

## Preparation of (Pomegranate Peel-Polystyrene) Composites and Study Their Optical Properties

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**Abstract:** In this research, samples of pure polystyrene and Polystyrene (PS) doped with (pomegranate peel) were prepared using casting method. The effect of addition of Pomegranate Peel (PP) concentration on optical properties of poly styrene have been studied in the wavelength range 200-800 nm. The absorption coefficient, energy gap, refractive index and extinction coefficient have been determined. The results show that the optical constants change with increase of PP concentration.

**Key words:** Polymer, polystyrene, pomegranate peel, optical properties, absorbance

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### INTRODUCTION

Optical polymers have attracted considerable attention in recent years because of their important industrial applications. The study of phase separation in thin films of binary mixtures is commercially important for the effective production of various coatings and films including dielectric layers, photographic materials and paint systems. While film of polymer blends often exhibit more desirable characteristics than individual homo polymers, most blend components are also highly incompatible with each other and will demix and phase-separate. The degree of separation in blends will greatly affect the resulting morphology which can have adverse affects on the properties of the resulting film (Ade *et al.*, 1992; Ade and Hsiao, 1993; Ade, 1997). One method often used to improve properties of a specific conductive polymer is to prepare composites using selective inorganic oxides such as SiO<sub>2</sub>, TiO<sub>2</sub> and zeolite (Stejskal *et al.*, 1996; Hebestreit *et al.*, 2003; Ballav and Biswas, 2006). Some other useful methods are the preparation of blends, composites or copolymers of poly thiophene using insulating polymers as processing aid (Monedero *et al.*, 1999; Jaczewska *et al.*, 2007, 2008; Kanemoto *et al.*, 2005; Masegosa *et al.*, 2002; Sari *et al.*, 2003; Ozgun *et al.*, 2009). Ideally, such composites would possess a combination of the outstanding process ability and thermal stability characteristic of the insulating polymers and the electrical conductivity and optical properties of the conducting polymers, resulting in an interesting advanced material. Among insulating polymers, Polystyrene (PS) and Poly Methyl Methacrylate (PMMA) show good and mechanical properties. PS and PMMA are chemically

stable thermoplastics that are designed for applications requiring optical transparency and outstanding mechanical behavior as well as good process ability. The objective of this study was to help in understanding the effect of different concentrations of (PP) on the optical Properties of (PS).

### MATERIALS AND METHODS

The Polymer (PS) was dissolved in chloroform by using magnetic stirrer in mixing process to get homogeneous solution. The weight percentages of PP are (2, 4 and 6 wt%) were added and mixed for 10 min to get more homogenous solution after which solution was transferred to clean glass Petri dish of (5.5 cm) in diameter placed on plate form. The dried film was then removed easily by using tweezers clamp. The polymer systems were evaluated spectra photo metrically by using UV/160/Shimadzu spectrophotometer.

### RESULTS AND DISCUSSION

**The absorbance of composites:** The relationship between absorbance of PS-PP composite with wave length from the Fig. 1, it was appeared that the absorbance tends to decrease with the wavelength increasing.

Figure 2 shows the optical absorption spectrum of composite for different impurities quantities it was found that the composite have a low absorption coefficient at a small photon energy then increase at different rates dependence on the composite structure. The pure sample had low absorption coefficient this may be as a result of low crystallinity.

