

Study of Some Physical Properties For Polystyrene Filled With Lithium Fluoride Additive

Dr. Asrar Abdul Muniam , Dr. Ziaad Tarig

Ahmed Hashim, Marwa Abdul-Muhsien, Hussein Hakim

Al-Mustansiriyah University, College of Science

Abstract

In the present work ,the effect of addition Lithium Fluoride on some optical properties of polystyrene has been studied . For that purpose , many samples has been prepared by adding Lithium Fluoride on the polystyrene with different volume percentages from these salts with polymer and by different thickness .The absorption and transmission spectra has been recorded in the wavelength range (190-1100)nm . The absorption coefficient and energy gap of the indirect allowed and forbidden transition have been determined .

الخلاصة

تم في هذا البحث دراسة تأثير إضافة فلوريد الليثيوم على بعض الخواص البصرية للبولي ستايرين. ولهذا الغرض تم تحضير نماذج بإضافة فلوريد الليثيوم إلى البولي ستايرين وبنسب حجمية مختلفة من هذه الأملاح مع البوليمر وبسبك مختلف. تم تسجيل طيفي الامتصاص و النفاذية و لمدى الاطوال الموجية (190-1100)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[A.R.Blyth,1979 and M. V. Ramos *et.al.*,2005].Researches, generally, have demonstrated that conductive polymers can be used as

energy storage element in:[D.A. Seanor,1982 and M. p. Alvarez *et*

1- Capacitors and Secondary *al*,2008]

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 shielding (EMI) and electrostatic protection. In

the recent 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[M. Harun *et.al*,2009 and Z.Al-Ramadhan,2008]

LiF 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 $0.104\mu\text{m}-7\mu\text{m}$ range[P. Heath and P. Sacher, 1986]. It is also very useful for X-ray nonochromaters and for the study of fundamental properties and defect in crystal[L. Reale *et al*,2008].

Experiment

The materials used in the paper is polystyrene as matrix and Lithium fluoride as a filler.

The electronic balanced of accuracy 10^{-4} have been used to obtain a weight amount of LiF powder and polymer powder . These mixed by Hand Lay up and the Microscopic Examination used to obtain homogenized mixture. The volume percentages of LiF which equivalent weight percentages are (0 , 21 37.4) vol%. The Hot Press method is used to press the powder mixture. The mixture of different LiF percentages have been compacted at temperature 145°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 (1.75-2.2)mm. The transmission & absorption spectra of PS-LiF composites have been recording in the length range (190-1100) nm using double-beam spectrophotometer (UV-210^oA shimedza).

Results and Discussion

The absorption coefficient (α) was calculated in the fundamental absorption region from the following equation[S. D. Hutagalwng and B. Y. Lee ,2007]:

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

Where : A absorbance and d the thickness of sample.

Figure (1) shows the relationship between the absorption coefficient and photon energy of the PS-LiF composites we note the change in the absorption coefficient is small at low energies this is indicates the possibility of electronic transitions is a few. At high energy , the change of absorption coefficient is large this is indicates the large

