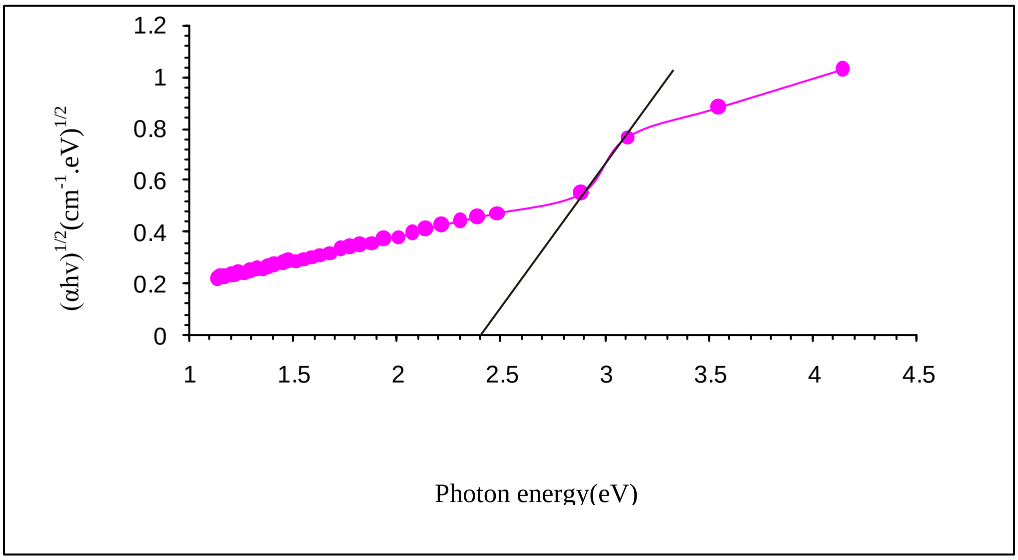

Figure -3: the relationship between $(\alpha h\nu)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of HDPE Cd $(NO3)_2$ .4H2O composites for 19.73 vol.% Cd $(NO3)_2$ .4H2O obtained on the value of forbidden energy gap of allowed indirect transition which equal (2.43eV) for 19.73 vol% *Cd* $(NO3)_2$ *.4H2O*, and (2.1eV) for 35.1vol.% *Cd* $(NO3)_2$ *.4H2O*.

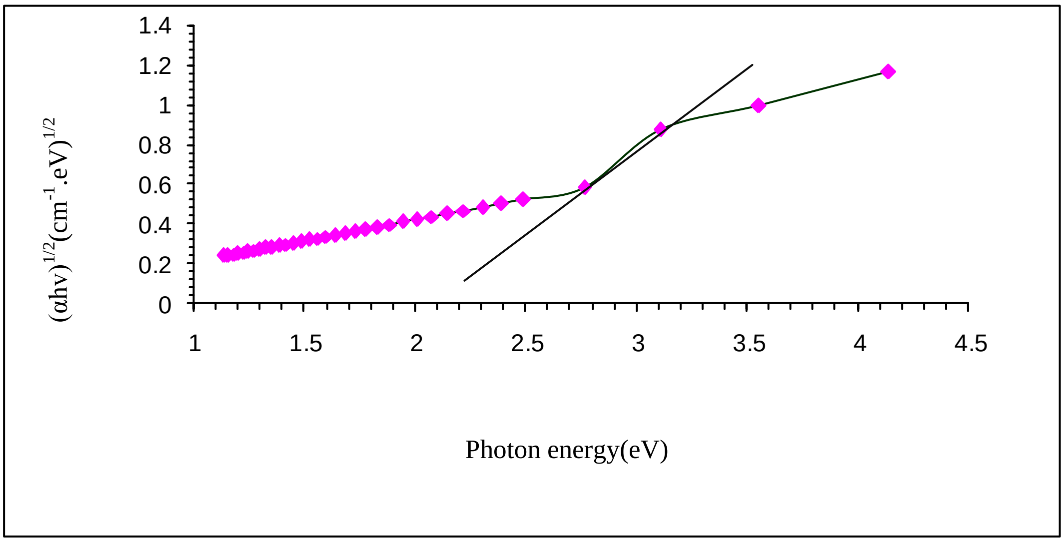

Figure -4: the relationship between $(\alpha h\nu)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of HDPE- Cd $(NO3)_2$ .4H2O composites for 35.1vol.% Cd $(NO3)_2$ .4H2O

we note that the value of the forbidden energy gap decreases with increasing *Cd* $(NO3)_2$ *.4H2O* concentration.. Figure(5) shows the relationship between the $(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of pure polymer (HDPE) , the indirect transition which equal (2.535eV).same way we obtain to the forbidden energy gap of forbidden