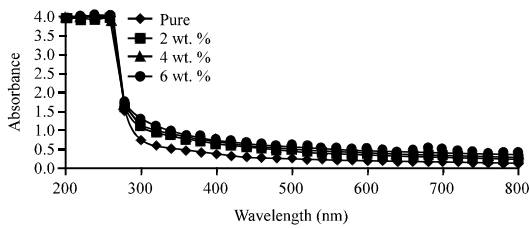


Fig. 1: The relationship between absorbance and the wave length of PS-PP

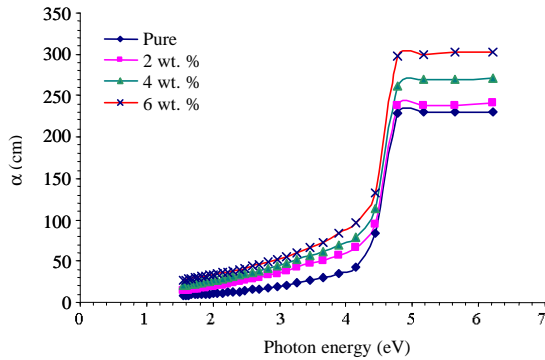


Fig. 2: The absorption coefficient of PS-PP composite with photon energy

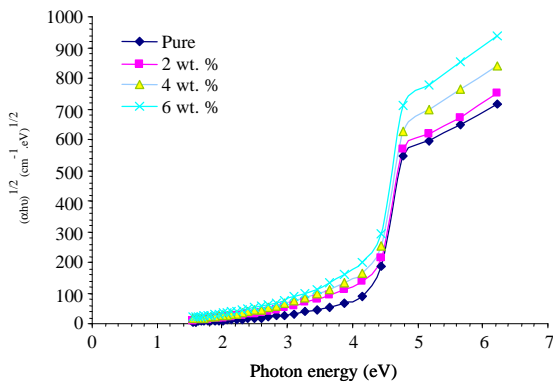


Fig. 3: Relationship between  $(\alpha h\nu)^{1/2} (\text{cm}^{-1}.\text{eV})^{1/2}$  and photon energy of PS-PP composites

Figure 3 and 4 represented the direct transition, the energy gap values dependence in general on the crystal structure of the composites and on the 6 arrangement and distribution way of atoms in the crystal lattice.

**Refractive index and extinction coefficient:** Figure 5 shows the variation of refractive index ( $n$ ) with of the composite with a given photon energy the values increase exponentially with increasing photon energy. This increase indicates that the electromagnetic radiation passing through the material is faster in the low photon energy.

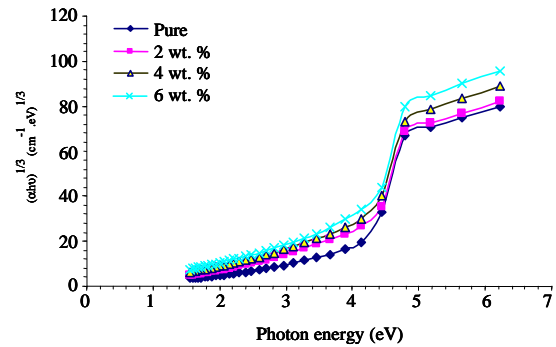


Fig. 4: The relationship between  $(\alpha h\nu)^{1/3} (\text{cm}^{-1}.\text{eV})^{1/3}$  and photon energy of PS-PP composites

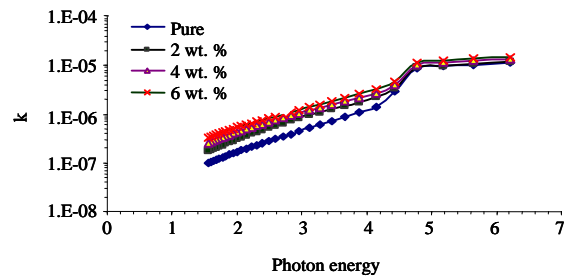


Fig. 5: The extinction coefficient of PS-PP composite with various photon energy

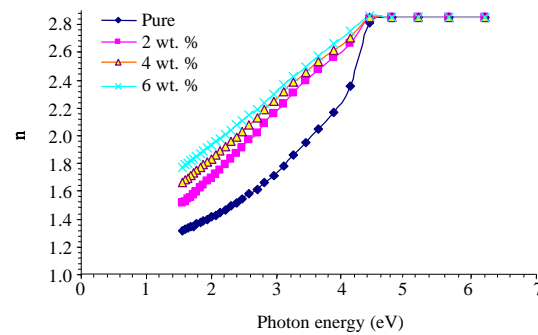


Fig. 6: The relationship between refractive index for (PS-PP) composite with photon energy

Figure 6 represent the variation of the extinction coefficient ( $k$ ) with the incident photon energy in this figure the variation is simple in the low energy region while the variation increased in the high photon energy region this behavior may be as a result to the variation of the absorption coefficient which leads to spectral deviation in the location of the charge polarization at the attenuation coefficient due to the loses in the energy of the electron transition between the energy bands.

**Dielectric constant:** Figure 7 and 8 represent the real and imaginary parts of the dielectric constant, respectively in the real part the variation is very clear spatially in the high

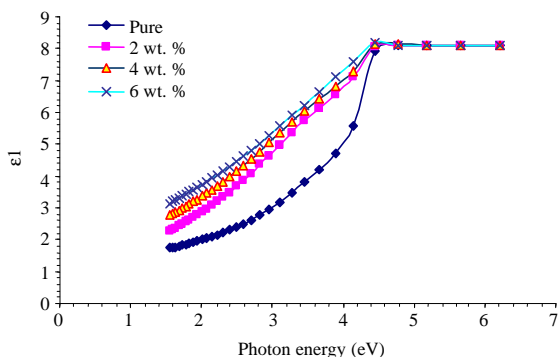


Fig. 7: The variation of real part of dielectric constant PS-PP with photon energy

