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Effects of Adding Coumarin Dye on Physical Properties of Blend (PC-PS) Film

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Abstract

Pure blend Polycarbonate- Polystyrene (PC-PS) and doped blend films with various volume of Coumarin dye were prepared by using the casting method. The absorption and transmission spectra for these films were measured using UV/VIS spectrometer technique in order to assess the type of transition which was found to be an indirect transition. The optical energy gaps of pure PC was 4.24 eV, pure PS was 4.39 eV, Coumarin dye was 4.08 eV, and the pure blend was 4.1 eV. After doping blend with Coumarin dye, the energy gap was decreased by 0.06 eV in a volume of 12 ml. The results showed that the absorption coefficient and energy band gap are affected by doping. When the Coumarin dye was added to the pure blend with different concentrations (12, 24, 36, and 48) ml, the FTIR spectrum was affected by the disappearance of peaks and appearance of new ones.

Keywords: Polycarbonate, Polystyrene, Coumarin dye, Optical Properties, FTIR Spectrum, Polymer Composite, Dye Doped Polymer.

تأثير اضافة صبغة الكومارين على الخواص الفيزيائية لمزيج غشاء (PC–PS)

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الخلاصة

تم تحضير مزيج نقي من البولي كاربونيت– بولي ستايرين (PC–PS)وأغشية المزيج مع حجوم مختلفة من صبغة الكومارين باستخدام طريقة الصب. تم قياس أطياف الامتصاص والنفاذية لهذه الأغشية باستخدام تقنية مطياف UV / VIS من أجل تقييم نوع الانتقال الذي وجد أنه انتقال غير مباشر. كانت فجوة الطاقة الضوئية للغشاء PCالنقي 4.24 الكترون فولت، وكانت لغشاءPS النقي 4.39 الكترون فولت، ولمحلول صبغة الكومارين 4.08 الكترون فولت، والمزيج النقي 4.1 الكترون فولت. بعد خلط المزيج مع صبغة الكومارين. تقل فجوة الطاقة بمقدار 0.06 فولت في حجم محلول الصبغة 12 مل. أظهرت النتائج أن معامل الامتصاص وفجوة الطاقة يتاثران بإضافة الكومارين. عند إضافة صبغة الكومارين إلى المزيج النقي بحجوم مختلفة (12 ، 24 ، 36 ، 48) مل ، سيتأثر طيف FTIR باختفاء القمم وظهور قمم جديدة.

Introduction

Polymer blending provides a powerful route to engineering new properties in materials when using available polymers. A polymer blend is a mixture of two or more polymers that is achieved through the physical mixing of the polymers in special amounts [1]. The principal advantage of using the blend

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system is the simplicity of preparation and ease of control of physical properties by changing composition. However, the miscibility between the constituents of polymer mixture on the molecular scale is responsible for the production of materials with superior properties [1,2].

Polycarbonate (PC) is a kind of polyester where the carbonate ester groups are connected with aromatic groups, with a structure that provides material resistant to high temperatures [3]. Polycarbonate exhibits a unique combination of properties compared to other thermoplastic such as excellent toughness, high transparency, and dimensional stability over a wide temperature ranges. It is usually used as a lighter and tougher substitute for glass or metal [4]. It has a good out-doors resistance in the UV-stabilized form, but it tends to turn yellow by long exposure to sunlight [5]. Because of its good properties, polycarbonate is an ideal material for use in specifically demanded applications where it is often exposed to environmental parameters.

Polystyrene (PS) can be naturally transparent, but can also be colored with colorants. As a Thermoplastic Polymer, Polystyrene is in a solid (glassy) state at room temperature but flows if heated above about 100 ˚C, which is its glass transition temperature [6]. PS is an inexpensive and extensively used polymer. It has applications in foam packaging and as transparent sheets for domestic applications. It is used for kitchen appliances and also as parts of toys, drinking cups and housing of computers [7, 8].

Coumarins are widely occurring in nature, with Coumarin itself being first isolated in 1820 from a specific variety of bean, while many other Coumarin derivatives were found in a wide range of plants [9]. As a group, Coumarins exhibit interesting fluorescence properties, which include a high degree of sensitivity to their local environment, which influences their polarity and viscosity. This sensitivity has led to their widespread application as sensitive fluorescent probes of a wide range of systems, including homogeneous solvents and mixtures as well as heterogeneous materials. Coumarin and its derivatives occur in a wide variety of natural plant sources. This family of compounds serves as bacteriostats and fungi stats; in other words, they help in controlling the population of bacteria and fungi in the plant. They can also act as growth regulators. Industrially, they are used for a wide variety of purposes such as cosmetics, anticoagulants, sunscreens, flavorings, preservatives, pesticides, optical brightening agents, and fluorescent laser dyes [9].

Infrared spectroscopy is the most important analytical techniques available to today's scientists. This technique depends on the vibration of the atoms of molecules. An infrared spectrum is obtained by passing infrared radiation through a sample and designating which fraction of the incident radiation is absorbed in a specific energy. The energy at which any peak in an absorption spectrum appears corresponds to the frequency of a vibration of a sample molecule. Infrared spectroscopy appears in the molecules that possess a certain feature so that the electric dipole moment of the molecule must change during vibration. Most infrared spectroscopy is carried out by using Fourier Transform Infrared (FTIR). This method is based on the interference of radiation between the two beams to product interferometer, i.e. a signal produced as a function of the change of the path length between two beams. The two domains of distance and frequency are inter-convertible by the mathematical method of Fourier transformation [10]. Fourier transform infrared spectroscopy (FTIR) supplies particular information about chemical bonding and molecular structures, making it useful for analyzing organic materials and certain inorganic materials [11]. The aim of this work is to study the effects of adding different volume of Coumarin dye solution on the optical properties and FTIR Spectrum of PC-PS composite film.

