ISSN 1991- 8690 الترقيم الدولي 8690 - 1991
Website: http:// jsci.utq.edu.iq Email:utjsci@utq.edu.iq

Influence of Thickness on Optical Properties of (PVA- $CoCl_2$) films

Shawki kh. Muhammad* Muhammad H.A ** Widad H. A***

*University of Thi-Qar, College of Science, Physics Department
** University of Diyala, College of Science, Physics Department
***AL- Mustansyriah University, College of Basic Education , Science Department

Abstract

(PVA- $CoCl_2$) films with different thicknesses were prepared by casting method. The thickness of the prepared films were 15, 25, 35 and 45 µm .The optical transmission (T %) in the wavelength range 190-900 nm of films deposited was measured. The results show that The absorption coefficient α ‹10^4 (cm^{-1}) .These films show indirect allowed transitions , the optical energy gap about (4.31 eV) for (15 µm),(4.51 eV) for (25 µm) ,(4.68 eV) for (35µm) and (4.72 eV) for (45 µm). The real and imaginary part of dielectric constant calculated and correlated with thicknesses.

تأثير السمك على فجوة الطاقة وبعض الخصائص البصرية لأغشية ($PVA- CoCl_2$)

شوقي خلف * محمد حميد عبد الله ** وداد هنو عباس***

*جامعة ذي قار – كلية العلوم – قسم الفيزياء

**جامعة ديالى – كلية العلوم – قسم الفيزياء

*** الجامعة المستنصرية – كلية التربية الأساسية – قسم العلوم

الخلاصة

حضرت أغشية (PVA- $CoCl_2$) بأسماك مختلفة باستعمال طريقة الصب. سمك الأغشية المحضرة كان (15، 25، 35، 45)µm . قيست النفاذية البصرية (T%) بمدى الأطوال الموجية 190-900 nm. بينت النتائج أن معامل الامتصاص أصغر من (10^4 (cm^{-1}). أظهرت الأغشية انتقالات غير مباشرة مسموحة، قيمة فجوة الطاقة ازدادت من (4.31 eV) للسمك (15 µm) و(4.51 eV) للسمك (25 µm) و(4.68 eV) للسمك (35 µm) و(4.72 eV) للسمك (45 µm). حسب تأثير السمك على الجزء الحقيقي والخيالي لثابت العزل.

Introduction

The PVA is an important material regarding its large scale applications. It is used in surgical devices, sutures, hybrid islet transplantation, implantation, blend membrane[1,2], and in synthetic cartilage in reconstructive joint surgery. A new type of soft contact lens was developed from PVA hydrogel prepared by low temperature crystallization technique [3]. PVA is also used in sheets to make bags for premeasured soap, for washing machines, or to make longer bags used in hospitals. PVA was selected as the hydrogel component based on its favorable watersoluble, desirable physicochemical properties, and its biocompatibility. Furthermore, chemically cross linked PVA hydrogel has been gaining increasing attention in the field of bio medics [4].

PVA is a potential material having a very high dielectric strength, good charge storage capacity and dopant-dependent electrical and optical properties. It is reported that the water content in the PVA based electrolyte enhanced the conductivity while preserving the dimensional stability of the electrolyte [5].The physical properties of polymers may be affected by doping and thickness. A graft copolymer is a type of branched copolymer with the side chain being different and separate from the main chain. Detailed studies of doped polymer with different dopant concentrations and thickness allow the possibility of choice of the desired properties [1].

The aim of this work is to study the Influence of thickness on optical properties of (PVA- $CoCl_2$) films which was prepared by using solvent casting method.

Experimental procedure

The poly-vinyl alcohol with molecular weight 10000 g/mol, supplied by (BDH chemicals, England) with high purity were used as basic polymeric materials , and $CoCl_2$. The weight percentages of $CoCl_2$ are (8 wt.%). (PVA:$CoCl_2$) composite films were prepared by solution casting method. Homogenous films were obtained after drying in an oven for 24 hours at 50C° , The average thickness of the produced films was in the range of 15, 25, 35 and 45 µm by using micrometer and the average area was (3×3 cm^2). The transmittance and absorbance measurements were carried out using a Shimadzu UV/VIS-160A double bean spectrophotometer in the wavelength range (190-900) nm.