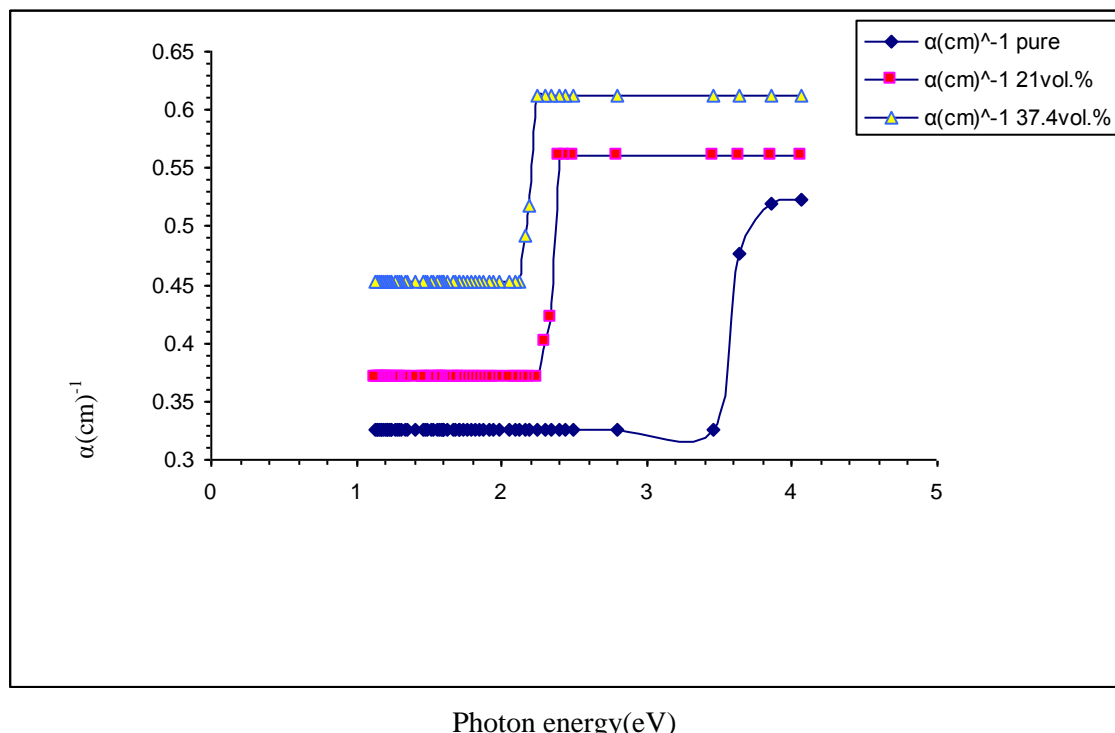


Figure (1) the relationship between the absorption coefficient and photon energy of the PS-LiF composites

Probability of electronic transitions are the absorption edge of the region [S. M Scholz *et al*,2008]. The absorption coefficient helps to conclude the nature of electronic transitions, when the high absorption coefficient values ($\alpha > 10^4 \text{ cm}^{-1}$) at high energies we expected direct electronic transitions, and the energy and momentum preserve of the electron and photon, when the values of absorption coefficient is low ($\alpha < 10^4 \text{ cm}^{-1}$) at low energies we expected in this case indirect electronic transitions, the momentum of the electron and photon preserves by phonon helps [B.Thangaraju and P. Kalianna,2000]. The results showed that the values of absorption coefficient of the PS-LiF composites less than 10^4 cm^{-1} which indicates to the indirect electronic

Study of Some Physical Properties For Polystyrene Filled With Lithium Fluoride Additive

transition. The forbidden energy gap of indirect transition both allowed, forbidden calculated according to the relationship[A. Kathalingam et.al. , 2007] :

$$\alpha hv = A(hv - E_g)^m \dots\dots\dots(2)$$

Where : $h\nu$ the energy of photon , A proportionality constant, E_g forbidden energy gap of the indirect transition If the value of (m=2) indicates to allowed indirect transition . when the value (m=3) indicates to forbidden indirect transition. Figure (2) shows the relationship between $(\alpha hv)^{1/2} (\text{cm}^{-1} \cdot \text{eV})^{1/2}$ and the photon energy of pure polymer (PS) , with take over part