Theoretical Part

In optical applications such as optical fiber, reflective coatings, and interference filters, the use of materials requires precise knowledge of their optical constants over a large range of wavelengths. All materials may be related to their atomic composition in the optical, electrical and electronic properties. By employing eq.(1), the absorption coefficient factor known as the function of the wavelength of the vector can be practically calculated from optical absorbance spectra [12].

$$\log\left(\frac{I}{I_{\circ}}\right) = 2.303\,A = \alpha\ d \qquad (1)$$

where I and I_o are the intensities of the transmitted and incident beams, respectively, A is the optical absorbance, d is the film thickness, and α is the absorption coefficient. Absorbance is defined by :$A = \log(I/I_o)$

The extinction coefficient K is related to the absorption coefficient α [13].

$$K = \alpha \lambda / 4\pi \tag{2}$$

where λ is the wavelength of light.

The transmission was calculated using the following formula [14]:

$$T = \exp[-2.303A] \tag{3}$$

While the Reflection can be obtained from the values of absorbance and transmission coefficient from eq.(4) [14].

$$R = 1 - (A + T) \tag{4}$$

The refractive index as a function of wavelength can be determined from the reflection coefficient data R and the extinction coefficient K using eq. (5) [15].

$$n = \sqrt{\frac{4R}{(R-1)^2} - K^2} - \frac{(R+1)}{(R-1)} \tag{5}$$

The absorption edge for direct and indirect transitions can be obtained in eq.(6) [16].

$$\alpha h \upsilon = C_o (h \upsilon - E_g^{opt.})^n \tag{6}$$

where C_o is an energy - independent constant related to the properties of the valance and conduction bands , h υ is the photon energy, α is the absorption coefficient, $E_g^{opt.}$ is the optical energy band gap of the material, and n=1/2, 3/2, 2, and 3 for direct allowed, direct forbidden, indirect allowed and indirect forbidden transitions, respectively .

A plot of $(\alpha h \upsilon)^{1/n}$ versus (h υ) often yields a reasonably good straight line fit to the absorption edge and the extrapolated (h υ) at which $(\alpha h \upsilon)^{1/n} = 0$ provides a convenient experimental benchmark for the optical band gap($E_g^{opt.}$) . The optical absorption coefficient (α(υ)) near the band edge shows an exponential dependence on photon energy (h υ) [16]:

$$\alpha(\upsilon) = \alpha_o \exp(h \upsilon / E_t) \tag{7}$$

where α_o is a constant and E_t is related to the width of the band tails of localized states in the forbidden band gap. It should be mentioned that this equation is applicable only in the absorption region of $\alpha = 10^3 - 10^4\ cm^{-1}$.

The real and imaginary parts of dielectric constant (ε_r and ε_i), respectively, can be calculated as [17]:

$$N^* = n - I k \tag{8}$$

$$\varepsilon^* = \varepsilon_r - i \varepsilon_i \tag{9}$$

where N* is the complex refractive index and (ε*) is the complex dielectric constant. From the relation $N = \sqrt{\varepsilon^*}$, there are:

$$(n - ik)^2 = \varepsilon_r - i \varepsilon_i \tag{10}$$

$$\varepsilon_r = n^2 - k^2 \tag{11}$$

$$\varepsilon_i = 2 n k \tag{12}$$

Experimental work

The casting method was used to prepare the film from the blend of polycarbonate and polystyrene. First, the pure blend was prepared by taking 0.3 g of polystyrene and 0.2 g of polycarbonate, dissolving them with 10 ml chloroform solvent, putting the mixture on a hotplate magnetic stirrer to shake well, and then pouring them into a glass petri dish. The mixture was placed inside the oven for 24 hours, so that it will get a PC+PS film was formed. Secondly, blends with different volume of

Coumarin dye solution in chloroform, with a concentration of 1× 10^{-5} mole/litter, were prepared as in the first step. The different volume of Coumarin solution was chosen to be (12, 24, 36, and 48) ml. Polycarbonate (Sabic company), Polystyrene (Imperial Chemical Industries (ICI), UK), and Coumarin dye (Sigma-Aldrich Chemie, Germany) were employed. UV-Visible spectrophotometer (T70/T80 Spectrophotometer) and Fourier Transform Infrared Spectroscopy (FTIR, Biotech. Engineering Management) used to measure the absorption and transmission spectra.

Results and Discussions

Figure-1 shows the absorption spectrum for the pure polycarbonate film. The behavior of the absorption spectrum is broadband with two peaks, the first one is at a wavelength of 305nm with an intensity of 0.7 and the second is located at a wavelength of 345nm with an intensity of 0.69. The difference between the two peaks is 40nm which indicates the same formation origin referring to the n→π* and π→π* transitions of the carbonyl group, that matched previously described results [18].

The absorption spectrum for the pure Polystyrene is shown in Figure-2. The absorption spectrum is a broadband, which agrees with results reported by other authors [19].