Results and discussions

The optical transmission spectra as a function of wavelength in the range of (190-900) nm is shown in Fig. (1). we can observe from this figure that the transmittance decreases with increasing the hickness. This may be attributed to the creation of levels at the energy band by increasing thickness and this leads to the shift of peak to smaller energies. There are no absorption bands in the visible region since the films are transparent and this result agree with previous studies [6].

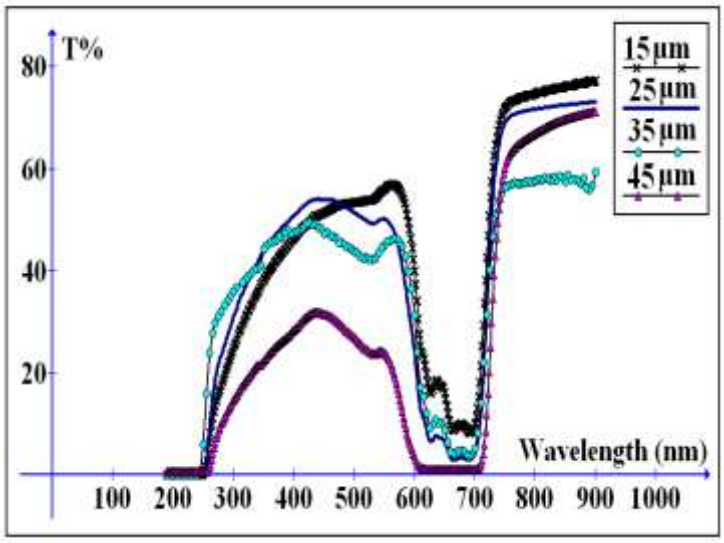

Fig. (1) Transmission Spectra of (PVA- $CoCl_2$) different thickness films.

The following relation could be use for calculating the absorption coefficient (α) [7,8]:

$$\alpha = \frac{2.303A}{t} \qquad \text{---------- (1)}$$

Where (A) is the absorption and (t) is the film thickness.

Fig. (2) show that absorption coefficient decreases with increases of thickness, at short wavelength (α) takes higher value and then increases with decreasing λ (increasing photon energy).

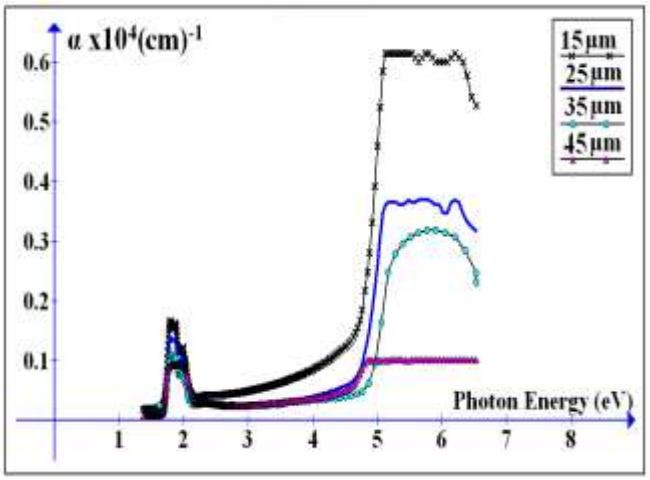

Fig. (2) Absorption Coefficient of (PVA- $CoCl_2$) different thickness films.

The optical energy gap of the films for allowed indirect transition is determined by the following relation [9,10]:

$$(\alpha h\nu)^{1/2} = A\,(h\nu - E_g) \quad \text{---------(2)}$$

Where (E_g) is the optical energy gap of films, (A) is a constant and (hν) is the incident photon energy. the optical energy gap can estimated by plotting $(\alpha h\nu)^{1/2}$ versus photon energy (hν) , then extrapolating the straight line part of the plot to the photon energy axis Figures (3) shows the variation of the optical energy gap of (PVA: $CoCl_2$) for different thickness films. The energy gap increases from (4.31- 4.72) eV as thickness increases from (15- 45)μm, This may be explained by invoking the occurrence of local cross linking within the amorphous phase of the polymer, in such a way as to increase the degree of ordering in these parts [11].