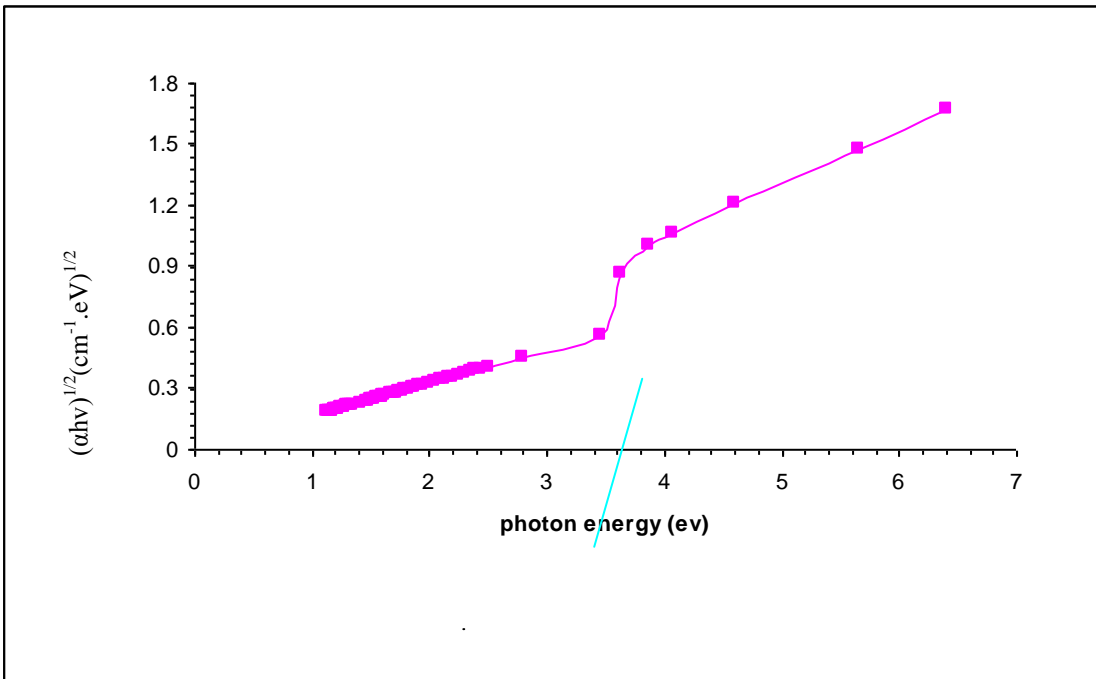


Figure (2) the relationship between $(\alpha hv)^{1/2} (\text{cm}^{-1} \cdot \text{eV})^{1/2}$ and photon energy of pure polymer (PS).

of the straight cut oriented axis at the point $(\alpha hv)^{1/2} = 0$ will get the value of forbidden energy gap of the allowed indirect transition , which equal (3. 2eV). Figure (3) and figure (4) represents the same

relationship but to the polymer filled with (LiF) with volume percentages of LiF are (21 , 37.4) vol% , the same way we can be obtained