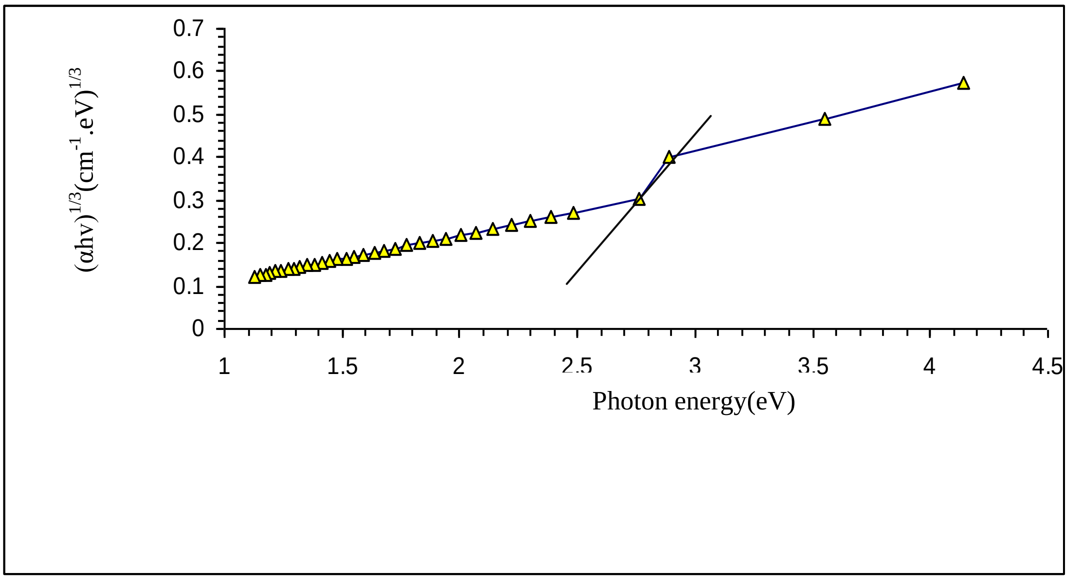

Figure -5: the relationship between $(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of pure polymer (HDPE).

Figure (6) and figure (7) represents the same relationship but to the polymer filled with *Cd* $(NO3)_2$ *.4H2O* with volume percentages of *Cd* $(NO3)_2$ *.4H2O* are (19.73 ,35.1) vol% ,the same way we can be obtained on the value of the forbidden energy gap. of the forbidden indirect transition which equal (2.41eV) for 19.73vol.% *Cd* $(NO3)_2$ *.4H2O* and (2.05eV) for 35.1 vol% we note that the value of the energy gap decreases with increasing *Cd* $(NO3)_2$ *.4H2O* concentration[15] .

