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Optical Properties of Polyvinyl alcohol-Diammonium phosphate Composite

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Abstract : In this work, samples of polyvinyl alcohol (PVA)-Diammoniumphosphate (DAP)) composites were prepared by using casting method. The effects of addition of (DAP) concentration on the optical properties of (PVA-DAP) composite have been studied in the wavelength range (200-800) nm. The absorption spectra, transmittance spectra absorption coefficient, energy gap, refractive index ,optical conductivity and extinction coefficient have been determined. The results show that the optical constants change with the increase of DAP concentrations.
Key word :composites ,optical properties , DAP,energy gap, absorption.

Introduction

Polymer composites are widely used in many applications due to excellent properties such as high hardness, good wear resistance ,non- corrosive, high melting point, high thermal conductivity, good chemical stability, low cost.[1,2]doping polymers with metals, oxides, nanoparticles, inorganic salt, and other materials improves and reach an optimum balance of its properties[3,4]

PVA one of the popular polymers which is mainly composed of C-C pounded, water soluble, biocompatibility, high hydrophobicity, process ability ,good chemical resistance, semi crystalline polymer has very important role of OH group and hydrogen bond[5]. it used in many applications extensively in semiconductor applications, usually different additives are added to polymer in order to improved its properties, this filler can modify optical absorption and electric conduction and this good for photoelectric materials[6,7].

In this study investigation of the effect of doping different concentrations of Diammonium hydrogen phosphate (DAP) $(NH_4)_2HPO_4$ on PVA polymer thin films, and study optical properties[8].

Experimental

Composite films were prepared in this study by using solution casting technique ,PVA was dissolved in double distilled water by using magnetic stirrer then DAP was added with ratio are (5,10,15,20)wt% and mixed until get homogeneous solutions. Absorption and transmission spectra were record for wavelength (200-800)nm.

Result and discussion

A (UV-210^0 A shimedza) double beam spectrophotometer with wavelength range (200-800) nm was used to measure the absorption spectra of the samples, fig.(1) shows the optical absorbance against the wavelength of the light incident for (PVA_DAP) composites.

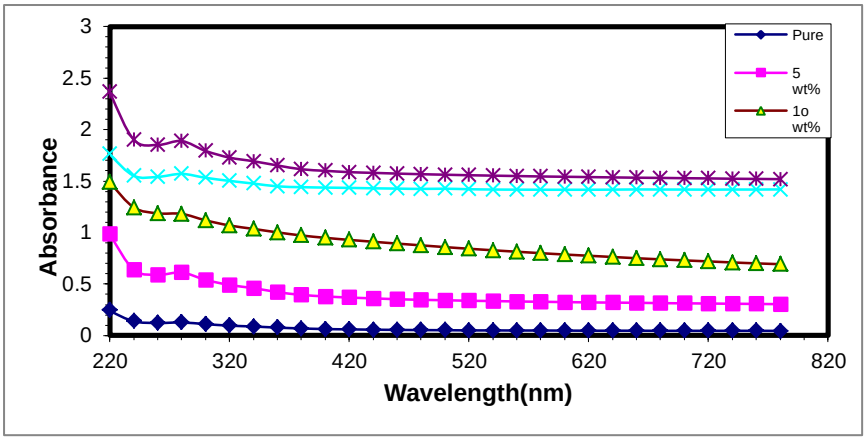


Fig.(1) :Absorption spectra for PVA-DAP composite.

The figure shows that the absorbance increases with increase of DAP concentration and this attributed to high absorbance of DAP. absorbance spectrum shows increase in absorption at wavelength near to the absorption edge ,the energy corresponding to this region determined the band gap of the composite sample[9],the addition of DAP increased absorption edge in the range (200-230)nm of wave length.