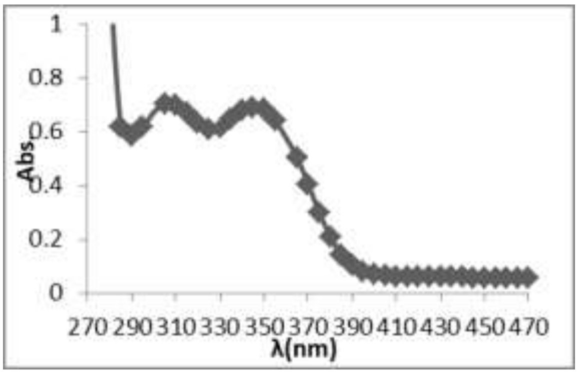

Figure 1-Absorption spectrum of pure polycarbonate film,

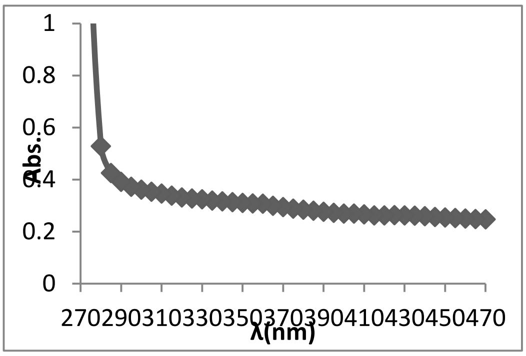

Figure2-Absorptio n spectrum of polystyrene film

The absorption spectrum of Coumarin in chloroform solution with a concentration of $1x10^{-5}$ mole/liter is shown in Figure-3. The behavior of the absorption spectrum is a broadband with two peaks. The maximum absorption for the first peak was at (275) nm with an intensity of 0.12 while that for the second peak was at (315) nm with an intensity of (0.064). The difference between the two maximum bands was about (40) nm. The electronic transitions corresponding to these bands were n–π* and π-π*. Both transitions are typical for basic Coumarin skeletons and are related to the charge transfer from the benzene cycle to the pyranone moiety [20].

The absorption spectrum for the pure blend (PC-PS) is shown in Figure-4 and Table-1 . The absorption spectrum is a broadband with two peaks, the first peak being at a wavelength of (305nm) with an intensity of (0.642), whereas the second peak was at wavelength of (345nm) with an intensity of (0.612).The difference between the two peaks is (40nm) which refers to the same formation origin, so that these two peaks are due to the n→π* and π→π* transitions of the carbonyl group, which is in agreement with previous results [18].

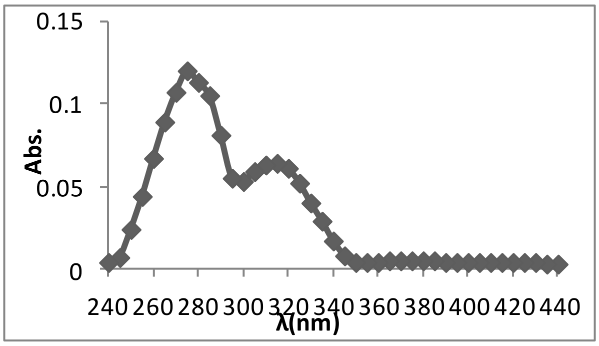

Figure 3-Absorption spectrum of Coumarin dye solution in chloroform with C=1 x 10^{-5} mole/liter.

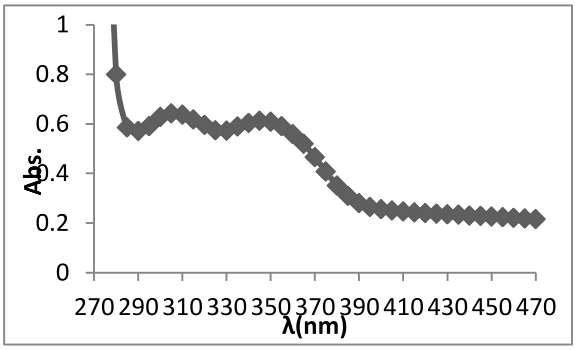

Figure 4- Absorption spectrum of pure polystyrene film

The UV-VIS spectrum for the absorption of pure blend and blends film with different volume of Coumarin solution (12, 24, 36 and 48) ml are shown in Figure-5 along with the wavelength of 270-470 nm. The maximum intensity appears in a volume (36) ml at a wavelengths of (315) nm and (355) nm. The minimum intensity appears in a volume (12) ml at wavelengths of (315) nm and (355) nm. The addition in the proportion of the volume of the Coumarin dye resulted in an uneven increase and deficiency, which can be explained by the formation of aggregates of Coumarin molecules, such as dimmer and trimer, as previously described [21]. Table-1 shows that there is a red shift toward long wavelengths (lower energy) when adding Coumarin dye with a range of (5)nm to (10)nm. The red shift was possibly caused by the solvent effect as well as one of the factors causing the displacement due to the elongation of the sequential system, or the increase in the length of the chain containing the successive bonds, with some of them leading to the lack of energy required for electronic transitions. Also, it was observed that, after the addition of the Coumarin dye, the peaks of absorption spectra were disintegrated or expanded, which could refer to the role of polystyrene that is dominant. This is because the weight ratio of polystyrene was higher than polycarbonate when preparing the blend.

The spectral transmittance for pure blend and blend with Coumarin dye for different volume (12, 24, 36 and 48 ml) are shown in the Figure-6. It is obvious that the behavior of the transmission spectrum of pure blend film and blend films with different volume of Coumarin dye is opposite to that of the absorption spectra. In that sense, the maximum intensity appeared in the volume of (12ml) at (315)nm and (355)nm, whereas the minimum intensity appeared in the volume of (36ml) at (315)nm and (365)nm.

