Effect of Lithium Fluoride on Some Optical Properties of Polystyrene

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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 (٣٠٠-١١٠٠)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 وبسمك مختلف.تم تسجيل طيفي الامتصاص و النفاذية و لمدى الاطوال الموجيةnm(٣٠٠-١١٠٠). 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,١٩٧٩ and M. V. Ramos *et.al.*,٢٠٠٥].Researches, generally, have demonstrated that conductive polymers can be used as energy storage element in:[D.A. Seanor,١٩٨٢ and M. p. Alvarez *et al*,٢٠٠٨]

١- Capacitors and Secondary batteries .

٢- As semiconductor material in schottky diode.

٣- Insulated gate field effect transitions (FET) and light emitting diodes.

٤- 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 ٢٠٠٠ 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*,٢٠٠٩ and Z.Al-Ramadhan,٢٠٠٨] .

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 ٠,١٠٤µm-٧µm range[P. Heath and P. Sacher, ١٩٨٦]. It is also very useful for X-ray nonochromaters and for the study of fundamental properties and defect in crystal[L. Reale *et al*,٢٠٠٨].

Experiment

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

The electronic balanced of accuracy $١٠^{-٤}$ 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 (٠ , ١٧,٦٦ and ٣٢,٧٥) vol%. The Hot Press method is used to press the powder mixture. The mixture of different LiF percentages have been compacted at temperature ١٤٥°C under a pressure ١٠٠ Par for ١٠ minutes . Its cooled to room temperature , the samples were disc shap of a diameter about ٣٠mm and thickness ranged between (١,٧٥-٢,٢)mm. The transmission & absorption spectra of PS-LiF composites have been recording in the length range (١٩٠-١١٠٠) nm using double-beam spectrophotometer (UV-٢١٠°A 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 ,٢٠٠٧]:

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

Where : A absorbance and d the thickness of sample.

Figure (١) 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

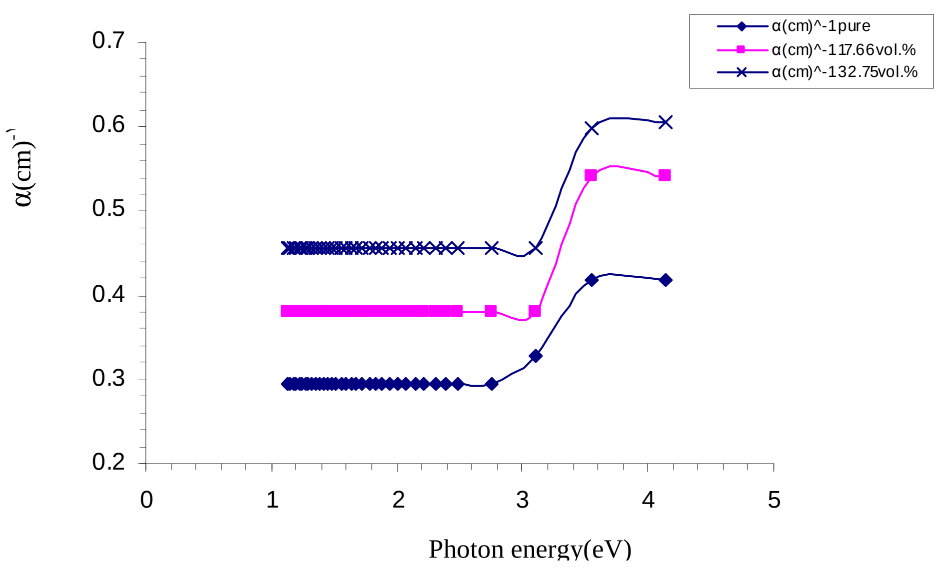

Figure (١) the relationship between the absorption coefficient and photon energy of the PS-LiF composites

Probability of electronic transitions are the absorption edge of the region [S. M Scholz *et al*,٢٠٠٨]. The absorption coefficient helps to conclude the nature of electronic transitions, when the high absorption coefficient values (α>١٠٤cm-١) 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(α<١٠٤cm-١) 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,٢٠٠٠]. The results showed that the values of absorption coefficient of the PS-LiF composites less than ١٠٤cm-١ which indicates to the indirect electronic transition. The forbidden energy gap of indirect transition both allowed, forbidden calculated according to the relationship[A. Kathalingam et.al. , ٢٠٠٧] :

