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The Effect of Ni on Some Optical Properties For (PVA-Ni) Composites

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Abstract :-

In the present work ,the effect of addition nickel on some optical properties of poly-vinyl alcohol has been studied . For that purpose , many samples has been prepared by adding nickel on the poly-vinyl alcohol with different weight percentages from nickel with polymer and by different thickness .The absorption and transmission spectra has been recorded in the wavelength range (300-900)nm . The absorption coefficient, extinction coefficient and energy gap of the indirect allowed and forbidden transition have been determined .

Introduction :-

The main two types of optical transitions are direct and indirect transitions, both involve the interaction of an electromagnetic wave with the electron in valence band which may cross the forbidden gap to the conduction band [6]. Indirect transitions are possible only by phonon assisted transition. The value and shape of the mobility gap in the amorphous semiconductors depend on the preparation condition such as substrate temperature, annealing temperature, degree of impurity and defect of the material. Any variation in such parameters leads to a shift in the absorption edge towards higher or lower energy [12]. In order to fulfill the requirements of polymer industry many developers usually blend polymers together in order to reach anoptimun balance of properties. this approach allows high flexibility in proerty adjustment and avoids development of new macromolecules which is generally long and expensive compared to polymer alloying [5].

This paper deals with results of the effect of Ni on the some optical properties of poly-vinyl alcohol

Experiment

The materials used in the papar is poly-vinyl alcohol as matrix and nickel as a filler.

The electronic balanced of accuracy 10^{-4} have been used to obtain a weight amount of Ni powder and polymer powder . These mixed by Hand Lay up and the microscopic examination used to obtain homogenized mixture . The weight percentages of Ni are (0 ,20, 50) wt%. The Hot Press method is used to press the powder mixture. The mixture of different nickel percentages have been compacted at temperature 145^{o}C under a pressure 100 Par for 10 minutes . Its cooled to room temperature , the samples were disc shap of a diameter about 30mm and thickness ranged between (1.85-2.2)mm. The transmission & absorption spectra of PVA-Ni composites have been recording in the length range (300-1100) nm using double-beam spectrophotometer (UV-210^{o}A shimedza).

Results and Discussion

The absorption coefficient (α) is known to be the key parameter which governs the optical properties of semi conducting materials, α can be calculated using[2]:

$\alpha = (\ln 10 \times A)\backslash d$…………….(1)

A : absorbance.

d : the thickness of sample.

Figure (1) shows the relationship between the absorption coefficient and photon energy of the PVA-Ni composites we note that the change in the absorption coefficient is small at low energies this indicates the possibility of electronic transitions is a few. At high energy , the change of absorption coefficient is large that indicate the large probability of electronic transitions are the absorption edge of the region[7]. The absorption coefficient helps to conclude the nature of electronic transitions, when the high absorption coefficient values ($\alpha > 10^4 cm^{-1}$) at high energies we expected direct electronic transitions ,and the energy and momentum preserve of the electron and photon , when the values of absorption coefficient is low($\alpha < 10^4 cm^{-1}$) at low energies we expected in this case indirect electronic transitions, the momentum of the electron and photon preserves by phonon helps[11]. The results showed that the values of absorption coefficient of the PVA-Ni composites less than $10^4 cm^{-1}$ which indicates to indirect electronic transition. The forbidden energy gap of indirect transition both allowed, forbidden calculated according to the relationship[4] :

