Indonesian Journal of Electrical Engineering and Informatics (IJEEI)
Vol.1, No.1, March 2013, pp. 8~13
ISSN: 2089-3272

Preparation and Characterization of PMMA-Berry Paper or Plan Leaves Composites

Farhan Lafta Rashid*[1], Ahmed Hashim[2], Fadhil Saeed Hasan[3], Saba R. Salman[4], Hind Ahmed[5]
[1,3]Ministry of Science and Technology, Iraq
[2,4,5]Babylon University, Iraq
Corresponding author, e-mail: engfarhan71@gmail.com, ahmed_taay@yahoo.com

Abstract

In this paper, study the effect of addition the Berry Paper or Plan Leaves on optical properties of PMMA. The samples have been prepared by casting technique and different thickness. The absorption and transmission spectra have been recorded in the wavelength range (200 – 800) nm. The experimental results show that the absorption coefficient, energy gap of the indirect allowed and forbidden transition, extinction coefficient, read and imaginary dielectric constant and refractive index are changing with increase the of Berry Paper or Plan Leaves concentration.

Keywords: *polymer, optical properties, complexes, berry paper, plan leaves*

1. Introduction

In recent years, polymers with different optical properties have been attracted much attentions due to their applications in the sensors, light-emitting diodes, and others. The optical properties of these materials can be easily tuned by controlling contents of the different concentrations. Though a great deal of excellent work has been reported on such materials, it is still meaningful to extend the research of these polymers [1]. There has been increasing concern about land filling non-degradable materials such as plastics. The main reasons for the continue increase in the demand of the commodity plastics are as follows:

- Plastics are low density solids, which makes it possible to produce lightweight objects.
- Plastics have low thermal and electric conductivities, since they are widely used for insulation purposes
- Plastics are easily moulded into desired shapes
- Plastics usually exhibit high corrosion resistance and low degradation rates and are highly durable materials
- Plastics are low cost materials

All these advantages make the plastic materials to be used in almost all fields of the every day life. The great majority of the plastic materials are derived from petroleum, which is a finite source (the most optimistic evaluations are foreseeing that the depletion of petroleum reserves will happen in about 50 years from now on [2]. PMMA is one of the earliest and best known polymers. PMMA was seen as a replacement for glass in a variety of applications and is currently used extensively in glazing applications. The material is one of the hardest polymers, and is rigid, glass-clear with glossy finish and good weather resistance. PMMA is naturally transparent and colorless. The transmission for visible light is very high. Polymeric composites of PMMA are known for their importance in technical applications [3].

2. Materials and Methods

PMMA as a matrix and Berry Paper or Plan Leaves as a filler. The electronic balanced of accuracy 10^{-4} have been used to obtained a weight amount of polymer and complex. The samples were prepared using casting technique thickness ranged between (205-655) µm. The transmission and absorption spectra of composites have been recording in the wave length range (200-800) nm by using double–beam spectrophotometer (UV- 210Ashimedza). The absorption coefficient (α) is calculated by using the following equation [4]:

Received December 23, 2012; Revised February 26, 2013; Accepted March 12, 2013

$$\alpha = 2.303A/t \quad (1)$$

Where A is absorption and t is the thickness of film.

The refractive index is calculated by using the following formula:

$$n= [4R/(R-1)^2- (R+1/R-1)]^{1/2} \quad (2)$$

The extinction coefficient is obtained by the relation:

$$K= \alpha\lambda/4\pi \quad (3)$$

Real and imaginary dielectric constant is calculated from the equations:

$$\varepsilon_1= n^2- k^2 \quad (4)$$

$$\varepsilon_2= 2nk \quad (5)$$

3. Results and Discussions
3.1. The Absorbance

Figures (1-a, b) show the relationship between the absorption and the wavelength. The value of absorption is exponentially decreased, by comparing the four curves in the high absorption region i.e.(in the UV region the absorbance is increased by increasing the ratio of nickel nitrate, while in the visible region the absorbance decreased to the minimum value and be stable at the longest wavelengths. The absorbance is higher in the case of high concentration because high absorbance of fillers (Berry Paper or Plan Leaves) [5].