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

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

If the value of (m=٢) indicates to allowed indirect transition . when the value (m=٣) indicates to forbidden indirect transition. Figure (٢) shows the relationship between (αhv)١/٢ (cm-١.eV)١/٢ and the photon energy of pure polymer (PS) , with take over part

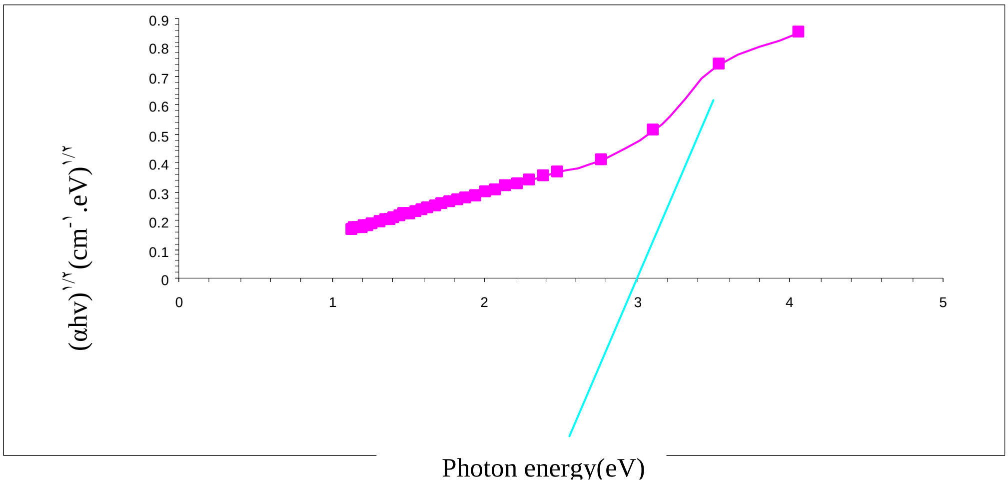

Figure (٢) the relationship between $(\alpha h\nu)^{١/٢}(cm^{-١}.eV)^{١/٢}$ and photon energy of pure polymer (PS).

of the straight cut oriented axis at the point $(\alpha h\nu)^{١/٢}$ =٠ will get the value of forbidden energy gap of the allowed indirect transition , which equal (٢.٥٨eV). Figure (٣) and figure (٤) represents the same relationship but to the polymer filled with (LiF) with volume percentages of LiF are (١٧,٦٦ , ٣٢,٧٥) vol% , the same way we can be

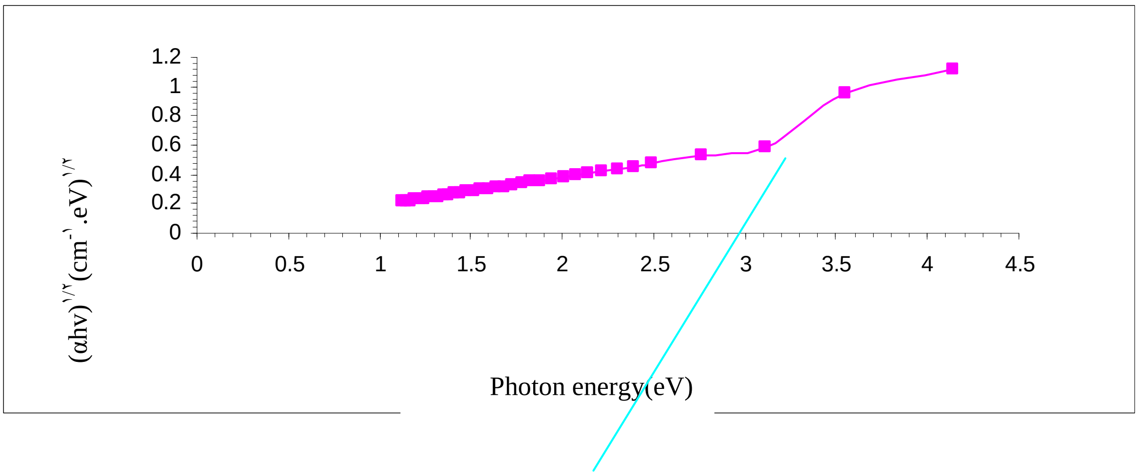

Figure (٣) the relationship between $(\alpha h\nu)^{١/٢}(cm^{-١}.eV)^{١/٢}$ and photon energy of PS-LiF composites for ١٧,٦٦ vol.% LiF obtained on the value of forbidden energy gap of allowed indirect transition which equal (٢,٤١eV) for ١٧,٦٦vol% LiF, and (٢,١٩eV)for ٣٢,٧٥ vol.% LiF . we note that the