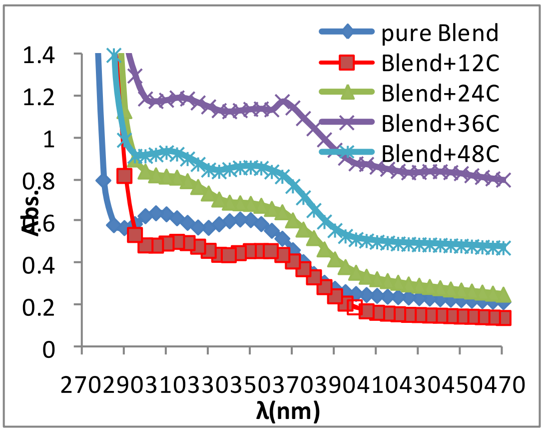

Figure 5-Absorption spectra for (PC-PS-C) films with different volume of Coumarin dye solution.

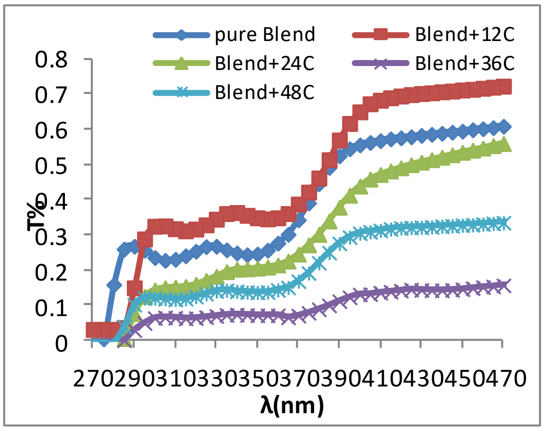

Figure 6-Transmission spectra for (PC-PS-C) films with different volume of Coumarin dye solution.

The reflection spectra of pure blend polymer and blend-C films for different volume (12,24,36 and 48) ml are illustrated in Figure-7. The reflection spectrum was calculated from absorption and transmission spectra according to eq. (5). The best reflection was obtained from this work with a doping ratio of (12 ml), whereas the minimum reflection was at a volume of (36)ml.

The absorption coefficient (α) is defined as the ability of a material to attenuate the light of a given wavelength per unit length. The value of absorption coefficient (α) was calculated from eq. (1) for all samples. The absorption coefficient (α) for (PC-PS-C) films for different volume is illustrated in Figure-8. The absorption coefficient has the advantages of deducing the nature of electronic transitions. Direct electronic transitions occurred when the high absorption coefficient values were at $\alpha > 10^4$ cm^{-1} at higher energies, and the energy and momentum preserved of the electron and photon. However, indirect electronic transitions occurred when the values of absorption coefficient were low ($\alpha < 10^4$ cm^{-1}) at low energies, for conservation of the energy and momentum law this transition happens with helpful of phonon. In our results, the value of α for all samples were less than 10^4 cm^{-1}, so that the indirect electronic transitions are deduced [20].

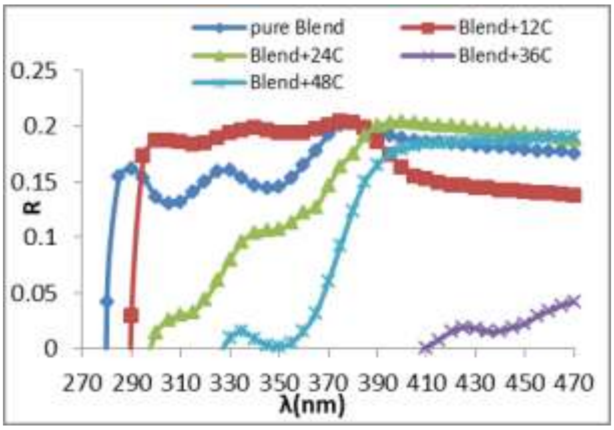

Figure7-Reflection spectra for (PC-PS-C) films with different volume of Coumarin dye solution.

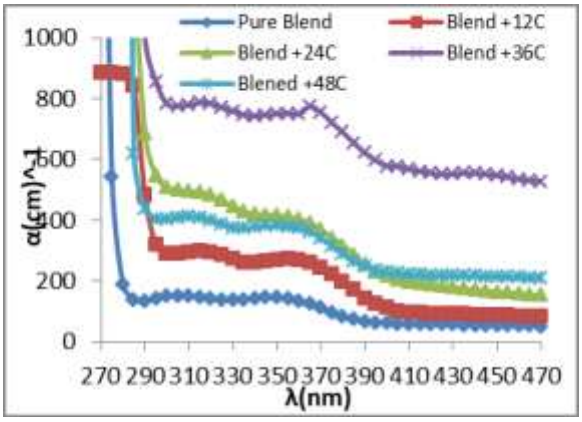

Figure 8-The absorption coefficient spectra for (PC-PS-C) films with different volume of Coumarin dye solution.

The optical band gap is necessary to develop the electronic band structure of film material. It can be obtained by plotting $(\alpha h\nu)^{1/2}$ versus $(h\nu)$ in the high absorption range, followed by extrapolating the linear region of the plots to $(\alpha h\nu)=0$ [13]. From the value of absorption coefficient of pure blend and Coumarin mixture blend films, the indirect transition happened at r=2. From Figure-9 and Table-1, the energy gap for pure PC film Figure-(9-A)) could be measured, and it was equal to 4.24 eV. The indirect transition could be calculated from the value of absorption coefficient , . The energy gap for PS film (Figure- (9-B)) was measured to be 4.39 eV. Coumarin solution (Figure-(9-C)) had an energy band gap of 4.08 eV, whereas the energy gap for the pure blend film (Figure-(9-D)) was found to be 4.1 eV.