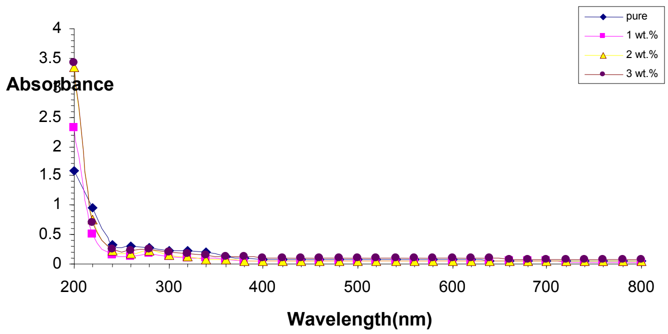

Figure.1-a
The variation of optical absorbance for (PMMA-Berry paper mulberry) composite with wavelength

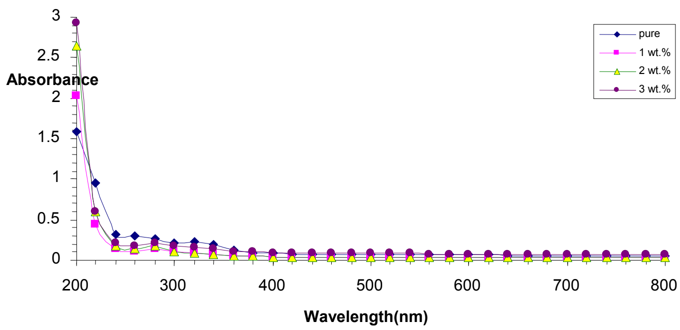

Figure1-b
The variation of optical absorbance for (PMMA-Plan leaves) composite with wavelength

3.2. The Absorption Coefficient

The absorbance depends on the type and the nature of the chemical and crystalline of the composite and the type of the impurities which is found in the structure. Variation of the absorption coefficient with the variation of the concentration of the added material and will be with constant values as shown in Figure (2-a, b).

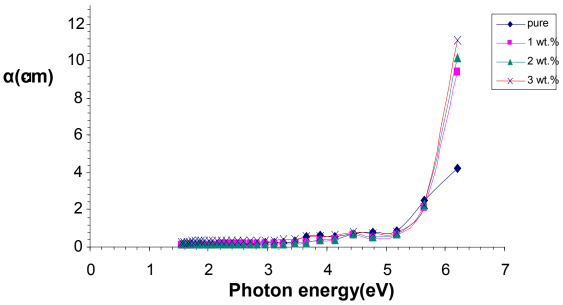

Figure 2-a. The Absorption coefficient for (PMMA-Berry paper mulberry) composite various photon energy

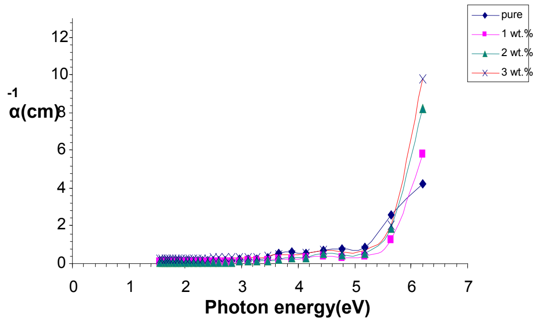

Figure 2-b. The Absorption Coefficient for (PMMA-Plan leaves) composite with various photon energy

When the material is pure, a few concentrations and the absorption coefficient will increase by increasing the photon energy (more than 5 ev). The high values refer to probability of occurring the indirect electronic transition.

3.2.1. Direct and Indirect Transitions

To be sure that the composite has a direct allowed transition we use different values of the power. From the Figure (3-a, b and 4-a, b) there is a variation in the energy gap values due to the mechanism of preparation, where the energy gap and its type depends on the crystal structure of the material and atoms distribution in the crystal lattice and the concentration of the energy levels, this means the variation of the structural properties and other parameters [6].

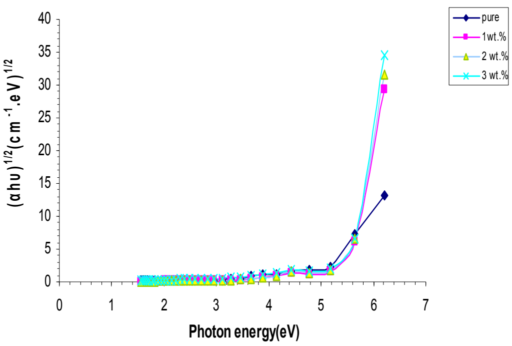

FIG.3-a

The relationship between $(\alpha h\upsilon)^{1/2}(cm\text{-}1.eV)^{1/2}$ and photon energy of (PMMA-Berry paper mulberry) composites.

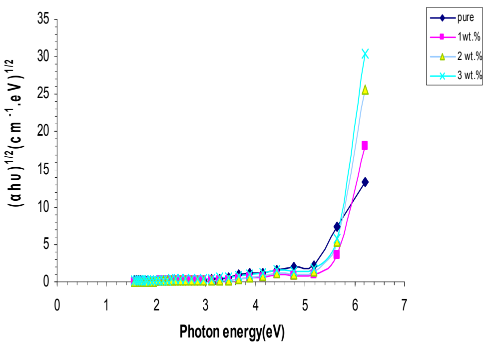

FIG.3-b

The relationship between $(\alpha h\upsilon)^{1/2}(cm\text{-}1.eV)^{1/2}$ and photon energy of (PMMA-Plan leaves) composites.

