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Optical Properties of polyvinylchloride / polymethylmethacrylate blends With Polyanilin

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Abstract

The aim of the present work is concerned with the study of the optical properties of PVC/ PMMA blends with 0.02% of polyanilin at different ratio, were prepared with different concentration (%PVC, 75%PVC+25%PMMA, 25%PVC+75%PMMA, %PAMM) using Casting. Technique . The absorption spectra of PVC/PMMA blends at different concentration showed absorption changes in the wavelength range, which depends on the polymer type, and the concentration of the polymer blends. It was found that %PVC, %PMMA ratio from these polymers showed higher absorption values in comparison with the other blend. The optical energy gap(E_{opt}), real and imaginary parts of dielectric constants have been evaluated.

Keywords: Polymer blend, PVC-PMMA, Optical propertie,FTIR.

1.Introduction

A good amount of work has been reported on the study of the optical absorption spectra in solids provides essential information about the band structure and the energy gap in the crystalline and non-crystalline materials. Analysis of the absorption spectra in the lower energy part gives information about atomic vibrations while the higher energy part of the spectrum gives knowledge about the electronic states in the atom[1]. Polyvinylchloride (PVC) is one of the most important commercial polymers that have wide range of applications[2]. Polymethylmethacrylate(PMMA) is one of the best organic optical materials and has been widely used to make variety of optical devices, such as optical lenses [3].Polymethylmethacrylate (PMMA), also known as acrylic, offers glass-like properties for the production of soft and flexible elastomers, rigid thermoplastics, and thermosets. Both PVC and PMMA are rigid polymers but by blending PVC with PMMA make the resultant blend soft and open to more uses and applications [4,5]. Polymeric materials have attracted the scientific and technological researchers, because of their wide applications. In (2008) Deshmukh, et al reported the optical transmission and UV-VIS absorption spectra in wavelength of (450-1000nm) with different concentration of polyanline doped PVC-PMMA thin films The absorption coefficient (α), optical energy gap (E_{opt}), refractive index (*n*) and optical dielectric constant had been evaluated. The effects of doping percentage of polyanilne on these parameters had been discussed and nonlinear behaviors for all the parameters were investigated [6], Burghate et al [7] we studied the optical properties of PVC-PMMA polymer blends. Joshi et al [8] study the polyblend of polyvinyl chloride (PVC) and polystyrene (PS), in the weight ratio 5: 1 using 1.25g of PVC and 0.25g of PS by casting method . Polyaniline (PANI) has been used as dopant and with 0.5 %, 1.0%, 1.5%, 2.0% and 2.5 % of the total whight of the two polymers .On the basis of optical absorbance and transmittance measurements at normal incidence of light in the wavelength range 500- 1000 nm,the absorption coefficient , optical energy gap , refractive index , optical dielectric constant , constant (B) and ratio of carrier concentration to the effective mass N/m* was reported for polyaniline doped PVC-PS blend.it was found that the behavior of all the optical parameters found to be non-linear. It can be concluded that the evaluated optical parameters such as absorption coefficient, optical energy gap, optical dielectric constant, refractive index, constant B, measure of extent of band tailing (n0B)-1 were forbidden direct transition.The refractive index n calculated in the region 500 to 1000 nm was found to be non-linear. The ratio of carrier concentration to the effective mass was found to be of the order of 1021cm^{-3}.

V.Sangawar and N.Moharil [9] Study They electrical, thermal and optical band gap of polypyrrole filled PVC: PMMA thin films themoelctrets .they Prepared Polypyrrole by chemical oxidative method from pyrrole monomer using ammonium per sulfate as oxidant and p-Toluene sulphonic acid as a dopant. the samples containing the two polymers and additives the following procedure is adapted using casting method . The X-RD diffractogram reveals the amorphous nature of the films. The thermograms are plotted between logs and temperature (103/T).From the analysis of the absorption spectra the band gap of polypyrrole filled PVC: PMMA composite have been found to be lie in the range 1.8 eV to 3.3 eV. Thermal stability of polypyrrole filled PVC: PMMA was investigated by TGA/DSC. It is evident from the results that PPy filled polyblends are more stable.

