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Study of Optical Properties for (Lithium Fluoride-Poly-Vinyl Alcohol) Composites

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Abstract

In this work , the optical properties of composites of poly-vinyl alcohol(PVA) and lithium fluoride were prepared by different concentrations of lithium fluoride. Results showed that the absorbance increases with increase the weight percentage of lithium fluoride, absorption coefficient, extinction coefficient, refractive index and real and imaginary parts of dielectric constants are increasing with increase the lithium fluoride content.

Keywords: Optical properties lithium fluoride, polyvinyl alcohol.

Introduction

Optical properties of polymers constitute an important aspects in study of electronic transition and the possibility of their application as optical filters, a cover in solar collection, selection surfaces and green house. The information about the electronic structure of crystalline and amorphous semiconductors has been mostly accumulated from the studies of optical properties in wide frequency range. The significance of amorphous semiconductors is in its energy gap[1]. Poly(vinyl alcohol) (PVA), as it is well known for its interesting behavior and its versatile applications. In water, there exist two possible intermolecular interactions among PVA chains or between PVA and water, as follows: (1) H-bonding between modified hydroxyl groups on PVA chains and (2) H-bonding between the —OH groups of PVA and water molecules[2].

Experimental Procedure

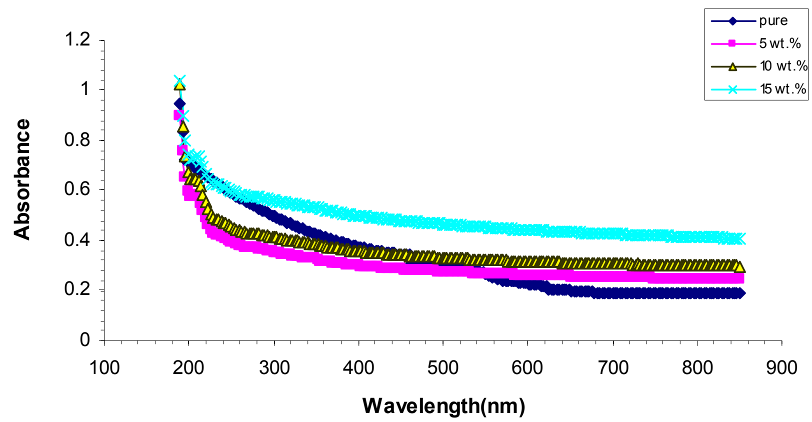
The materials used in this paper are polyvinyl alcohol and lithium fluoride. The weight percentages of lithium fluoride are (0,5,10 and 15)wt.%. The samples were prepared using casting technique thickness ranged between (210-418)μm.

The transmission and absorption spectra of PVA-LiF composites have been recording in the length range (190-850) nm using double-beam spectrophotometer (UV-210^{o}A shimedza).

Results and Discussion

The variation of absorbance with wavelength of the incident light of composites is shown in figure(1). The figure shown that no shift in the peak position while the intensity of these peak increased as a result increase the concentrations of lithium fluoride. .

Figure 1: Variation of Optical absorbance for (PVA-LiF) composite with wavelength



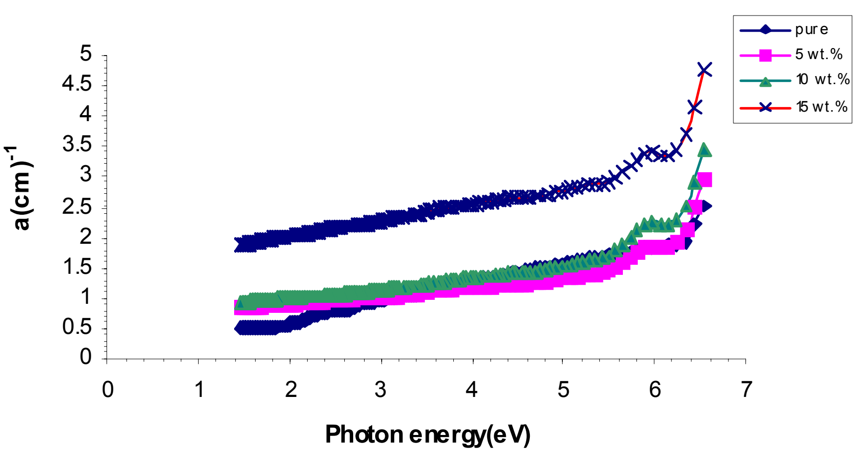
The absorption coefficient (α) was calculated from the following equation[3]:

$$\alpha = 2.303\frac{A}{d}. \quad (1)$$

Where : A is absorbance and d is the thickness of sample.

