Effect of ($KMnO_4$)Doping on Optical Properties of polymer (PVA) Films

Suhama A. Hamid

Abstract

Films of pure (PVA) and (PVA) doped by ($KMnO_4$) have been prepared using casting method. Transmission and absorption spectra have been recorded in the wavelength range (300-900) nm . the study of the optical properties of the deposited films have done in order to identify the possible change that happen to the (PVA) films due to doping. The study of the optical parameters gives an indication that the doping affected all the studied parameters like, absorbance , reflectance, refractive index , extinction coefficient.

Introduction:

Polymer materials present an increasing interest for the optical data processing technologies. They may be used as convenient data storage materials as well as in the fabrication of the passive and active light guides [1].

Poly (vinyl alcohol) (PVA) is one of the most important polymeric materials as it has many applications in industry and is of relatively low cost in manufacture. There are a large number of reports on pure PVA or on PVA with different additives [2].

In order to tailor materials with improved properties within the doped polymer class, the first step is to understand and control the electronic mechanisms involved in the optical behavior. Many studies shows that the properties like crystallinity, structural order, thermal stability, electrical and optical behavior of the polymer are affected by doping which depends on the interaction between the dopant and the polymer. In recent years, the doped polymers have been the subjects of interest for both theoretical and experimental studies, because of the physical and chemical properties needed for specific application may be obtained by adding or doping with some dopant. It is observed that doping a polymer with metal salts has significant effect on their physical properties including optical, thermal, electrical properties. These changes in physical properties, depends on the chemical nature of the dopant and the way in which they interact with the

host polymer. The present work reports on the electronic transfer induced by the UV-VIS exposure of films of (PVA) doped with a ($KMnO_4$).

Experimental details:

Poly (vinyl alcohol) (molecular weight 10000 g/mol) were used as a matrix polymeric material in this research supplied by (BDH chemicals) with high purity, the aqueous solution of this polymer were prepared by dissolving PVA in a mixed of deionzed water and ethanol and stirred by magnetic stirrer for about one hour until PVA was completely dissolved.

($KMnO_4$) were dissolved in deionzed water. Appropriate mixtures of (PVA) and 8% weight ($KMnO_4$) solutions were mixed .

The solution was poured into flat glass plate dishes. Homogenous films were obtained after drying the solution in an oven for 24 hours . the thickness of the prepared films was in the range of (25 ± 1) μm.

Absorbance and transmittance measurements were carried out using double bean UV/VIS spectrometer (shimadzu Japan) in the wavelength range (300-900) nm

Results and discussion :-

The absorption spectra in the lower region (IR) are useful in studying the molecular vibrations. The higher energy region (UV) can be useful to manifest the electronic states of the atoms and other important phenomena affected by irradiation [3]. Fig.(1) shows the absorptance spectra of as-deposited (PVA) film of thickness ٢٥ μm and another sample of the same film thickness doped with (٨% $KMnO_4$)It was found that the absorption edge shifts towards lower energies due to doping (red shift). Furthermore, the absorptance was found to increase with doping.

Fig. (٢) shows the reflectance as a function of Photon energy. reflectance after doping became larger than before doping.

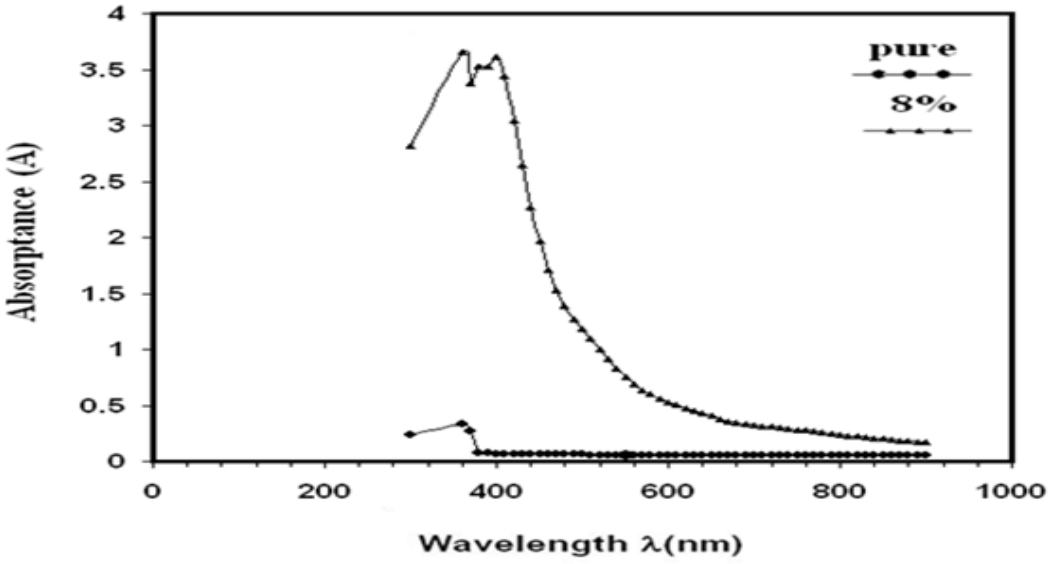

Fig. (1) absorptance of pure PVA and 8wt% $KMnO_4$ doped PVA samples.