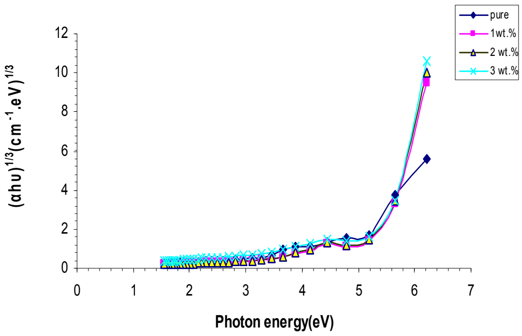

FIG.4-a
the relationship between $(\alpha h\upsilon)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of (PMMA-Berry paper mulberry) composites.

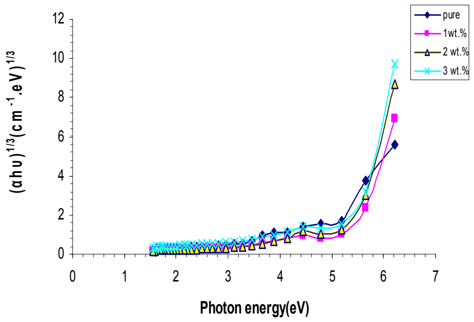

FIG.4-b
the relationship between $(\alpha h\upsilon)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of (PMMA-Plan leaves) composites.

3.3. Extinction Coefficient

It refers to the amount of the attenuation which occurs in the electromagnetic wave when it passes through any medium. In the Figure (5-a, b) the extinction value is high in the region of high energies as a result to high absorption and this is affected by the structural formation of the composite the deviation increased at the increasing point of the chemical equilibrium the minor increasing occur in the lowest energies.

The extinction coefficient represent the imaginary part of the refractive index it is the loss of the energy due to the interaction between the light with the charges of the medium [7].

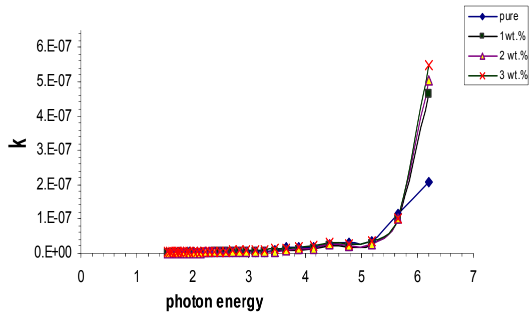

FIG.5-a
The extinction coefficient for (PMMA-Berry paper mulberry) composite with various photon energy

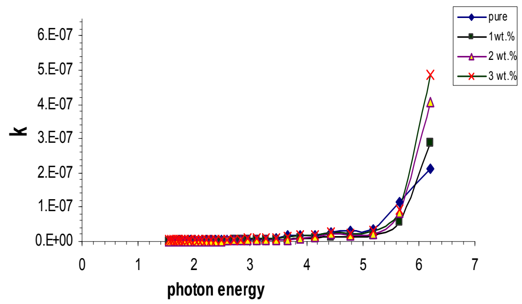

FIG.5-b
The extinction coefficient for (PMMA-Plan leaves) composite with various photon energy

3.4. The Refractive Index

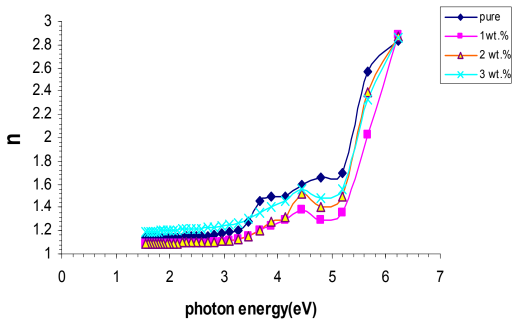

FIG.6-a
The relationship between refractive index for (PMMA-Berry paper mulberry) composite with photon energy

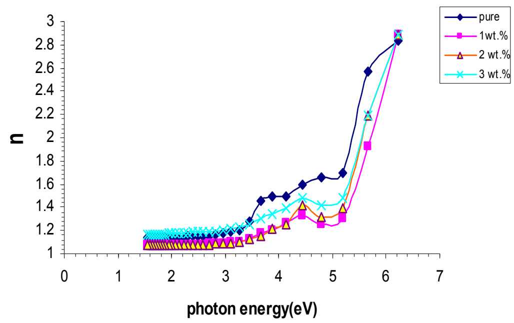

FIG.6-b
The relationship between refractive index for (PMMA-Plan leaves) composite with photon energy

It is the function of the spectral reflectivity, so that the results of the refractive index will be affected by the spectral reflectivity and its variation with the wave lengths. From Figure (6-a, b) the refractive index increased with the deviation from the chemical equilibrium also the refractive index is increasing with the increase different concentrations of Berry Paper or Plan Leaves, this because of increase of the density of composite.