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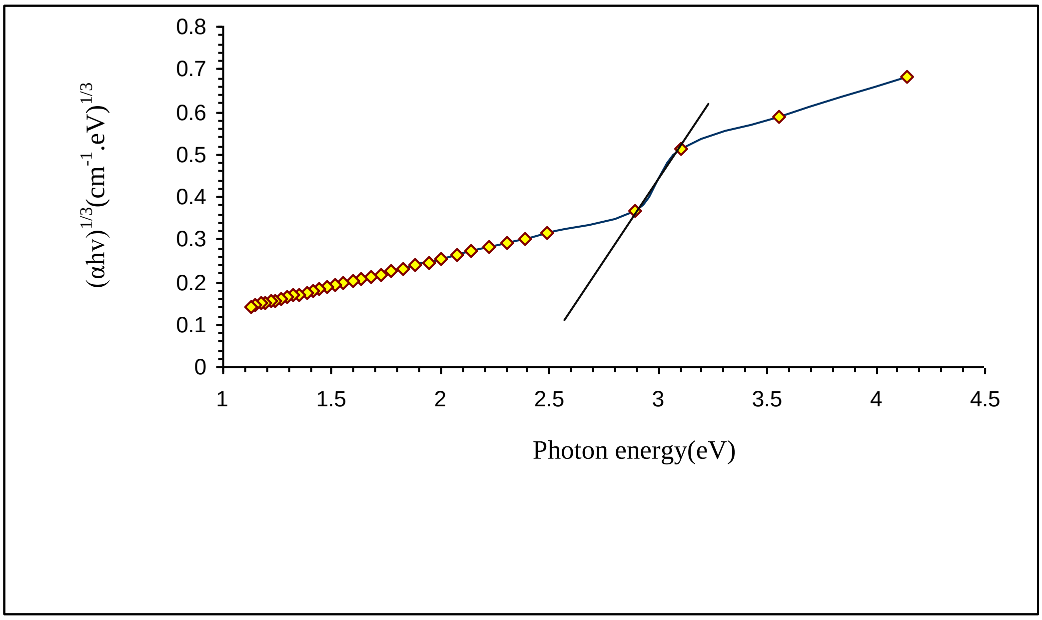

Figure -6: the relationship between $(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of of HDPE- Cd . $(NO3)_2$ .4H2O composites for 19.73 vol.% Cd $(NO3)_2$ .4H2O

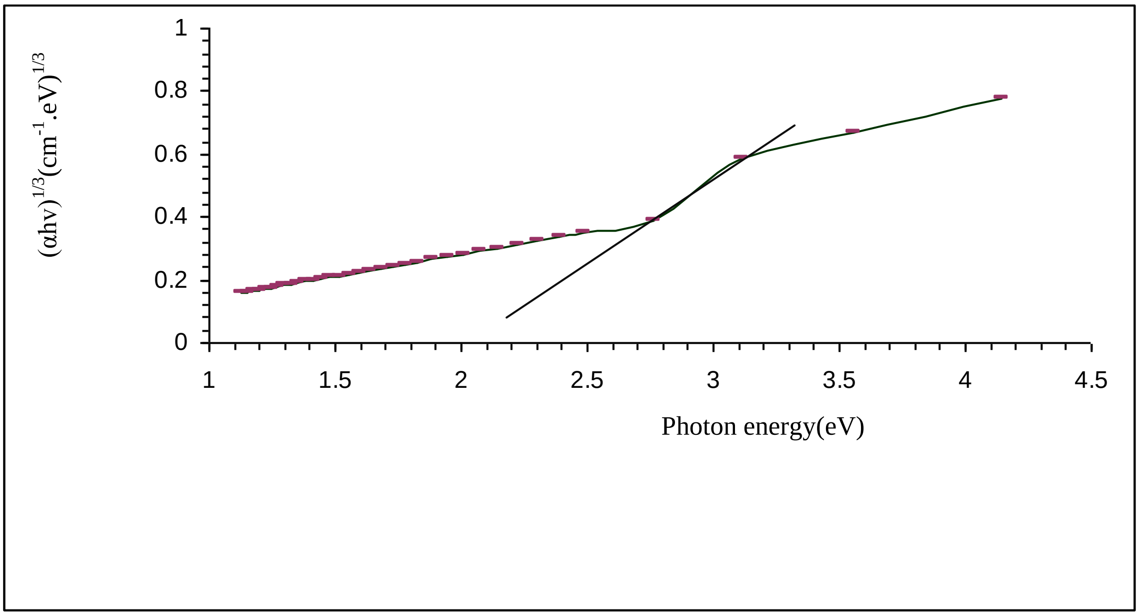

Figure -7: the relationship between $(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of HDPE- Cd $(NO3)_2$ .4H2O composites for 35.1 vol.% Cd $(NO3)_2$ .4H2O

CONCLUSION

1. The absorption coefficient is increasing with increasing of the filler vol.% content.
2. The experimental results showed that the absorption coefficient less than $10^4 cm^{-1}$ this is indicates to forbidden and allowed indirect electronic transitions.
3. The *Cd* $(NO3)_2$ *.4H2O* additive change not the nature of electronic transfers of HDPE samples.
4. The forbidden energy gap is decreasing with increasing of the filler vol.% content.

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