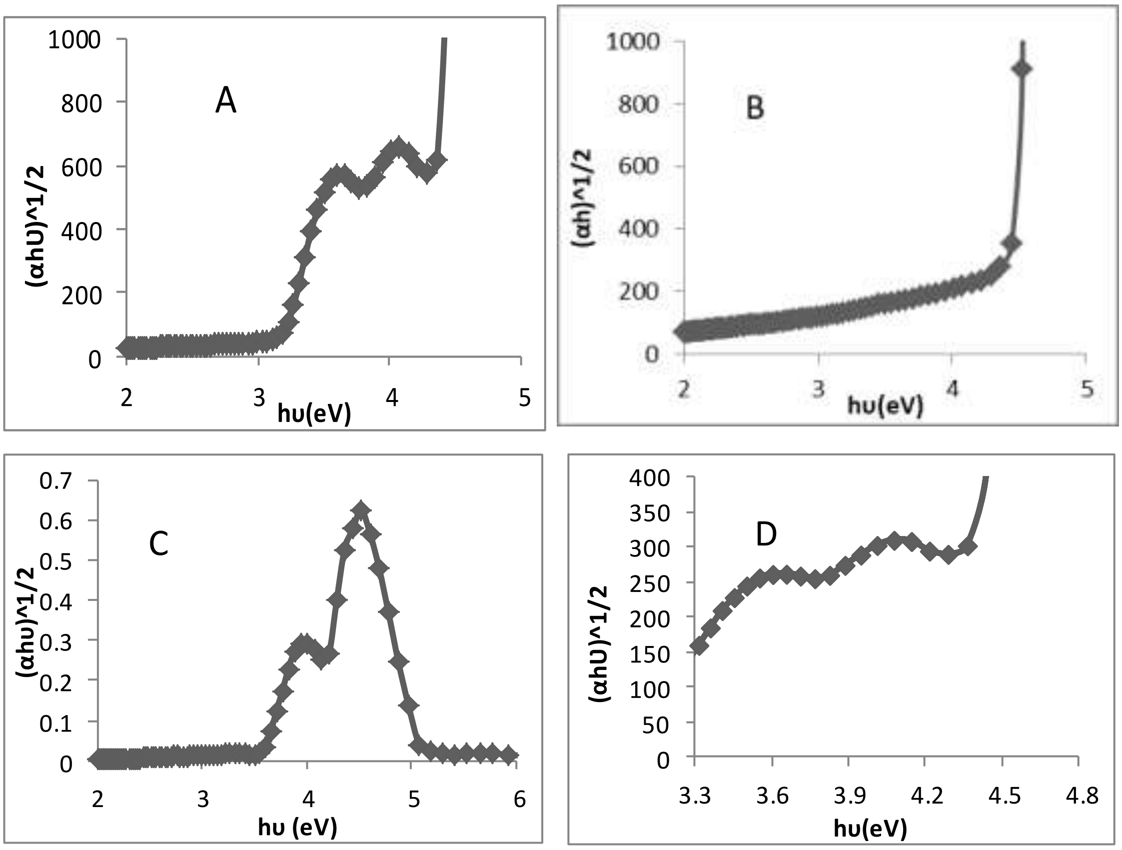

Figure 9-Energy gap for (A)pure PC film, (B) pure PS film,(C) Coumarin dye solution and (D) pure Blend film.

Figure-10 shows results for all samples (12,24,36,48)ml. The E_g gap could be measured when adding the coumarin dye to the mixture with a different volume of the dye. It is observed from Table-1 that the energy gap before adding the dye was 4.1eV while the value after adding the dye was decreased by 0.06 eV using the volume of 12ml. The value continued to decrease to the volume of 36 ml and then started to increase slightly at the volume of 48 ml. This is ascribed to the increase in absorption coefficient as a result of introducing dopant atoms and, hence, E_g will increase. It was found that increasing the dye added to the mixture causes a decrease in the energy gap, because the increase in the added dye leads to the formation of new local levels higher than the Valance band and below the Conduction band. These levels are ready to receive electrons and generate tails in the gap, which in turn reduces the energy gap and is one of the crystal defects.

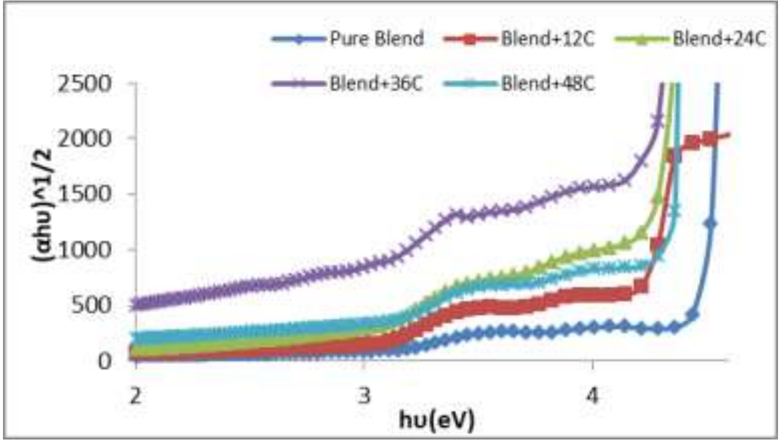

Figure 10-Energy gap spectra for (PC-PS-C) films with different of Coumarin dye solution

Table 1-Absorption information for Blend Pure and Coumarin dye and (blend+ C) films with Energy gap