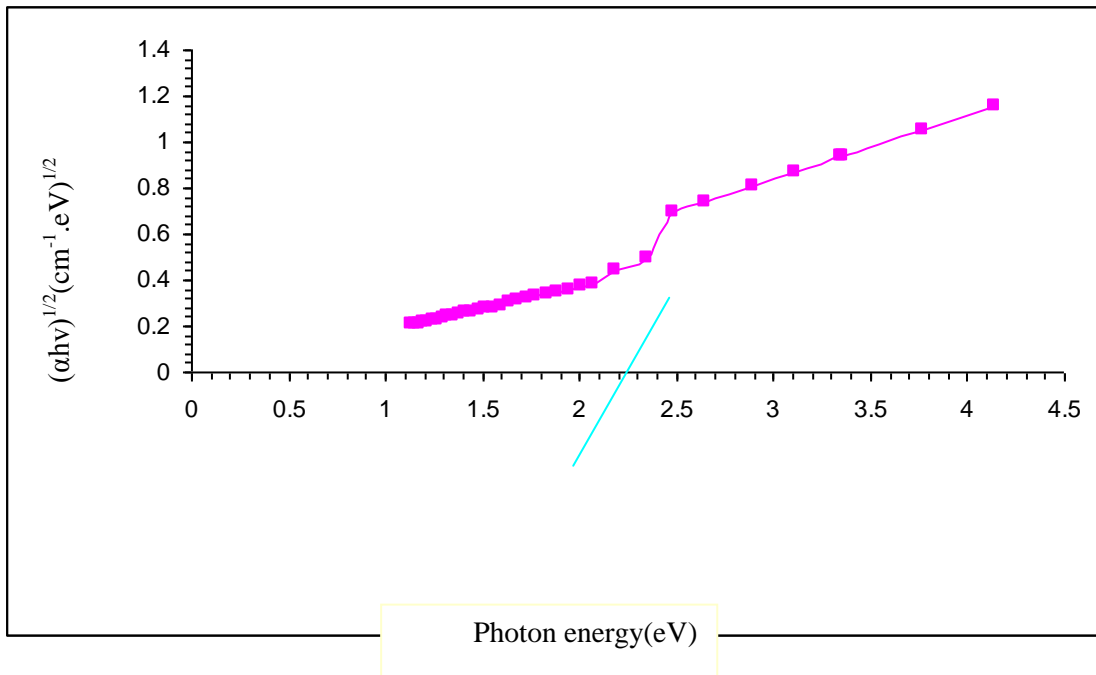
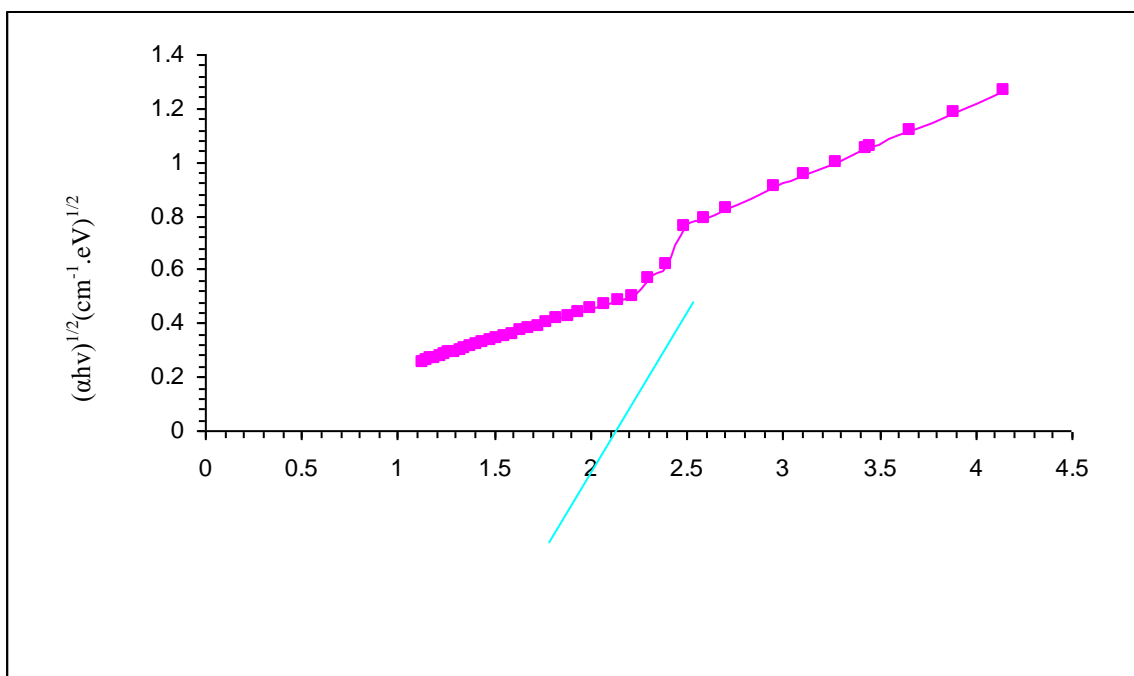