3.5. Dielectric Constant

In the Figure (7-a, b) and (8-a, b) the real and the imaginary parts of the dielectric constant can be calculated from the refractive index and the extinction coefficient, so the real and the imaginary parts of the dielectric constant show a behavior similar to that of refractive index and extinction coefficient. In the real part at the low energy region the curves still nearly constant, while it increases rapidly at the high region. For the imaginary part the behavior is differ may be because the polarization is the main parameter.

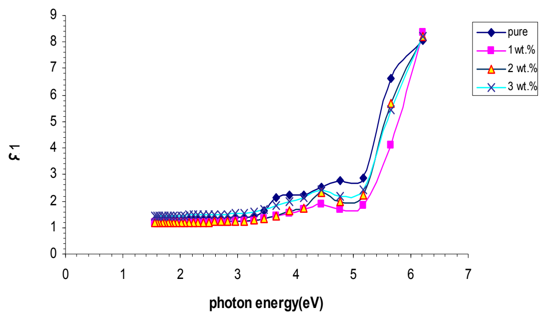

FIG.7-a
The variation of real part of dielectric constant of (PMMA-Berry paper mulberry) composite with photon energy

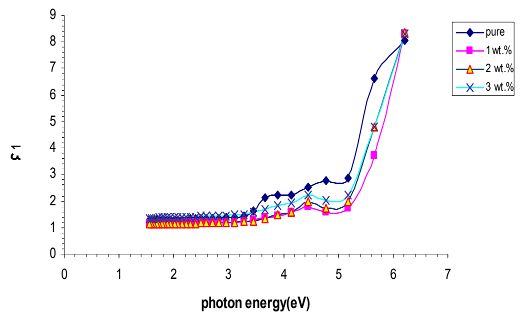

FIG.7-b
The variation of real part of dielectric constant (PMMA-Plan leaves) composite with photon energy

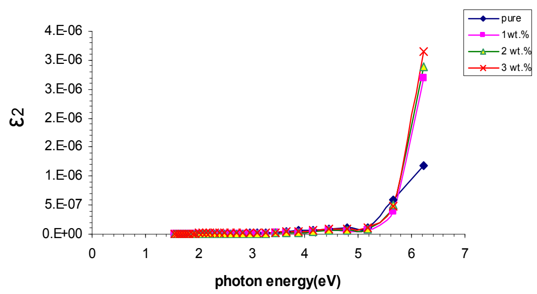

FIG.8-a
The variation of imaginary part of dielectric constant of (PMMA-Berry paper mulberry) composite with photon energy

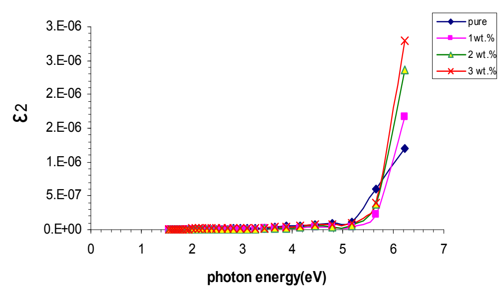

FIG.8-b
The variation of imaginary part of dielectric constant(PMMA-Plan leaves) composite with photon energy

4. Conclusion

From this study, the addition of Berry Paper or Plan Leaves to PMMA lead to increase the absorbance, on the other hand, absorption coefficient, extinction coefficient, real and imaginary dielectric constant and refractive index increase by increasing of Berry Paper or Plan Leaves concentration for all samples.

References

[1] Tariq J Alwan. Refractive Index Dispersion and Optical Properties of Dye Doped Polystyrene Films. *Malaysian Polymer Journal*. 2010; 5(2): 204-213.

[2] IR Salagean, MC Pascariu, G Bandur, LM Rusnac. Thermal Properties of Copolymers Based on Sugar, *Journal of Chem. Bull.,* 2009; 54(68): 100-103.

[3] Adnan KURT. Influence of AlCl3 on the optical properties of new synthesized 3-armed poly(methyl methacrylate) films. *Turk Journal Chem.* 2010; 67-79.
[4] J Tauce. Statesint the Gap. *Journal of Non–Crystalline Solids*. 1972; 565-569.
[5] Ahmad AH, Awatif AM, Zeid Abdul-Majied N. *Journal of Eng. & Technology.* 2007; 25(4): 558-568.
[6] Gabriel Pinto, Abdel-Karim Maaroufi. Critical filler concentration for electro conductive polymer composites. *Society of Plastics Engineers (SPE)*. 2011; 10.1002/spepro.003521.
[7] Karol Bula1, Teofil Jesionowski, Sławomir Borysiak. Proceedings of the Conference of Multiphase Polymers and Polymer Composites: From Nan scale to Macro Composites. Paris-Est, Creteil University. France. 2011.