Figure (2) shows the relationship of the absorption coefficient with photon energy of different weight percentages of lithium fluoride. The figure shows that the absorption coefficient increases with increase weight percentages of lithium fluoride, this may be attributed to increase the absorbance with increasing the concentration of lithium fluoride [3] .

Figure 2: Absorption coefficient for (PVA-LiF) composite with various photon energy



The variation of absorption coefficient, α, with the incident photon energy, hν, can be written as[4] :

$$(\alpha h\nu)^n = B(h\nu - Eg) \quad (2)$$

where *B* is an constant depending on the transition probability and *n* 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. The usual method to calculate the band gap energy is to plot a graph between $(\alpha h\nu)^n$ and photon energy, hν, and find the value of the n which gives the best linear graph. This value of n decides the nature of the energy gap or transition involved. If an appropriate value of n is used to obtain linear plot, the value of *Eg* will be given by intercept on the hv-axis as shown in figure (3,4).

Figure 3: The relationship between $(\alpha hu)^{1/2}$ (cm-1.eV) $^{1/2}$ and photon energy of (PVA-LiF) composites

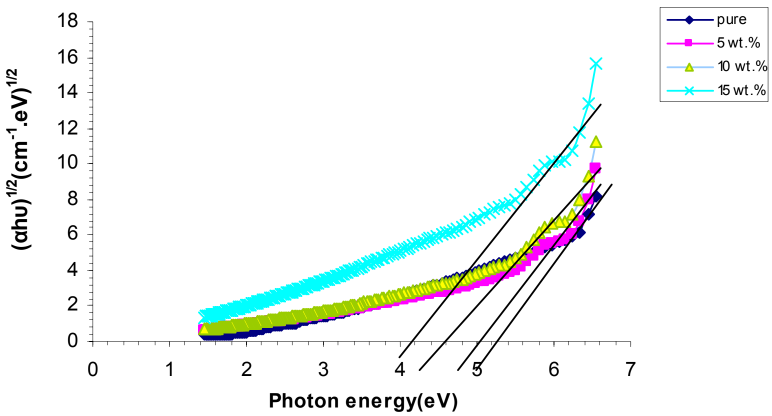
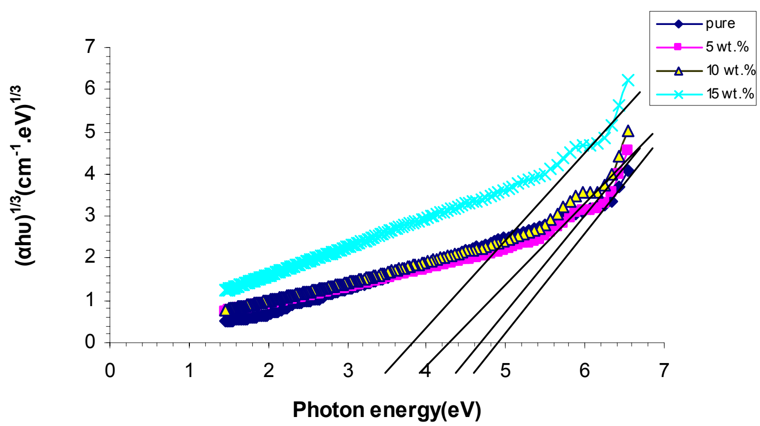
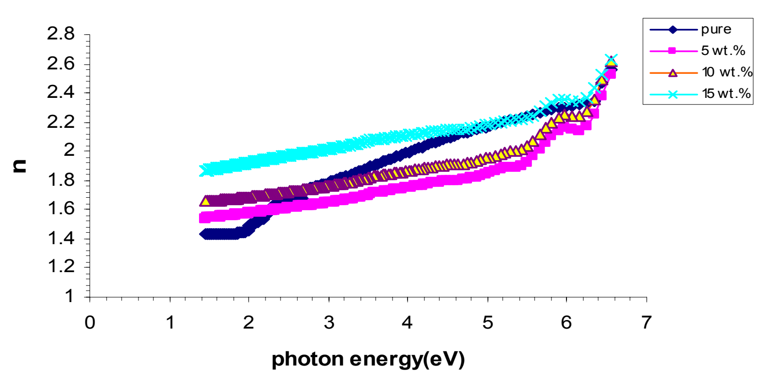


Figure 4: The relationship between $(\alpha hu)^{1/3}$ (cm-1.eV) $^{1/3}$ and photon energy of (PVA-LiF) composites