Sample	λ_{m1} (nm)	Abs.$_1$	λ_{m2} (nm)	Abs.$_2$	Energy gap(eV)
Pure PC	305	0.691	345	0.7	4.24
Pure Coumarin	275	0.12	315	0.064	4.08
Pure PS	-	-	-	-	4.39
Pure Blend	305	0.642	345	0.612	4.1
Blend+12mlC	315	0.505	355	0.461	4.04
Blend+24mlC	315	0.813	350	0.687	3.92
Blend+36mlC	315	1.195	355	1.172	3.67
Blend+48mlC	310	0.932	350	0.861	3.77

From Figure-11 which represents FTIR spectrum of the pure PC film. C-H out phase bend appeared at 633.84 cm^{-1}, 707.09 cm^{-1} , 828.72 cm^{-1} and 887.11 cm^{-1}. The C-O stretch bond was located at 1080.02 cm^{-1}, 1158.70 cm^{-1}, 1187.31 cm^{-1}, 1219.73 cm^{-1} and 1290.71 cm^{-1}. The CH_2 bending bond was shown at 1364.53 cm^{-1}. The C–H aliphatic stretch appeared at 1409.10 cm^{-1} and 2967.68 cm^{-1}, while 1503.94 cm^{-1} refers to C=C stretching and 1769.84 cm^{-1} to C=O stretch bond, which agrees with previous results[22, 23].

Figure-12 represents FTIR spectrum of pure PS. The peaks at 621.27 cm^{-1}, 695.32 cm^{-1}, 748.80 cm^{-1}, 841.37 cm^{-1} and 906.11 cm^{-1} refer to =C–H out-of-plane bending, and the aliphatic bond C-H stretch was shown at 2849.37 cm^{-1} and 2920.81 cm^{-1}, whereas 3025,16 cm^{-1} and 3059.50 cm^{-1} refer to the aromatic C-H stretch. In addition, 1068.20 cm^{-1} was illustrated at the C-O stretch bond, whereas the peak at 1600.73 cm^{-1} indicated the C=C stretch bond, and at 1451.77 cm^{-1} and 1492.40 cm^{-1}

referred to the aliphatic C=C stretching, which is compatible with results from previous studies[10, 22, 24].

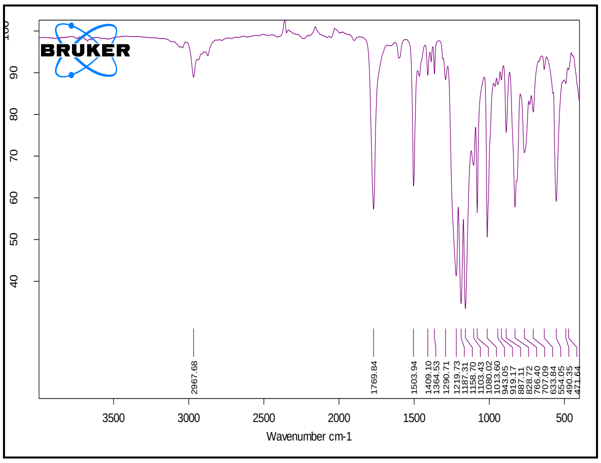

Figure 11-FTIR for pure PC film

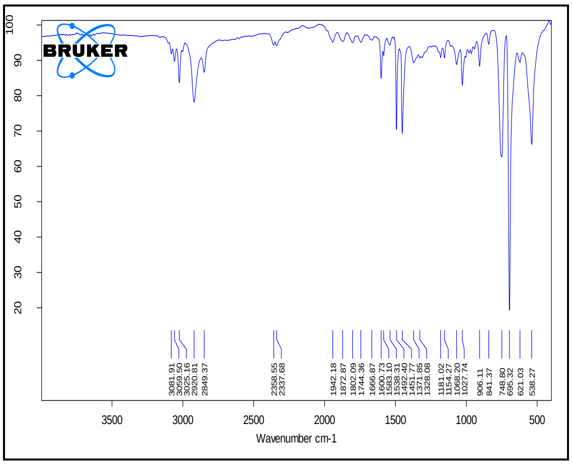

Figure 12-FTIR for pure PS

Figure-13 which demonstrates FTIR spectra of Coumarin Dye, with the appearance of the peaks at 608.20 cm^{-1}, 686.91 cm^{-1}, 752.48 cm^{-1}, 825.92 cm^{-1}, 890.49 cm^{-1} , 916.91 cm^{-1}, 994.69 cm^{-1} which refer to the =C–H out-of-plane bending alkenes. The C-O stretch bond appeared at 1027.77cm^{-1}, 1102.05 cm^{-1}, 1174.56 cm^{-1}, 1227.99 cm^{-1}, 1258.72 cm^{-1}, whereas the peak 1396.62 cm^{-1} refers to CH_2 bending bond. The peaks at 1452.20 cm^{-1}, 1486.71 cm^{-1}, 1560.00 cm^{-1} appeared at the aliphatic C=C stretching, while those at 1601.00 cm^{-1}, 1619.04 cm^{-1} denote the C=C stretching alkenes. The peaks at 1698.36 cm^{-1} and 1753.65 cm^{-1} refer to the C=O stretch bond, which is consistent with earlier data [22].