2.Experimental part

2.1. Raw Material

PVC(polyvinyclorid) and PMMA (poly methyl methacrylate) was used in this study were obtained from Sigma, Aldrich (Germany) and reported to have molecular weights of 93.92605 and 996000 g/mol respectively. Tetrahydorfuran (THF) has purity 99.8% optained from (G.I.D.C) in England used as a common solvent for PVC and PMMA .

2.2 Preparation of Blends with additives

The two polymers PVC (1g) and PMMA (1g) were taken in the ratio of %PVC ,%PMMA by weight The 1 g of PVC in 10 ml of tetrahydorfuran (THF), 1g of PMMA in 10ml of THF and polyaniline (PANI) 0.2% by weight in 5ml of THF were dissolved separately. After allowing them to dissolve completely . then 0.02% of Polyanilin was mixed with the solution of (%PVC , 75%PVC+25%PMMA , 50%PVC+50%PMMA , 25%PVC+75%PMMA and %PMMA) w%.

3. Results and Discussion

3.1FTIR spectroscopy

FTIR spectra were recorded on Shimadzu-8001 Spectrophotometer using to clear structure bond of polymer blend. The films were prepared by casting the ternary solutions on glass plates. The number of scans per samples was 200 and resolution of the measurements was 4 cm^{-1}.FT-IR transmission spectra as shown in Figure (1) for PVC, PMMA, and their (50/50PVC/ PMMA) (75/25PVC/PMMA) (25/75PVC/PMMA) blends with 0.02% Polyanilin. Figure 1(a) shows the Fourier-transformed infrared (FT-IR) spectra of PVC with 0.02% of polyaniline . shows the appearance of new peaks at 3447.02,1586.67 and 1509.52cm^{-1} due to the stretching vibration of N-H, quinoid ring and benzenoid rings, respectively [11]. The intensity of the stretching bands of PVC were found to decrease in the additives PANI.The decrease in the intensity of PVC bands was due to the interaction of PVC contents with the nucleophilic imine part of polyaniline. at figure (b) Apear new peaks with low intensity 3438.84cm^{-1} due to the stretching vibration of N-H, quinoid ring. The addition of 0.02%PANI show appearance of peaks at 3438.84cm ,3153.40cm^{-1} which could be attributed as due to NH stretching mode. Figure 1(c)At add 0.02%PANI, peak position for the C=O stretching also shifts to (1726.55 cm-1),(1720.39 cm-1)and(1724.24 cm-1) respectively. Figure 1 (e)the absorption band of PMMA at 1485.19-1435.04 cm-1 which causes the slight shifting of peak towards lower wavenumber side with reduce in intensity. These changes can be assigned to formation of hydrogen bonding between these groups because of H donation in NH group. This H bonding allows compatibility between PANI and polymers containing carbonyl group such as PMMA and enhances the formation of an inter-penetrating network of PANI and the matrix chain.and shows the appearance of new peaks at 3629.78,3556.49,3436.91cm-1 could be attributed as due to NH stretching mode.

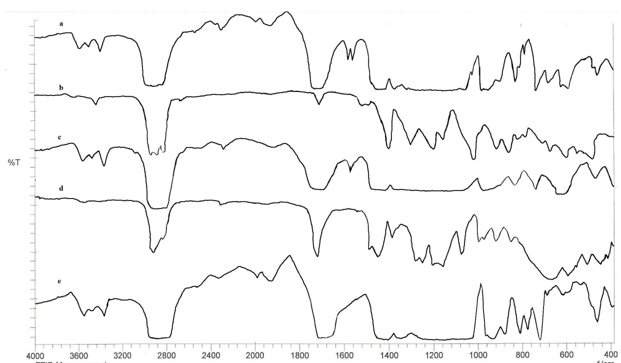

Figure (1) FTIR of PVC and PMMA with 0.02%PANI (a) % PVC(b)75%PVC+25%PMMA (c) 50%PVC+50%PMMA (d) 25%PVC+75PMMA(e)%PMMA

The variation of absorption coefficient α with the incident photon energy hυ can be expressed byequ(1) Tuuc formula [12]

$$(\alpha h\nu) = B(h\nu - Eg)^{r} \quad \ldots\ldots\ldots\ldots (1)$$

Where B is constant depending on the transition probability and r is an index that characterizes the optical absorption process and is theoretically equal to 1/2,2, 1/3 or 2/3 for indirect allowed, direct allowed, indirect forbidden and direct forbidden transition, respectively [13].The usual method to calculate the optical band gap energy is to plot a graph between $(\alpha h\nu)^{r}$ and photon energy hυ and find the value of the r=1/r which gives the best linear graph . This value of r decides the nature of the energy gap or transition involved. If an appropriate value of r is used to obtain linear plot, the

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value of E_{opt} will be given by intercept on the h υ-axis as shown in figure (2).It illustrates the energy gap values of polymer blend. optical energy gap E_{opt} of (PVC-PMMA) with PANI it was found non systematic sequence similar behavior were reported by Burghate et al [14] and D.K. Burghate et al [15]. PANI ratio causes lowering in the optical energy gap which means a rising in conductivity[16].