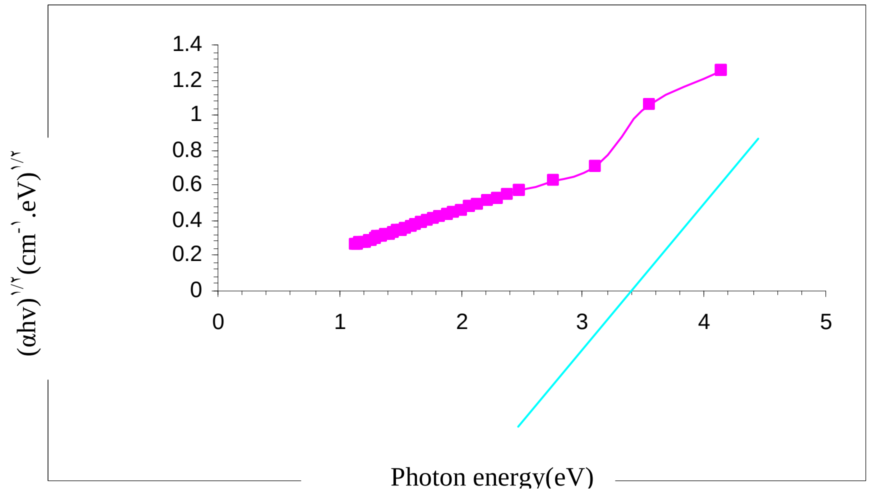

Figure (٤) the relationship between $(\alpha h\nu)^{١/٢}(cm^{-١}.eV)^{١/٢}$ and photon energy of PS-LiF composites for ٣٢,٧٥vol.% LiF

value of the forbidden energy gap decreases with increasing LiF concentration.. Figure(٥) shows the relationship between the $(\alpha h\nu)^{١/٣}$ $(cm^{-١}.eV)^{١/٣}$ and photon energy of pure polymer (PS),the same way we obtain to the forbidden energy gap of

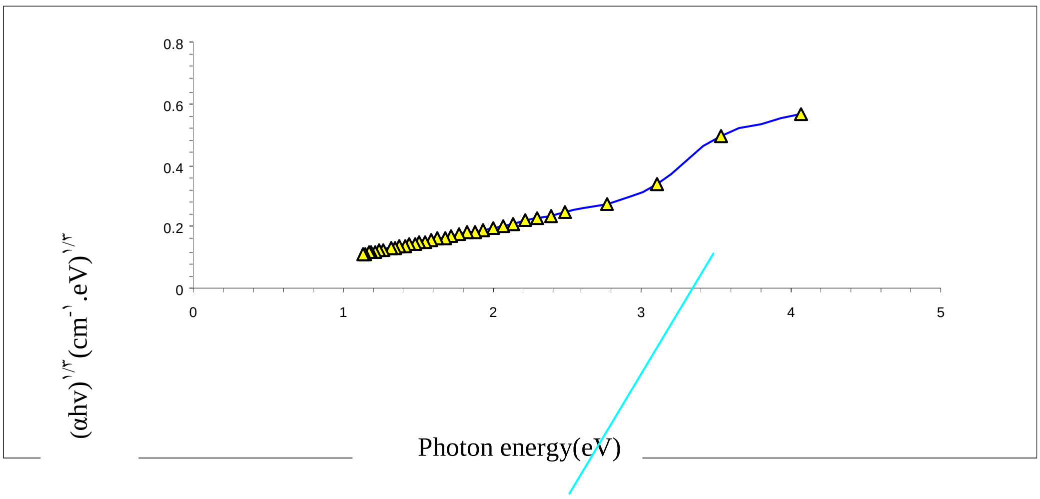

Figure (٥) the relationship between $(\alpha h\nu)^{١/٣}(cm^{-١}.eV)^{١/٣}$ and photon energy of pure polymer (PS).