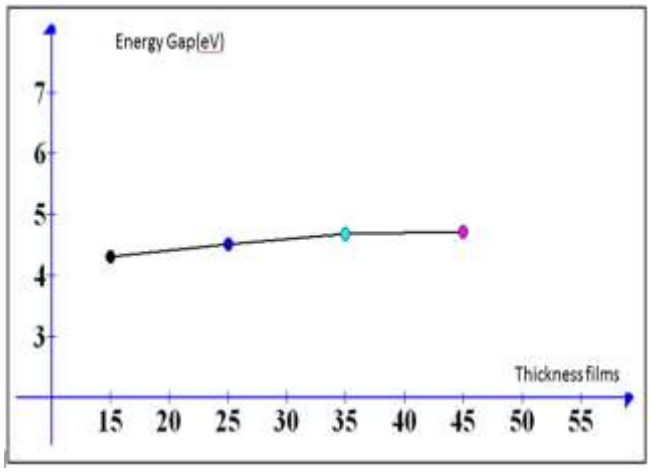

Fig. (3) Optical Energy Band Gap of (PVA- $CoCl_2$) for different thickness films.

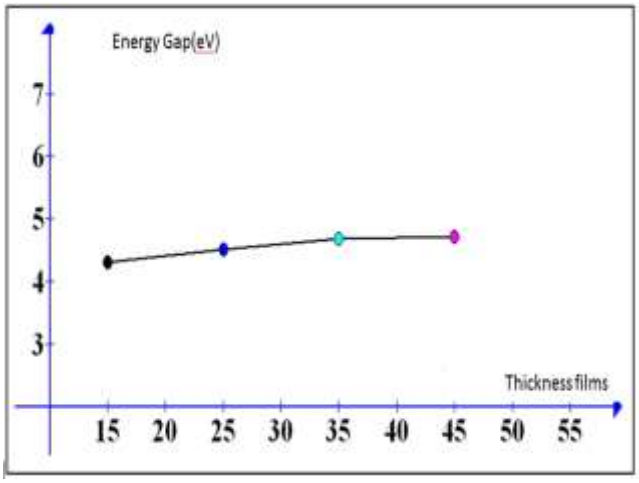

Figure (4) Variation of Thickness films with Energy Gap.

The variation of the real (ε_r) and imaginary (ε_i) parts of the dielectric constant values versus wavelength in the range 190 – 900 nm at different thicknesses (15, 25, 35 and 45)μm are shown in Figs.(5 and 6). The behavior of ε_r is similar to that of refractive index because the smaller value of $k_\circ^2$ compared with $n_\circ^2$[12]:

$$\varepsilon_r = n_\circ^2 - k_\circ^2 \quad \text{---------- (3)}$$

while ε_i is mainly depends on the k values, which are related to the variation of absorption coefficient[13]:

$\varepsilon_i = 2n_\circ k_\circ$ ---------- (4)

It is found that ε_r and ε_i increases with increasing of films thickness. The real and imaginary parts of the dielectric constant indicate the same pattern and the values of real part are higher than imaginary part [14]:

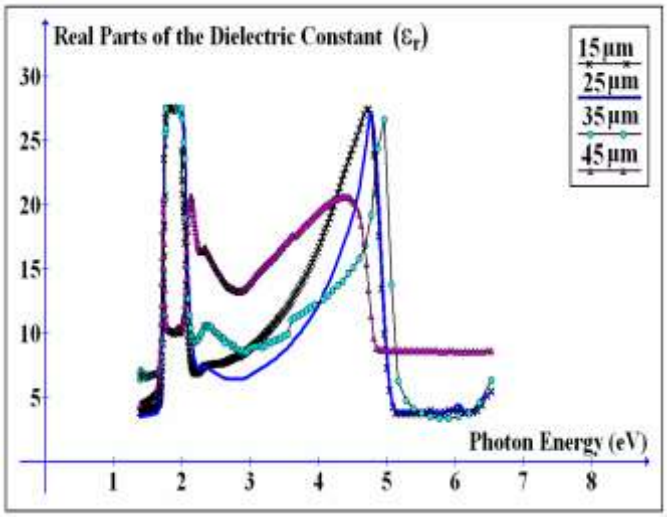

Fig. (5) Real par t of Dielectric Constant of (PVA-$CoCl_2$) for different thickness films.