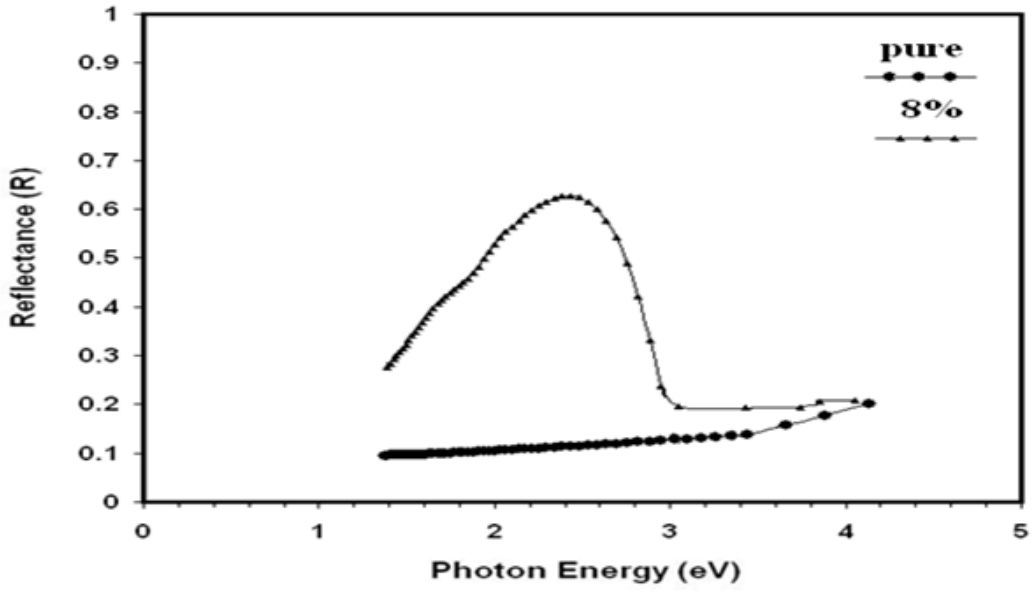

Fig. (2) reflectance of pure PVA and 8wt% $KMnO_4$ doped PVA samples.

The refractive index of the thin films can be determined from the following equation [4]:

$$R = \frac{(n-1)^2 + k^2}{(n+1)^2 + k^2} \quad \text{.....(2)}$$

where k ($k=\alpha\lambda/4\pi$) is the extinction coefficient [5].

Fig. (3) Shows the measured values of the refractive indices for the (PVA) samples. This figure reveals a tendency for an increase in refractive index with doping. The variation of (n_o) in investigated frequency range shows that some interactions take places between photons and electrons. (n_o) changes with variation of the wavelength of the incident light beam are due to these

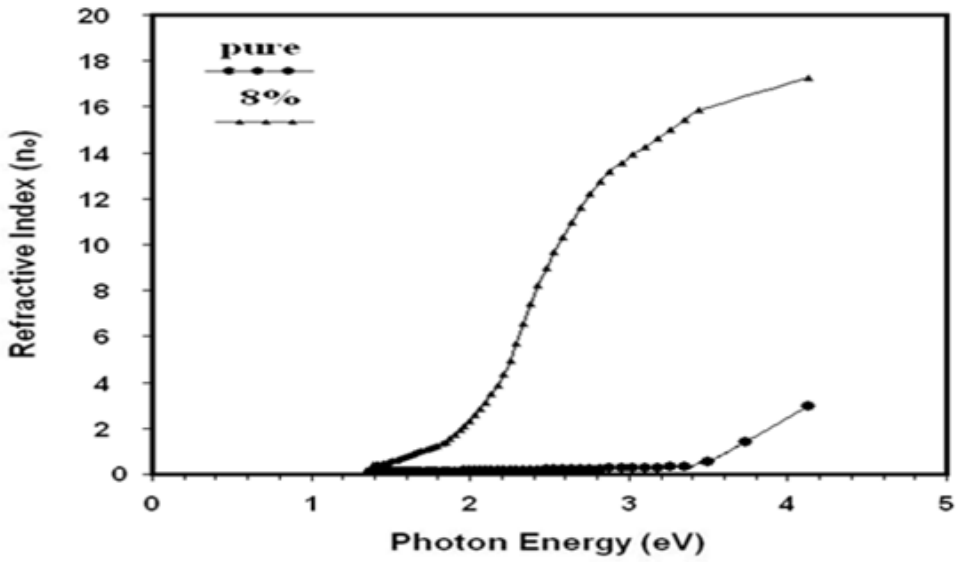

Fig. (3) refractive index of pure PVA and 8wt% $KMnO_4$ doped PVA samples.

interactions [6].