Figure-14 demonstrates FTIR spectra of the pure blend. The peaks appearing at 631.04 cm^{-1} to 887.36 cm^{-1} refer to C-H out of plane bending, whereas the bond C-O stretching vibration was located at 1013.92 cm^{-1} to 1222.00 cm^{-1} and the peak at 1374.20 cm^{-1} refer to CH_2 bending. The C=C stretching bend was located at 1452.73 cm^{-1} to 1506.61 cm^{-1}. The peaks at 1616.93 cm^{-1}, 1771.74 cm^{-1}, 1828.97 cm^{-1} and 1844.82 cm^{-1} showed the C=O stretching, whereas those at 2849.36 cm^{-1} and 2919.58 cm^{-1} indicated the aliphatic C-H stretch, and those at 3025.22 cm^{-1} and 3059.12 cm^{-1} refer to the aromatic C-H stretch, which agrees with previous results [22,23].

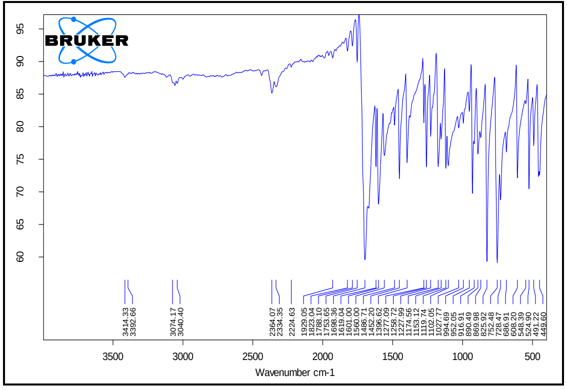

Figure 13-FTIR for Coumarin Dye

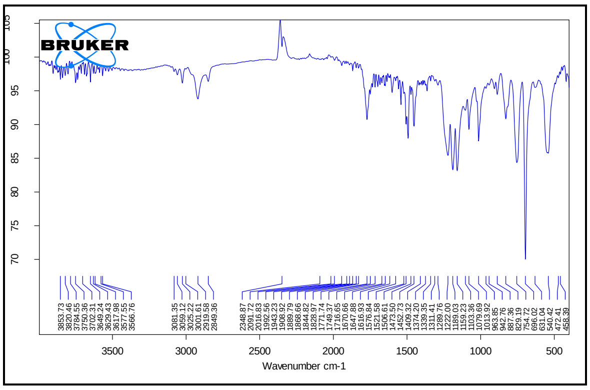

Figure 14-FTIR for pure Blend film

Figure-15 shows FTIR spectra of blend +12ml C. New peaks appeared for the blend with (12) ml volume of Coumarin dye compared with the pure blend, as shown in the Table-2, with a peak at 623.25 cm^{-1} referring to =C-H out of plane bending. The CH_2 bending was located at 1363.47 cm^{-1}, whereas the C=C stretching was at peaks 1452.07 cm^{-1} and 1491.85 cm^{-1}. Moreover, a peck at 1600.99 cm^{-1} referred to alkenes C=C stretching, which agrees with previous results [10, 22].

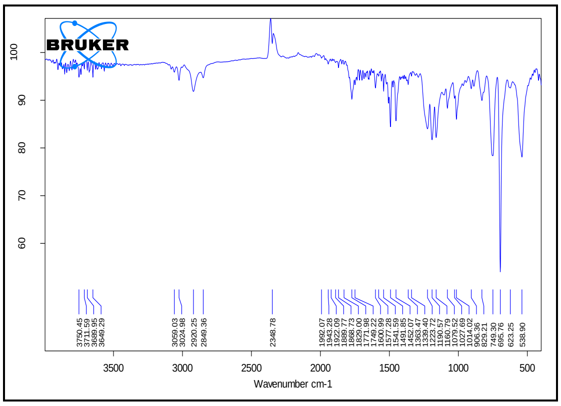

Figure 15- FTIR for Blend + 12 C film

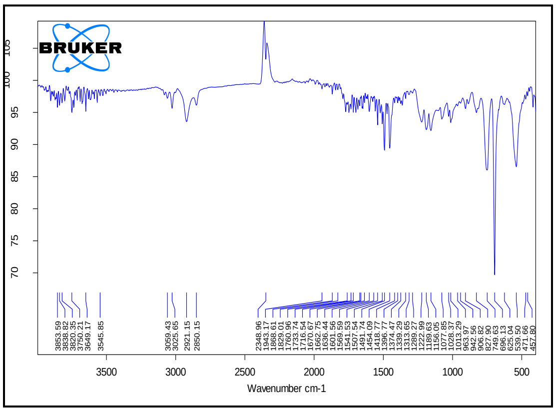

Figure 16-FTIR for Blend + 24 C film

The FTIR spectra of Blend+24ml C are illustrated in Fig.(16), with the peaks at 625.04 cm^{-1}, 749.63 cm^{-1}, 827.90 cm^{-1}, and 906.82 cm^{-1} referring to the C-H out phase bend. The bond C-O stretch was located at 1077.85 cm^{-1}, 1156.05 cm^{-1}, and 1454.09 cm^{-1} , whereas peaks at 1491.74 cm^{-1} and 1541.53 cm^{-1} indicated the C=C stretching. The peaks at 2921.15 cm^{-1} refer to the aliphatic C-H stretch. These results are consistent with those from an earlier work [10].

Figure-17 demonstrates the FTIR spectra of blend +36ml C. The peaks at 624.33 cm $^{-1}$ and 749.24 cm^{-1} refer to the =C-H out plane bending, whereas the C-O stretch bond was shown at 1161.70 cm^{-1}, 1191.67 cm^{-1}, and 1224.94 cm^{-1}. The bond C=C stretching of the aromatic range appeared only at the peak 1491.81 cm^{-1}. The peak at 1772.09 cm^{-1} refers to the C=O stretch bond. These results agree with those of previous studies [22,23].