Figure (3) the relationship between $(\alpha hv)^{1/2}(\text{cm}^{-1}.\text{eV})^{1/2}$ and photon energy of PS-LiF composites for 21 vol.% LiF

on the value of forbidden energy gap of allowed indirect transition which equal (2eV) for 21 vol% LiF, and (1.85eV) for 37.4 vol.% LiF . we note that the value



Photon energy(eV)

Figure (4) the relationship between $(\alpha h\nu)^{1/2}(\text{cm}^{-1}.\text{eV})^{1/2}$ and photon energy of PS-LiF composites for 37.4vol.% LiF concentration.. Figure(5) shows the relationship between the $(\alpha h\nu)^{1/3}(\text{cm}^{-1}.\text{eV})^{1/3}$ and photon energy of pure polymer (PS),the same way we obtain to the forbidden energy gap of forbidden

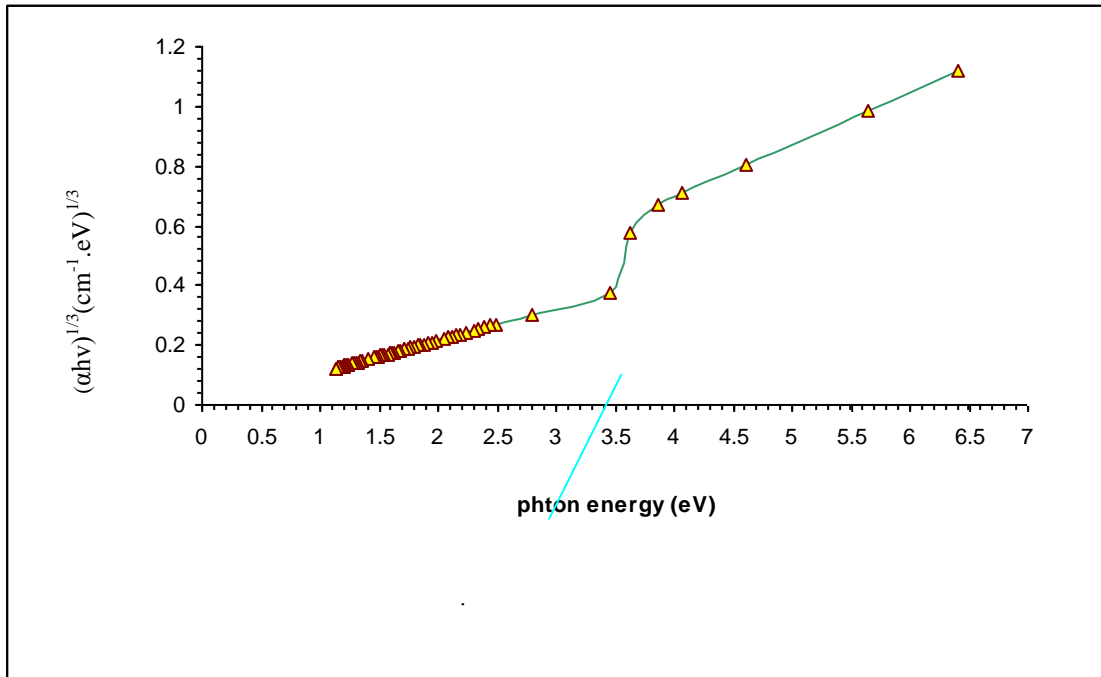


Figure (5) the relationship between $(\alpha h\nu)^{1/3}(\text{cm}^{-1}.\text{eV})^{1/3}$ and photon energy of pure polymer (PS).