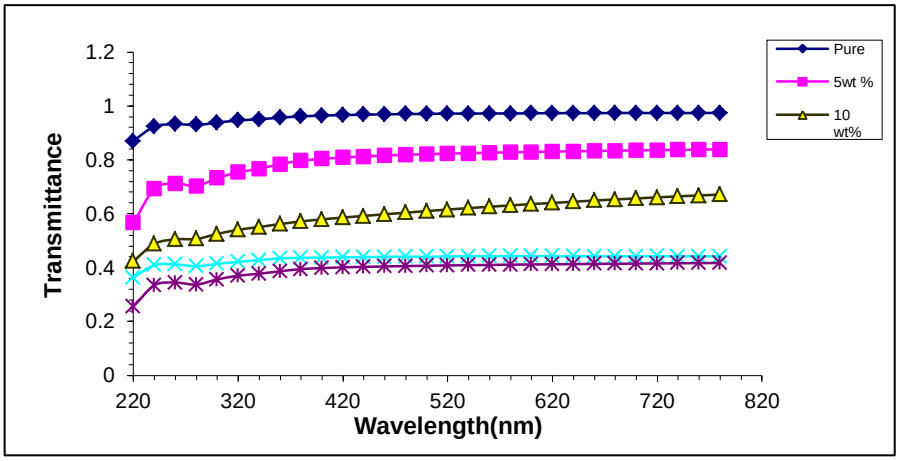


Fig. (2): Transmittance spectra for PVA –DAP composite

Fig.(2) shows transmittance spectra of the samples ,the optical transitions was increased with wave length for all samples ,the optical transmission for pure PVA was nearly 85% while it decreased with increasing DAP concentration for other samples .

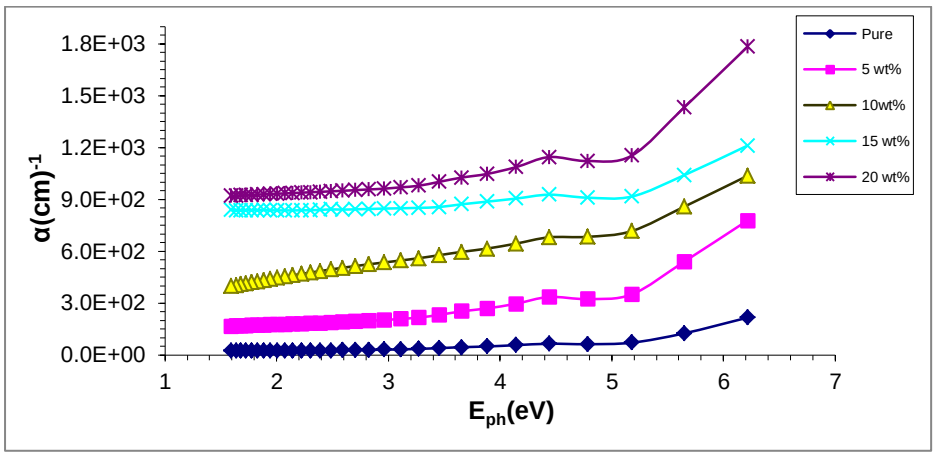


Fig.(3): Absorption coefficient for (PVA-DAP) composite

Fig (3) shows the variation of absorption coefficient for (PVA-DAP) as function photon energy, absorption coefficient can calculate from equation [10].

$\alpha = 2.303 \frac{A}{d}$

Where A is absorbance and d is the thickness of sample, the values of (α) are less than(10^4 cm^{-1}) (the fundamental of absorption coefficient can be used to determines the nature of the optical band gap E_g ,A plot of $(\alpha h\nu)^{1/2}$ versus photon energy for PVA-DAP is shown in fig. (4)

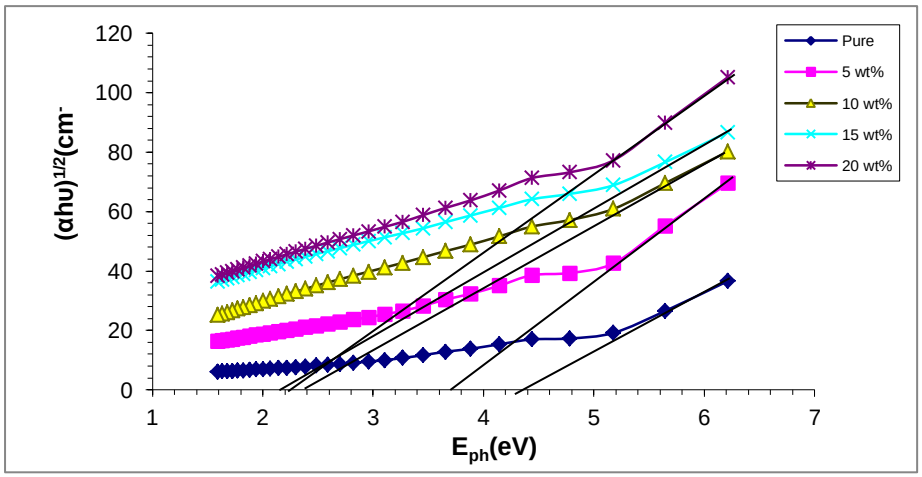


Fig (4): variation of $(\alpha h\nu)^{1/2}$ versus photon energy for PVA-DAP composite

Reflective index and extinction coefficient for (PVA-DAP) films as a function of wavelength are shown in figs (5) and (6) respectively