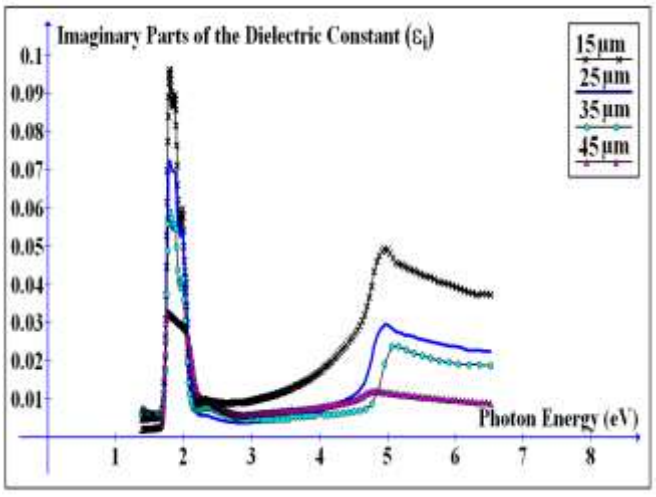

Fig. (6) Imaginary Part of Dielectric Constant of (PVA- $CoCl_2$) for different thickness films.

Conclusions

The PVA doped $CoCl_2$ films have been prepared successfully by casting method , The type of electronic transition was indirect allowed transition , the E_g(15 µm)= (4.31 eV) , E_g(25 µm)= (4.51 eV), E_g(35 µm) = (4.68 eV), E_g(45 µm)= (4.72 eV). and the detailed study effect of thickness on optical properties has shown that all the optical properties such as transmittance, absorption coefficient, and the real and imaginary parts of dielectric constant have been affected by increasing the thickness.

References

[1] Osiris W. Guirguis, Manal T. H. Moselhey, J Mater Sci., (2011), 5775 ،46–.5789
[2] Saxena AK , Marler J, Benvenuto M, Willital GH, Vacanti JP (1999) Tissue Eng 5:525
[3] Eaga CM, Kandukuri JM, Allenki V, Yamsani MR (2009) Der Pharm Lett 1:21
[4] Kim SJ, Lee YM, Kim IY, Kim SI (2003) React Funct Polym.55:291
[5] M. A. Vargas, R. A. Vargas, B. E. Mellander, Electrochim. Acta 45(2000) .1403-1399
[6] K. A. Abd El-Kader, S. F. Abdel Hamied, A. B. Mansour, A. M. Y El- Lawindy, F. El-Tantaway, Polymer Testing 21(2002) 847–.850
[7] Zishan H.Khan, NumanSalah, SamiHabib, A.A.Al-Ghamdi, ShamshadA.Khan ,Optics & Laser Technology 44(2012) 6–.11
[8] M. Abdelaziz , MagdyM.Ghannam ,Physica B , 405(2010) 958–.964
[9] L. Leonite, M. Roman, F. Brinza, C. Podaru and G. I. Rusu , Synthetic Metals, 138(2003) .157
[10] J.B. Yadav , R.K. Puri , Applied Surface Science , p.p 1382–1388, (2007)
[11] A. Ashour, M. A. Kaid, N. Z. El-Sayed and A. A. Ibrahim, Applied Surface Science, 252,(2006),.7844
[12] A. K. Baker and P. E. Dyer, Journal Applied Physics Materials Science and Processing, Vol. 57, (1993), .543
[13] E. Elangovan and K. Ramamurthi, Cryst. Res. Technol., (2003), Vol. 38(9) , .779
[14] E. Elangovan and K. Ramamurthi, Cryst. Res. Technol., 38(9) (2003), 779.