Indirect transition which equal (3eV) . Figure (6) and figure (7) represents the same relationship but to the polymer filled with (LiF) with volume percentages of LiF are (21 , 37.4) vol% , the same way we can be obtained on the value of the forbidden

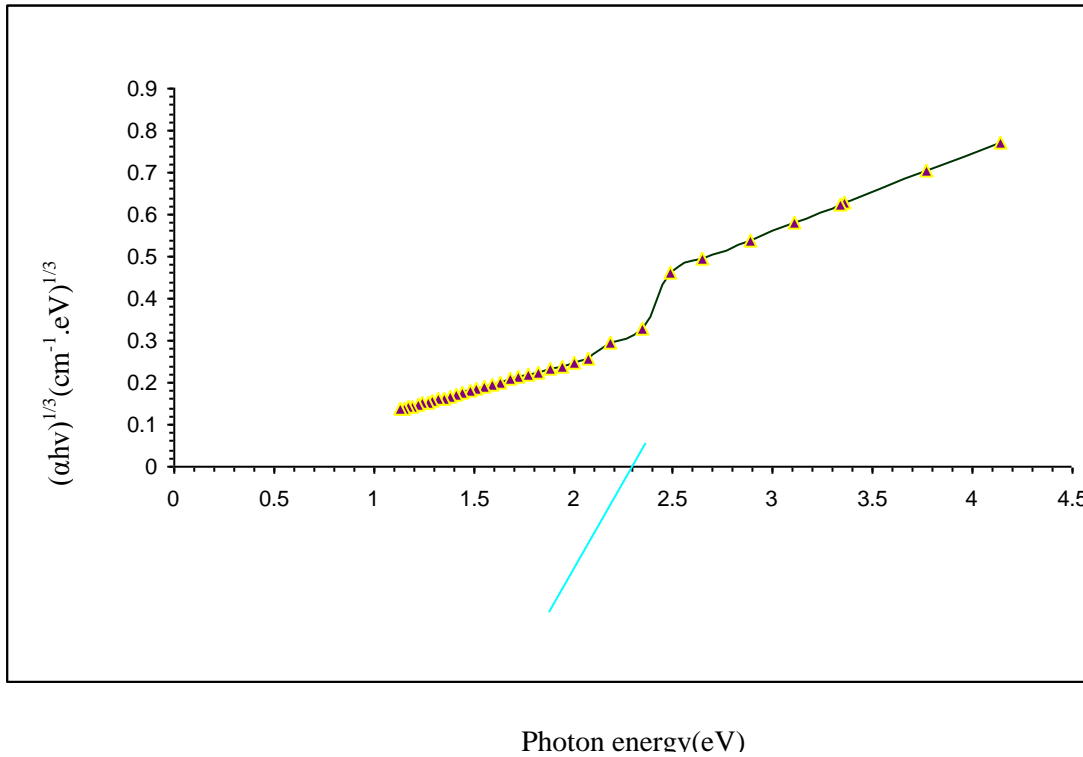
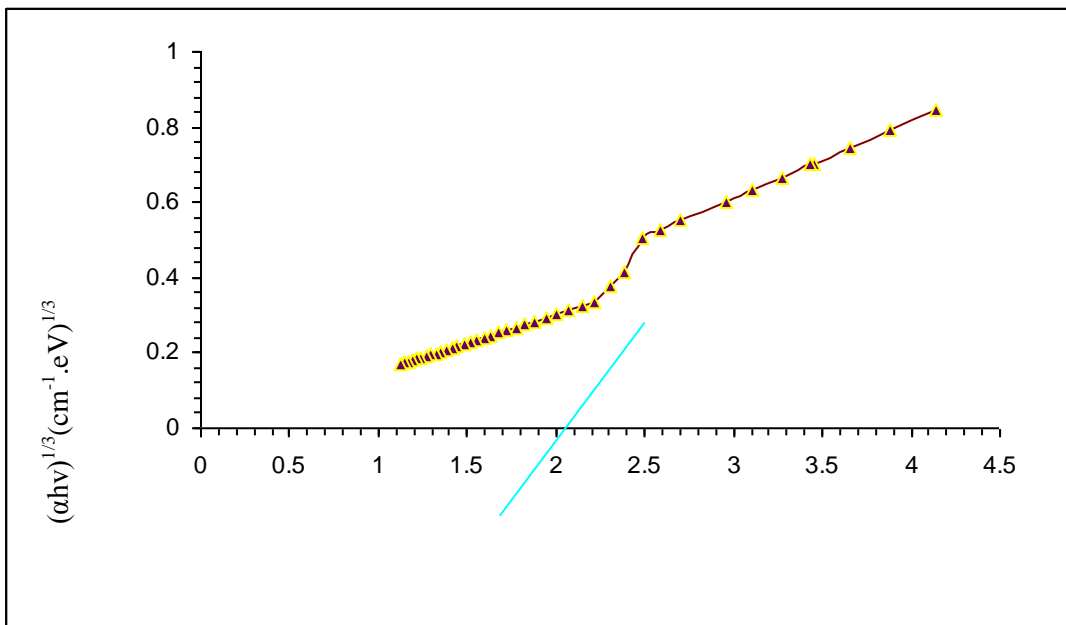