Fig. (4) shows the extinction coefficient as a function of Photon energy, the behavior of (k_o) is $(K_o)_{\text{PVA (pure)}}$ and $(K_o)_{\text{doped (10\%)}}$ because it has smaller absorption coefficient .

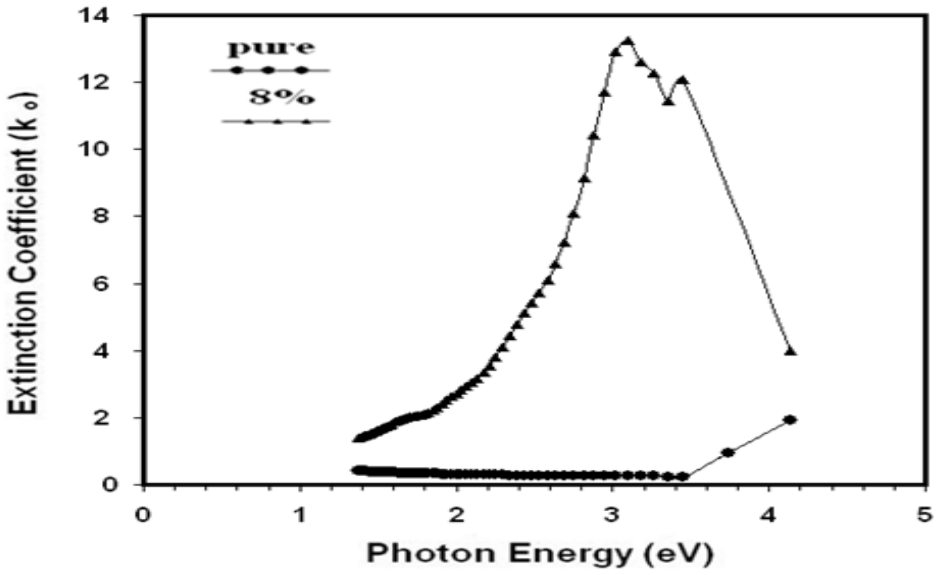

Fig. (4) Extinction coefficient of pure PVA and 8 wt%$KMnO_4$ doped PVA samples.

Conclusions:

Pure (PVA) and ($KMnO_4$) doped (PVA) have been prepared successfully by casting method. ($KMnO_4$)doping have affected all the parameters under investigation by reducing the optical energy gap

The increase of the dopant (PVA) with photon energy makes this mixture a good candidate to be used as an optical waveguide

References

[1] V. Kuncser, M. Bulinski, S. Krautwald and H. Franke, Journal of Optoelectronics and Advanced Materials, Vol. 8, No. 3, June 2006, p. 1225 – 1229.

[2] K. M. Abd El-Kader and A. S. Orabi, Polymer Testing 21 (2002) 591–595.

[3] A. Abu El-Fadl, Cryst. Res. Technol. 39, No. 2, 143 – 150 (2004).

[4] V. O. Balitska, O. I. Shpotyuk, J. Non-Cryst Solids, Vol. 227, pp. 723, (1998).

[5] B. A. Ezekoye, C. E. Okkek, The Pacific Journal of Science and Technology, , Vol. 7(2), pp. 108, (2006).

[6] B. A. Ezekoye, C. E. Okkek, The Pacific Journal of Science and Technology, , Vol. 7(2), pp. 108, (2006).

تاثير شائبة برمنغنات البوتاسيوم على الخصائص البصرية لأغشية البولي فينايل الكحول

سهامة عبد حسين حميد العبيدي
وزارة التربية– مديرية تربية ديالى

المستخلص:

حضرت أغشية بولي فنايل الكحول (PVA) النقية والمشوبة ببرمنغنات البوتاسيوم ($KMnO_4$) المحضرة بطريقة الصب. سجلت قيم النفاذية والامتصاصية في مدى الطول الموجي (300 – 900) nm . تم دراسة الخصائص البصرية للأغشية المحضرة وذلك لغرض تحديد التغير الممكن حدوثه لغشاء البولي فنايل الكحول بسبب التشويب. أن دراسة المعلمات البصرية أعطت تصور عن تأثير التشويب والذي اثر في كل المعلمات التي درست كالامتصاصية، الانعكاسية ، معامل الانكسار، معامل الخمود.