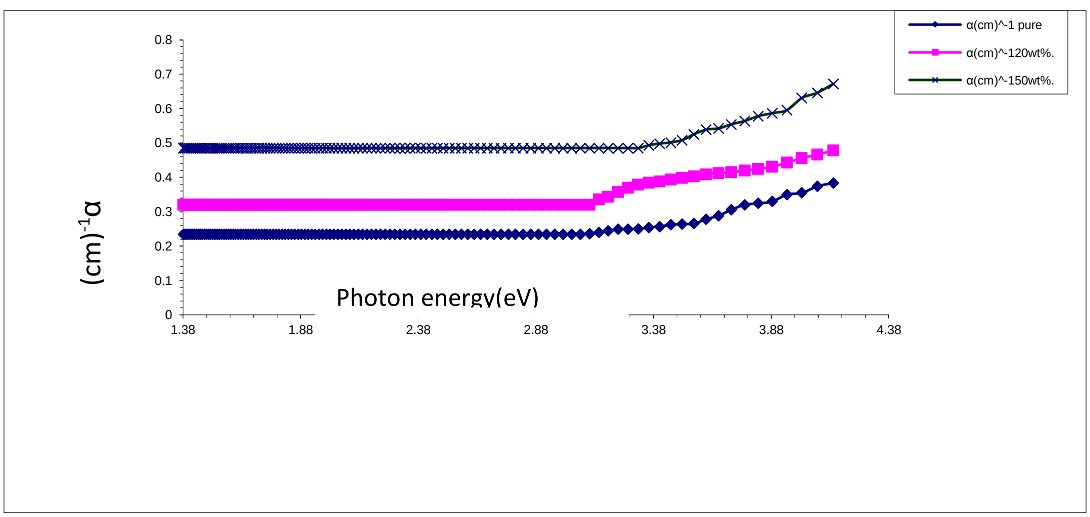


Figure (1) The relationship between the absorption coefficient and photon energy of the PVA-Ni composites

$\alpha h\nu = A(h\nu - E_g)^m$……………………(2)

Where : hυ is the energy of photon , A is proportionality constant, Eg is forbidden energy gap of the indirect transition.

If the value of (m=2) indicates to allowed indirect transition . when the value (m=3) indicates to forbidden indirect transition. Figure (2) shows the relationship between $(\alpha hv)^{1/2}(cm^{-1}.eV)^{1/2}$ and the photon energy of pure polymer (PVA) , with take over part of the straight cut oriented axis at the point $(\alpha hv)^{1/2}=0$ will get the value of forbidden energy gap of the allowed indirect transition , which equal (2.7eV). Figure (3) and figure (4) represents the same relationship but to the polymer doped with (Ni) with weight percentages of Ni are (20,50) wt.% we can concluded that the forbidden indirect transition equal (2.4eV) for 20wt.% Ni, and (2eV) for 50 wt.% Ni, we note that the value of the forbidden energy gap decreases with increasing Ni concentration.

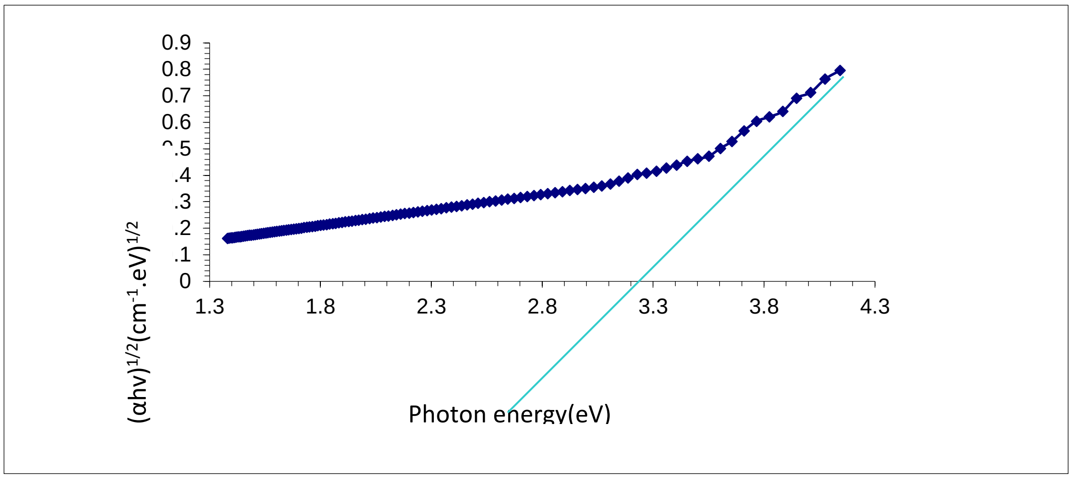
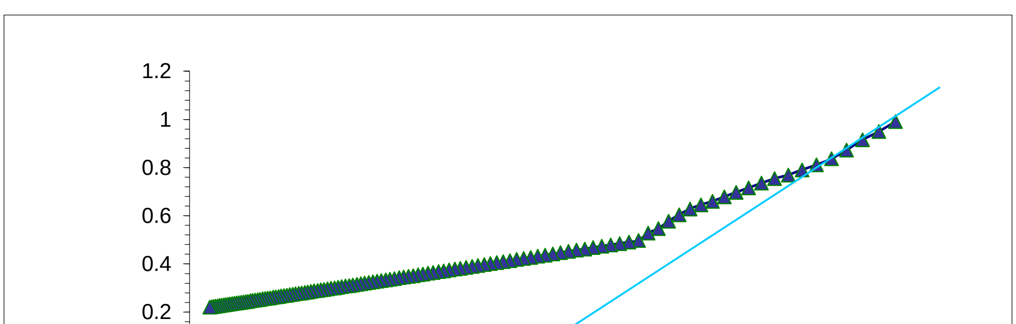


Figure (2) the relationship between $(\alpha hv)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of pure polymer (PVA).