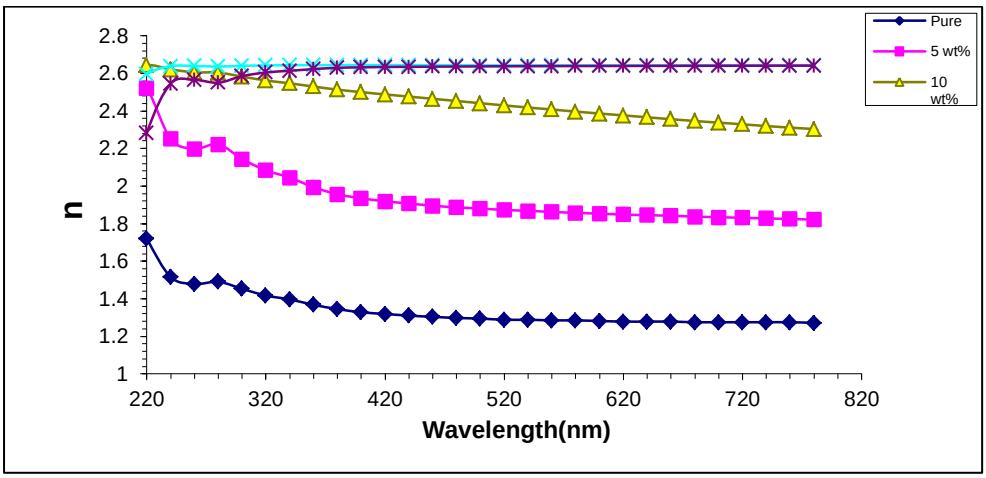


Fig (5) : reflective index versus wavelength of PVA-DAP composite

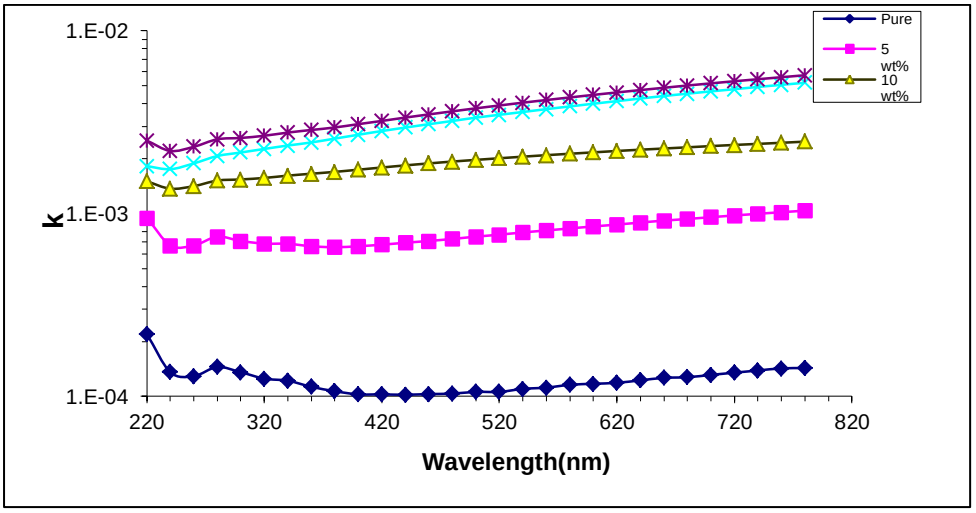


Fig (6): extinction coefficient versus wavelength of PVA-DAP composite

The reflective index for composite decreases with increasing of wavelength while, reflective index closely related to the electronic polarization of ion and local field in side materials from fig. (5) the reflective index increasing with increased of DAP concentration which is a result of increasing the number of atomic refractions due to increase linear polarizability

The extinction coefficient increases with increasing DAP concentration as shown from fig. (6)

Figures (7and8) shows the variation of real and imaginary part of dielectric constants $\varepsilon_1 = n^2 - k_2^{12}$ and $E_2 = 2nk^{13}$,ε_1 mainly depends on n^2 because of small values of k^2 ,ε_2 mainly depend on the (k) values ,dielectric constants increases with increasing DAP concentration and the parameters are almost constant at higher wavelength