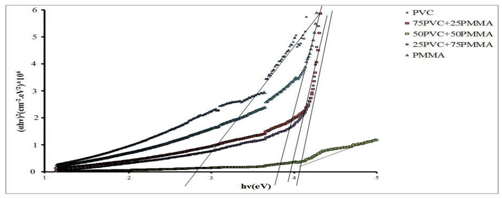


Figure 2: The relationship between $(\alpha h\upsilon)^2 (cm^{-1}.eV)^2$ and photon energy of PVC and PMMA with 0.02% PANI

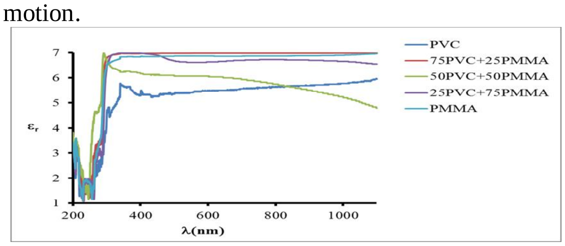
Dielectric constant is defined as the response of the material toward the incident electromagnetic field. The dielectric constant of compound (ε) is divided into two parts real(ε_r), and imaginary (ε_i).The real and imaginary parts of dielectric constant ($\varepsilon_r$and ε_i) can be calculated by using equations[17] The dielectric constant ε, can be considered to be real and defined as:-

$\varepsilon_r = n^2 - k^2$ **………………(2)**

one can also defined the dielectric constant to be complex:-

$\varepsilon_i = 2nK$ **……………….(3)**

Figure (3) and figure(4) Shows (ε_r) and (ε_i) values dependence of wavelength . The real part (ε_r) and imaginary part (ε_i) of dielectric constant calculated from the optical parameters (n and k) using Maxwell equations(2,3) . the real and imaginary parts dielectric constant for pure and doped PMMA the real part of it associated with the term that how much it will slow down the speed of light in the material and imaginary part gives that how a dielectric absorb energy from electric field due to dipole motion.



Figuer (3) Variation of the real part of the dielectric constant as a function of wavelength of PVC and PMMA blends with 0.02% PANI .

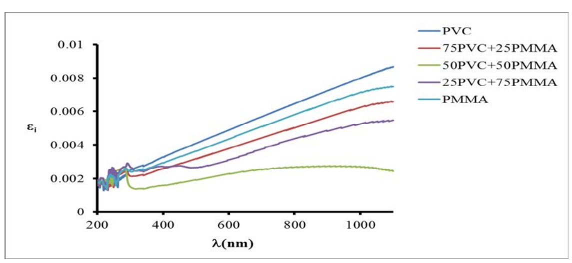


Figure (4) Variation of the imaginary part of the dielectric constant as a function of wavelength of PVC and PMMA blends with 0.02% PANI.

Table (1): Represents the parameters of optical properties of PVC/PMMA blends Involved at same wave length 550nm

Blends with Pani	Eg(ev)	ε_r	ε_i
%PVC	2.8	5.41	0.0045
75%PVC+25%PMMA	4	6.98	0.0034
50%PVC+50%PMMA	4.3	6.06	0.0021
25%PVC+75%PMMA	4.1	6.61	0.0028
%PMMA	3.8	6.87	0.0039

4. Conclusion:

1- The optical results showed that there were no chemical changes in the blend structures by FTIR analysis .
2- The optical energy gap (E_{opt}) which indicates a transition of direct type.
3- %PVC, %PMMA blend showed the best optical properties.

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My name is rouaramadan received the B.S.degrees in physics science from university of Baghdad in 2011.At present student of M.SC. in the same science and university.I have this paper and I hope to puplish it in your journal. Greetings to all.