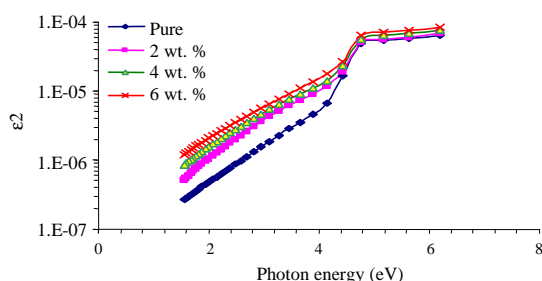


Fig. 8: The variation of imaginary part of dielectric constant of PS-PP composite with photon energy

impurities concentration this may be due to the no resonance between the frequencies of the incident photon energy (electromagnetic and the induced dipoles in the composite) while in the imaginary part there is an absorption to the energy of the incident photon energy, so the variation nearly constant until it reaches to the high photon energy. The pure composite shows the smaller variation.

### CONCLUSION

- The absorbance is very large in the uv region. The absorption coefficient is smaller and stable in the low photon energy
- The absorption and ( $k$ ) will increase as a result of the scattering centers in the composites. The values of the refractive index ( $n$ ) of the composites increase exponentially with increasing photon energy
- The real and imaginary dielectric constant shows the exponential increase with increasing the incident photon energy

### REFERENCES

Ade, H. and B. Hsiao, 1993. X-ray linear dichroism microscopy. *Science*, 262: 1427-1429.

Ade, H., 1997. Compositional and orientational characterization of polymeric materials with X- ray microscopy. *Trends Polym. Sci.*, 5: 58-66.

Ade, H., X. Zhang, S. Cameron, C. Costello, J. Kirz and S. Williams, 1992. Chemical contrast in X-ray microscopy and spatially resolved XANES spectroscopy of organic specimens. *Science*, 258: 972-975.

Ballav, N. and M. Biswas, 2006. A conductive composite of polythiophene with 13X-zeolite. *Mater. Sci. Eng.*, 129: 270-272.

Hebestreit, N., J. Hofmann, U. Rammelt and W. Plieth, 2003. Physical and electrochemical characterization of nano composites formed from polythiophene and titanium-dioxide. *Electrochimica Acta*, 48: 1779-1788.

Jaczewska, J., A. Budkowski, A. Bernasik, E. Moons and J. Rysz, 2008. Polymer vs solvent diagram of  $\pi$ m structures formed in spin-cast poly(3-alkylthiophene) blends. *Macromolecules*, 41: 4802-4810.

Jaczewska, J., A. Budkowski, A. Bernasik, I. Raptis and J. Raczkowska *et al.*, 2007. Humidity and solvent effects in spin-coated polythiophene-polystyrene blends. *J. Applied Polym. Sci.*, 105: 67-79.

Kanemoto, K., K. Shishido, M. Sudo, I. Akai, H. Hashimoto and T. Karasawa, 2005. Concentration-dependence of photoluminescence properties in polythiophene diluted in an inactive polymer matrix. *Chem. Phys. Lett.*, 402: 549-553.

Masegosa, R.M., D. Nava, S. Garcia, M.G. Prolongo and C. Salom, 2002. Thermal behaviour of unsaturated polyester resins + poly(3-octylthiophene) blends. *Thermochimica Acta*, 385: 85-94.

Monedero, M.A., G.S. Luengo, S. Moreno, F. Ortega, R.G. Rubio, M.G. Prolongo and R.M. Masegosa, 1999. Calorimetric and dielectric study of a blend containing a conductive polymer: Poly(3-octylthiophene) plus poly(ethylene-co-vinylacetate). *Polymer*, 40: 5833-5842.

Ozgun, A., B. Sari, A. Uygun, H.I. Unal and C. Cakanyildirim, 2009. Conducting composites and blends of polythiophene and poly oxymethy lene. *Int. J. Polym. Anal. Charact.*, 14: 469-480.

Sari, B., M. Talu, F. Yildirim and E.K. Balci, 2003. Synthesis and characterization of olyurethane/poly thiophene conducting copolymer by electrochemical method. *Applied Surf. Sci.*, 205: 27-38.

Stejskal, J., P. Kratochvil, S.P. Armes, S.F. Lascelles and A. Riede *et al.*, 1996. Polyaniline dispersions. 6. Stabilization by colloidal silica particles. *Macromolecules*, 29: 6814-6819.