(αhv)1/2(cm-1.eV)1/2

Photon energy(eV)

Figure (3) the relationship between $(\alpha h\nu)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of PVA-Ni composites for 20wt.%

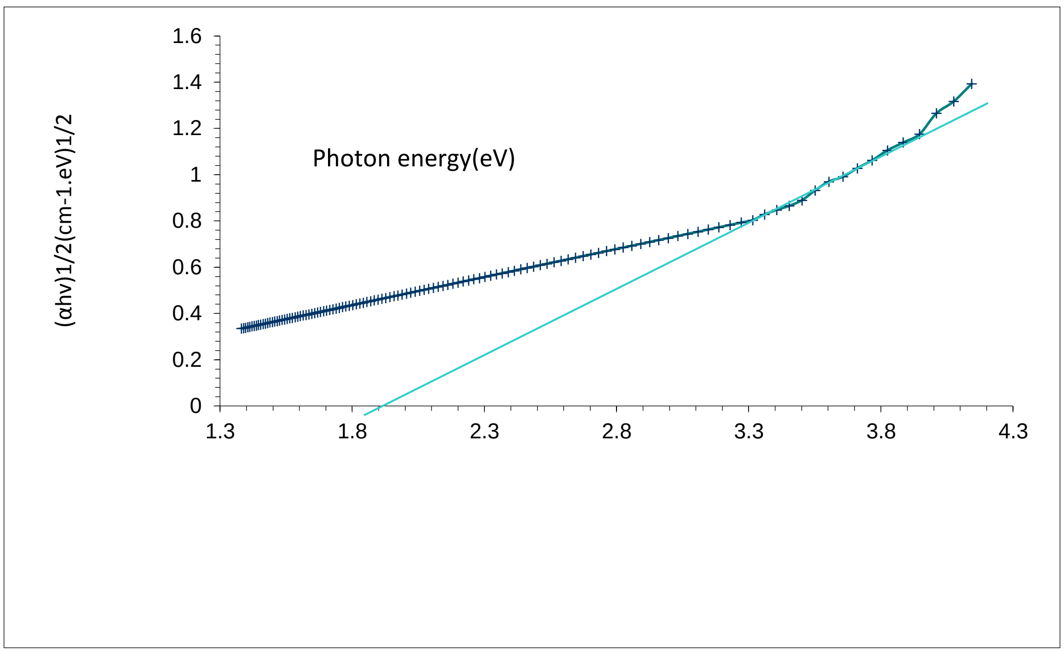


Figure (4) the relationship between $(\alpha h\nu)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of PVA-Ni composites for 50wt.% Ni

Figure(5) shows the relationship between the $(\alpha hv)^{1/3}$ $(cm^{-1}.eV)^{1/3}$ and photon energy of pure polymer (PVA),the same way we obtain to the forbidden energy gap of forbidden indirect transition which equal (2.65eV) . Figure (6) and figure (7) represents the same relationship but to the polymer doped with (Ni) with volume percentages of Ni are(20,50) wt.% , we can concluded that the forbidden indirect transition equal (2.3eV) for 20wt.% Ni, and (1.95eV) for 50 wt.% Ni. We note that the value of the energy gap decreases with increasing Ni concentration[9]. Figure(8) shows the variations of extinction coefficient (K) with wave length of pure and doped PVA-Ni . (k) shows an increase with increasing dopant concentration. The behavior of (k) can be ascribed to high absorption coefficient. This result indicates that the dopant atoms of Ni will modify the structure of the host polymer. An interesting result is Ni dopants increases the absorbance in the visible region[1].