Figure (6) the relationship between $(\alpha hv)^{1/3}(\text{cm}^{-1}.\text{eV})^{1/3}$ and photon energy of PS-LiF composites for 21vol.% LiF

energy gap of the forbidden indirect transition which equal (1.95eV) for 21 vol%



Photon energy(eV)

Figure (7) the relationship between $(\alpha h\nu)^{1/3}(\text{cm}^{-1}.\text{eV})^{1/3}$ and photon energy of PS-LiF composites for 28.5 vol.% LiF has the value of the energy gap decreases with increasing LiF concentration [L. I. Soliman and W. Sayed, 2002].

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 10^4cm^{-1} this indicates to forbidden and allowed indirect electronic transitions.
3. The LiF additive change not the nature of electronic transfers of PS samples.
4. The forbidden energy gap is decreasing with increasing of the filler vol.% content.

References

- Al-Ramadhan. Z. , 2008, "Effect of Nickel salt on electrical properties of polymethylmethacrylate" , Al-Mustansiriyah Uni..
- Alvarez M. P. *et.al*, 2008, " Submicron Copper- Low- Density polyethylene conducting composites : Structural, Electrical and percolation Threshold" ,Chile.
- Blyth A. R., (1978), "Electrical properties of polymers", London-New York,.
- Harun M. H. *et. al*, 2009, "Temperature dependence of AC electrical

conductivity of PVA-PPY-FeCl₃ composite polymer films", Malaysia , Malaysian polymer Journal (MPJ), Vol. 3, No. 2 , p(24-31) .

- Hutagalwng. S. D. and Lee. B. Y. ,2007, Proceeding of the 2nd international conference Nano/Micro Engineered and Molecular systems, January ,Bangkok,Thailand.
- Heath P. and Sacher P.,1986 ,"Quality crystals and optics for laser applications", Applied opt. , vol. 15 , No. 937.
- Kathalingam A .*et al* , "Materials Chemistry and physics, vol.106,No.215.
- Scholz. S.M, Carrot.G and Hilborn.J ,2008, "Optical properties of Gold-Containing poly (Acrylic Acid) composites" , Lausanne, Switzerland.
- Scaglione S. *et al* ,2008, "F-color centers and Lithium nano clusters in ion-beam assisted LiF thin Films.
- Soliman . L. I and Sayed. W. M,2002,"Some physical properties of Vinylpyridine Carbon-Black composites", Cairo, Egypt.
- Seanor D.A., (1982)"Electrical properties of polymers", New York.
- Reale L. *et al* ,2008, "X-ray microscopy of plan cells by using LiF crystal", microscopy research and technique.
- Ramos M. V. *et .al* , 2005," conductive polymer- copposite Sensor for Gas Detection ", Newzeland.
- Thangaraju B. , Kalianna P. ,Cryst. Res. Techon., vol. 35, No.71.