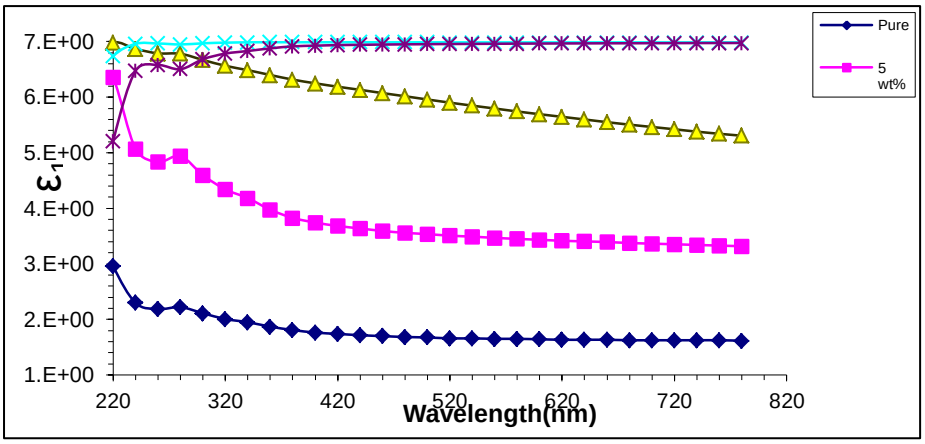
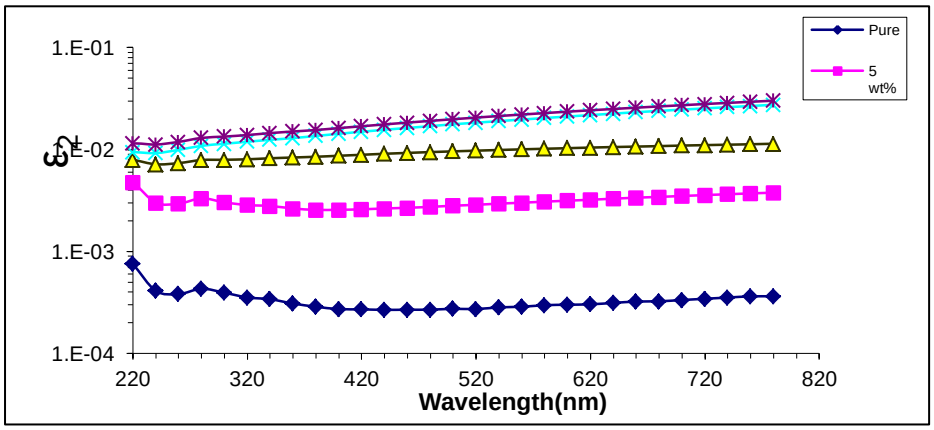


Fig.(7): variation of real part of dielectric constant (PVA-DAP) composite with photon energy



Fig(8):variation of imaginary part of dielectric constant (PVA-DAP) composite with photon energy

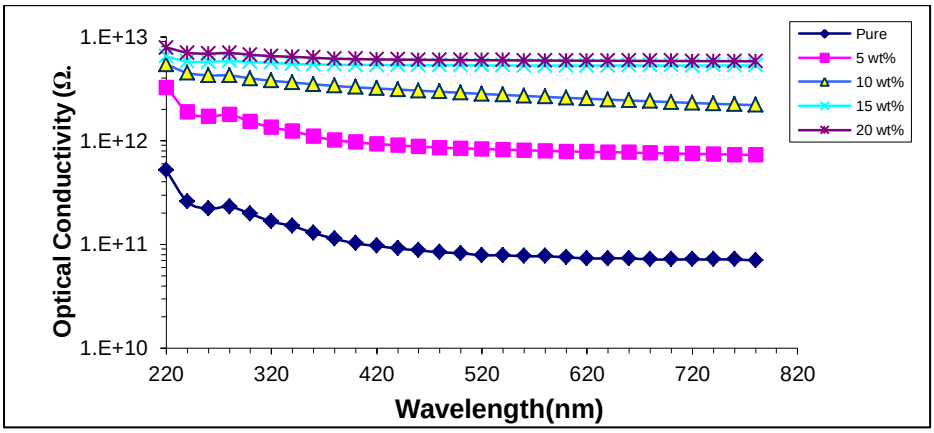


Fig (9): Optical conductivity for PVA-DAP composite

Fig. (9) shows the variation of optical conductivity of (PVA-DAP) composite optical conductivity for all samples increases with increasing of DAP concentration due to high absorbed of polymer composite films ,the increase of optical conductivity and decrease in band gap energy with increase of DAP concentration can be attributed in the increase in number of mobile charge carriers and also to the increase in amorphous nature of polymer composite.

Conclusion

PVA polymer with different concentration of DAP has been prepared using casting technique. The values of optical conductance increase with increasing DAP concentration and optical band gap decrease with increasing concentration DAP this attributed to the increase in number of mobile charge and increase amorphous nature of polymer, The optical constants such as reflective index ,extinction coefficient ,real and imaginary dielectric constants are found depend on DAP concentration in PVA films

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