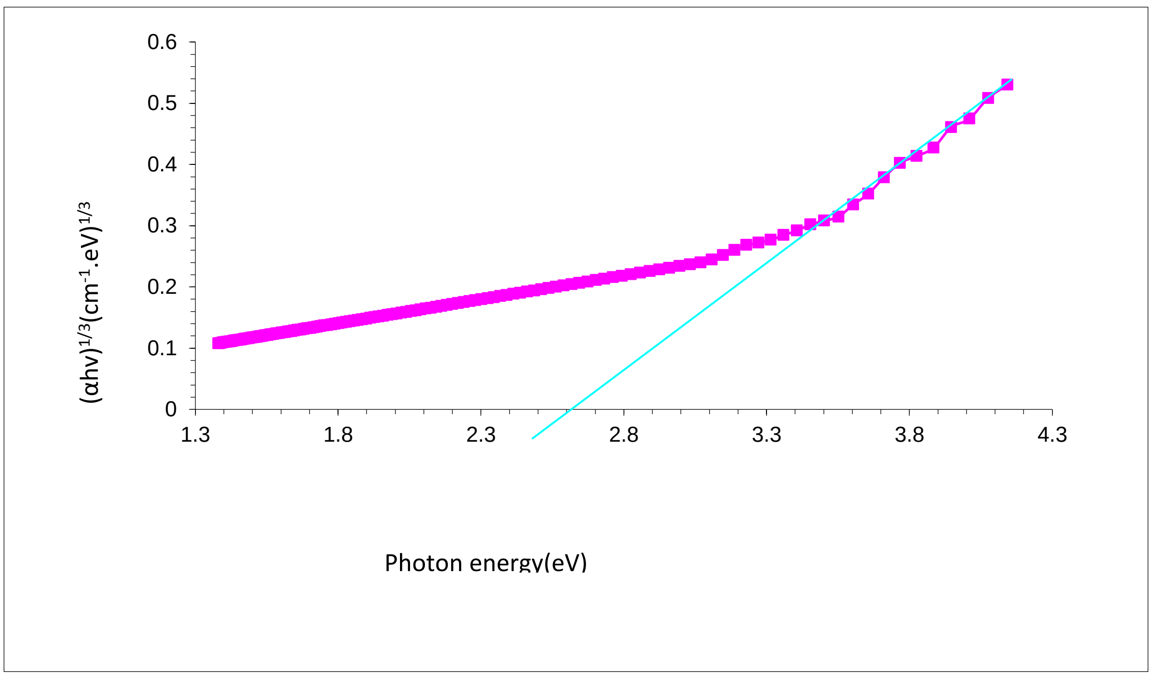
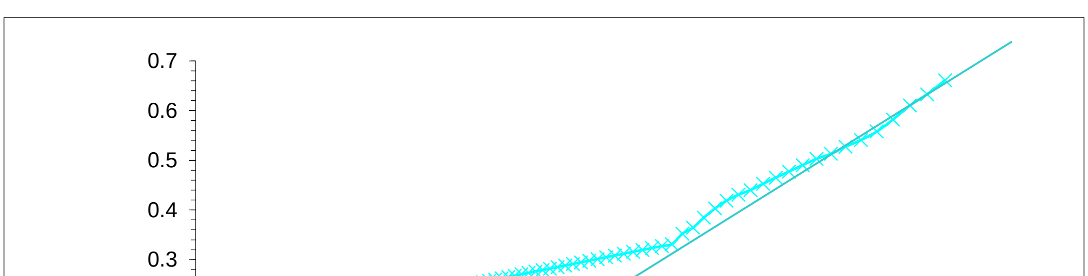


Figure (5) the relationship between $(\alpha hv)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of pure polymer (PVA).



$(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$

Photon energy(eV)

Figure (6) the relationship between $(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of of PVA-Ni composites for 20wt.% Ni