Figure-18 represents the FTIR spectra of the blend +48ml C, with the peaks at 625.40 cm^{-1} to 905.39 cm^{-1} referring to the C-H out phase bend, while that at 1014.05 cm^{-1} corresponds to the C-H stretch bond. The bond C=C stretching appeared at 1454.85 cm^{-1} and 1541.43 cm^{-1}. These results are consistent with those from earlier works [10, 22].

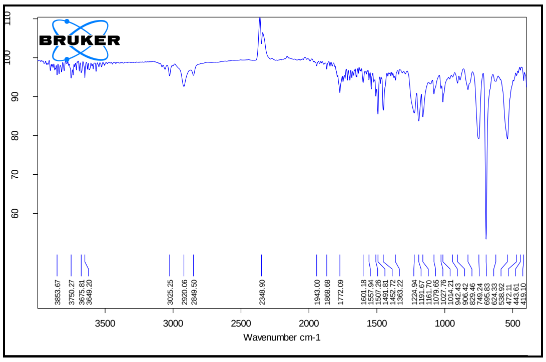

Figure 17- FTIR for Blend + 36C film

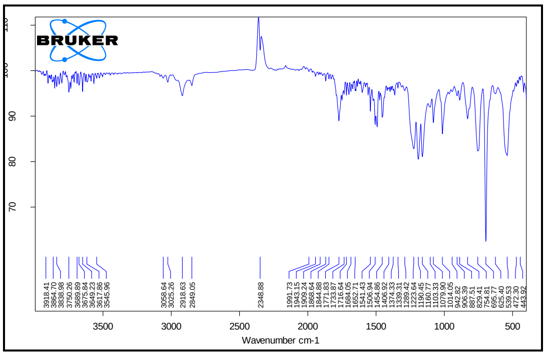

Figure 18- FTIR for blend + 48C film

*The number with yellow colors represents the appearance of new peaks with the addition of the dye compared to the pure blend

Table 2-FTIR-characteristic of pure Blend film and Coumarin dye mixture Blend films for different volume

Bond	Pure PC	Pure PS	Coumarin dye	Pure Blend	Blend+12 C	Blend+24 C	Blend+36 C	Blend+48 C
=C–H out-of-plane bending (600-1000) cm^{-1}	-	621.03 695.32 748.80 841.37 906.11	608.20 686.91 752.48 825.92 890.49 916.91 994.69	-	**623.25**	-	**624.33** **749.24** 695.83 749.24 829.46	-
C-H out phase bend (625-970)cm^{-1}	633.84 707.09 828.72 887.11		-	631.04 696.02 754.72 829.19 887.36	695.76 829.21	**625.04** **696.13** **749.63** **827.90** **906.82**	-	**625.40** **645.77** **754.81** **829.41** **887.51** **906.39**
C-O stretch (1015-1300) cm^{-1}	1080.02 1158.70 1187.31 1219.73 1290.71	1068.20	1027.77 1102.05 1174.56 1227.99 1258.72	1079.69 1159.23 1189.03 1222.00	1079.52 1160.79 1190.57 1223.72	1077.85 1156.05 1189.63 1222.99	1079.65 **1161.70** **1191.67** **1224.94**	**1014.05** 1079.90 1160.77 1190.45 1223.64
CH_2 bending (1300-1380) cm^{-1}	1364.53	-	1396.62	1374.20	**1363.47**	-	-	1374.33
C–H aliphatic (1392-1454)cm^{-1}	**1409.10**	-	-		**1452.07** **1491.85**	-	1452.72 1491.81	**1454.86** 1506.94 **1541.43**
C=C stretching (1430–1600)cm^{-1}	1503.94	1451.77 1492.49	1452.20 1486.71 1560.00	1452.73 1506.61	1491.85 1541.59	**1454.09** **1491.74** **1541.53**	1491.81	1454.86 1541.43
Alkenes C=C stretching (1600-1680)cm^{-1}	-	1600.73	1601.00 1619.04		**1600.99**	-	-	-
C=O stretch (1550-1780)cm^{-1}	1769.84	-	1698.36 1753.65	1616.93 1771.74	1771.98	-	**1772.09**	1771.83
C-H stretch Aliphatic (2800-3000)cm^{-1}	2967.68	2849.37 2920.81	-	2849.36 2919.58	2849.36 2920.25	2850.15 2921.15	2849.50 2920.06	2849.05 2918.63
C-H stretch Aromatic (3000-3200)cm^{-1}	-	3025.16 3059.50	-	-	3024.98 3059.03	3025.65	3025.25	3025.26

Conclusions

The results obtained in this work indicate that the optical properties of the polymer blend are affected by the addition of coumarin dye (12, 24.36, 48 ml).The E_g of blend-C films was decreased by (0.06 eV) compared with that of the pure blend, and continued to decline to (3.67 eV) in a volume ratio of (36ml). FTIR-characteristics of the pure blend film and Coumarin dye mixture blend films for different volume of dye solution show that; there was no apparent peak in the 1600 cm^{-1} region of polycarbonate, in the 1300cm^{-1} region of polystyrene, and in the 2000-3000cm^{-1} region of the coumarin dye. The disappearance of peaks in the region of 1300cm^{-1} for the proportions of volumes of 24 ml and 36 ml when adding coumarin dye.Also, in 24ml the disappearance of peaks clear in the region of 1600-1700cm^{-1}. Whereas, in 36 ml and 48 ml, the disappearance of peaks in the 1600 cm^{-1} region.

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