Indirect transition which equal (٢,٥eV) . Figure (٦) and figure (٧) represents the same relationship but to the polymer filled with (LiF) with volume percentages of LiF are (١٧,٦٦،٣٢,٧٥)vol%, the same way we can be obtained on the value of the forbidden

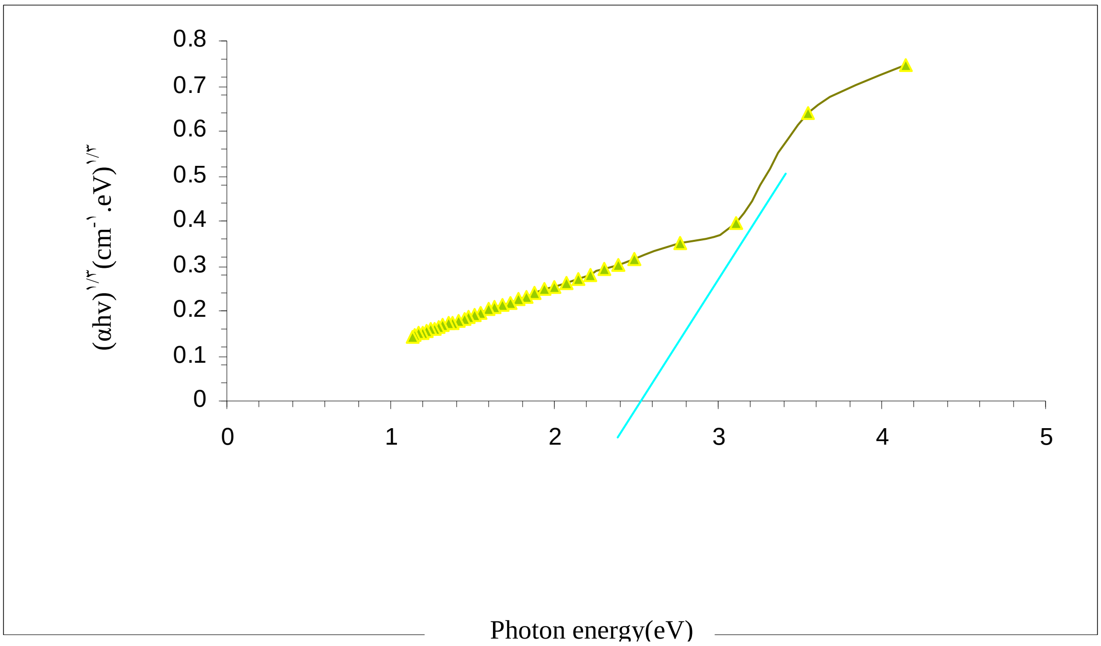

Figure (٦) the relationship between $(\alpha h\nu)^{١/٣}(cm^{-١}.eV)^{١/٣}$ and photon energy of of PS-LiF composites for ١٧,٦٦vol.% LiF

forbidden energy gap of the forbidden indirect transition which ، (٢,٤eV) for ١٧,٦٦vol% LiF, and (٢,٠٧eV) for ٣٢,٧٥vol% LiF we note that the value of the energy

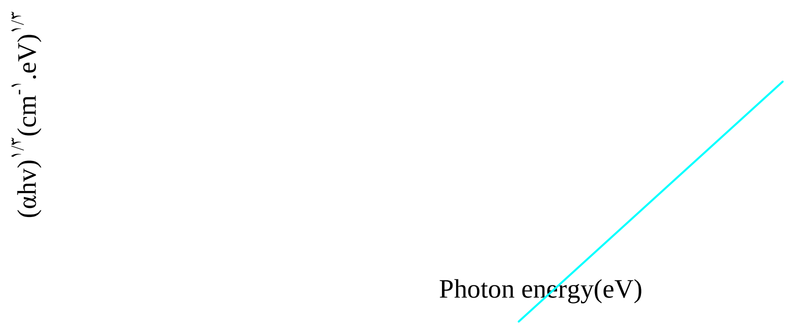

Figure (٧) the relationship between $(\alpha h\nu)^{١/٣}(cm^{-١}.eV)^{١/٣}$ and photon energy of of PS-LiF composites for ٣٢,٧٥ vol.% LiF

gap decreases with increasing LiF concentration[L. I. Soliman and W. Sayed,٢٠٠٢].

Conclusion

١. The absorption coefficient is increasing with increasing of the filler vol.% content.

٢. The experimental results showed that the absorption coefficient less than $١٠^{٤}cm^{-١}$ this is indicates to forbidden and allowed indirect electronic transitions.

٣. The LiF additive change not the nature of electronic transfers of PS samples.

٤. The forbidden energy gap is decreasing with increasing of the filler vol.% content.

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