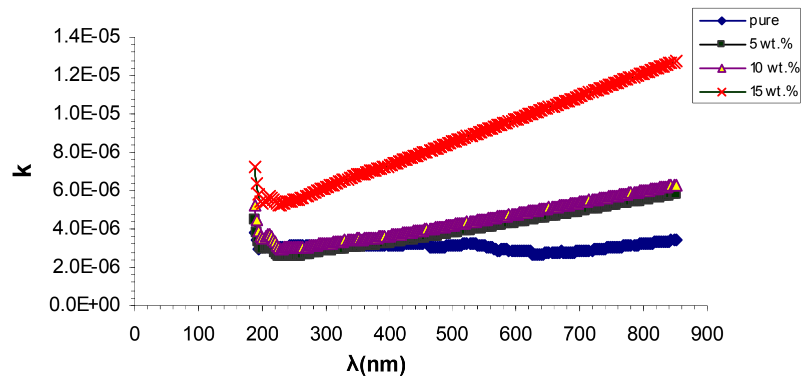
The variation of refractive index $n = \left[\frac{4R}{(R-1)^2 - k^2} - \frac{R+1}{R-1} \right]^{\frac{1}{2}}$ of composites with photon energy as shown in figure(5). The refractive index increases with increase the lithium fluoride concentrations , this can be attributed to the increasing of the density with increase the concentration of lithium fluoride [3].

Figure 5: The relationship between refractive index for (PVA-LiF) composite with photon energy



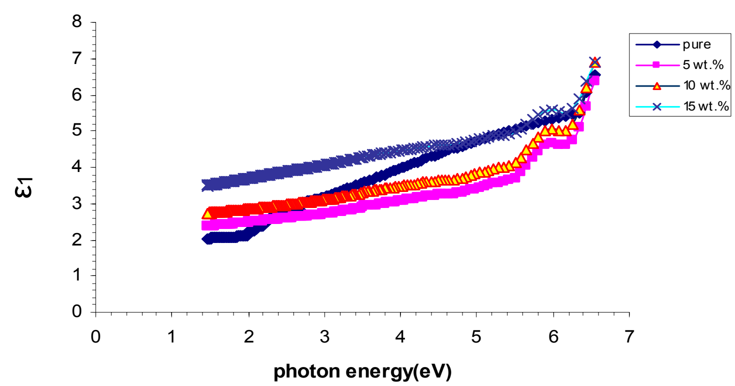
Figure(4) shows the variation of extinction coefficient ($k=\alpha\lambda/4\pi$) with wave length(λ) of composites as shown in figure(6). The extinction coefficient increases with increasing of lithium fluoride concentration, this may be attributed to absorption coefficient which increases with increase of concentration of lithium fluoride [4].

Figure 6: Extinction coefficient for (PVA-LiF) composite with various photon energy



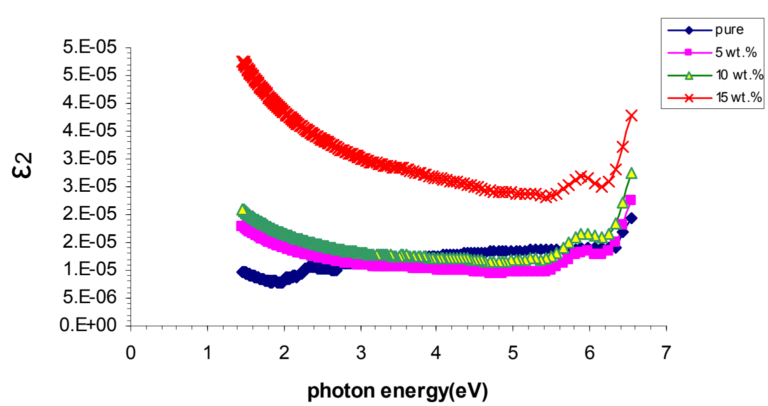
The relationship between real and imaginary parts of dielectric constants($\varepsilon_1 = n^2 - k^2$ and $\varepsilon_2 = 2nk$)[4] and energy photon of composites are shown in figures(7 ,8).

Figure 7: Variation of real part of dielectric constant (PVA-LiF) composite with photon energy



The real and imaginary parts of dielectric constants are increasing with increase the concentration of lithium fluoride, this related to increase the refractive index and extinction coefficient with increase the weight percentages of lithium fluoride.

Figure 8: Variation of imaginary part of dielectric constant(PVA-LiF) composite with photon energy



Conclusions

1. The absorbance increases with increase of concentration of lithium fluoride.
2. The absorption coefficient, extinction coefficient, refractive index and real and imaginary parts of dielectric constants are increasing with increase the weight percentages of lithium fluoride.

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