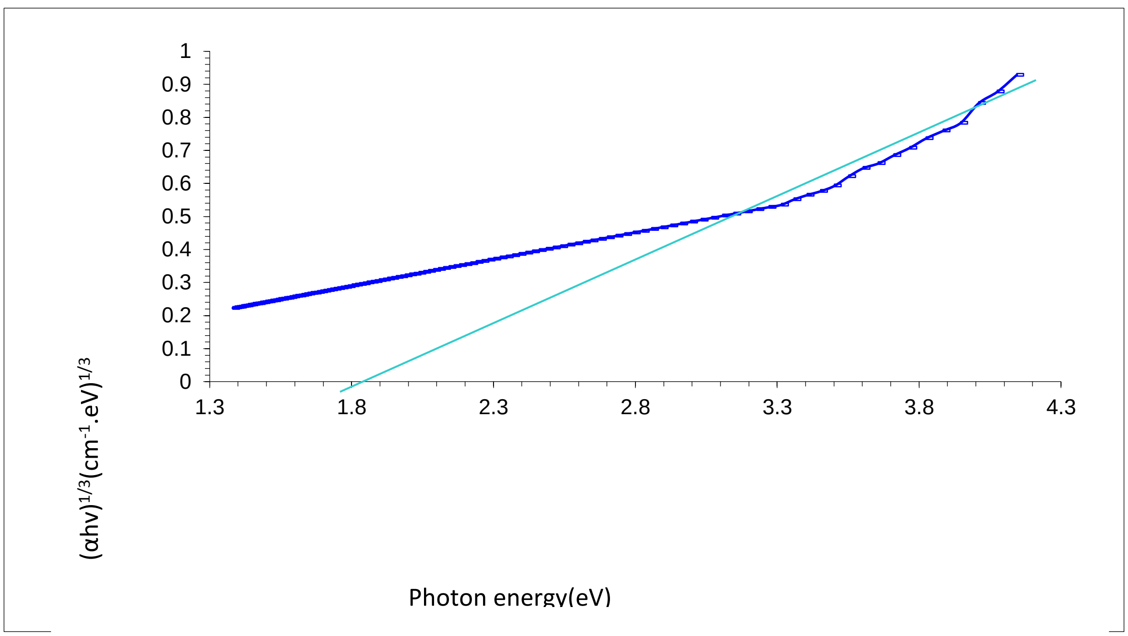
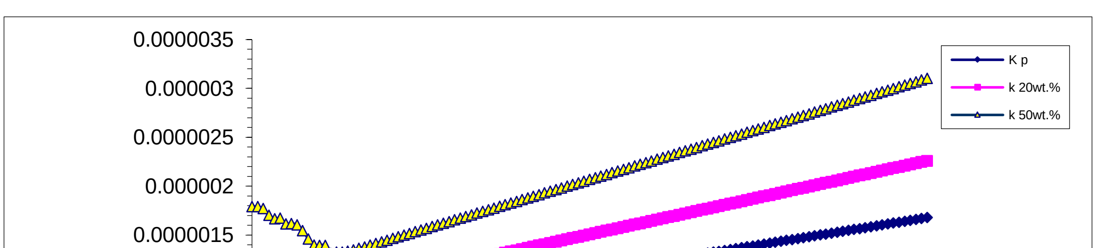


Figure (7) the relationship between $(\alpha h\nu)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of of PVA-Ni composites for 50wt.% Ni



k

λ(nm)

Figure (8) the relationship between the extinction coefficient (k) and wave length(λ) of the PVA- Ni composites

Conclusion

1. The absorption coefficient is increasing with increasing of the filler wt.% content.

2. The experimental results showed that the absorption coefficient less than $10^4 cm^{-1}$ this is indicates to forbidden and allowed indirect electronic transitions.

3. The forbidden energy gap is decreasing with increasing of the filler wt.% content.

4- The extinction coefficient is increasing with increasing of the filler wt.% content.

References

1. Ahmed R.m. ,2008,"Optical study on poly(methyl methacrylate)/poly(vinyl acetate)", Zagazig Uni., Zagazig, Egypt, E-mail-rania 8_7@hotmail. com.
2. Hutagalwng. S. D. and Lee. B. Y. ,2007, Proceeding of the 2nd international conference Nano/Micro Engineered and Molecular systems, January ,Bangkok,Thailand.
3. Kathalingam. A .*et al* , "Materials Chemistry and physics, 2007,vol.106,No.215.
4. Mohammed A.,2007, "Improvement of thermal properties for binary systems PVF-Ph, PVF-B by addition of silicon carbide", Eng. Techn., Vol. 25, No.7.
5. Mott N, "Electrical processes in non-crystalline materials", Clarendon Press, Oxford, 1971.
6. Scholz. S.M, Carrot.G and Hilborn.J ,2008, "Optical properties of Gold-Containing poly (Acrylic Acid) composites" , Lausanne, Switzerland.

8. Scaglione S. *et al* ,2008, "F-color centers and Lithium nano clusters in ion-beam assisted LiF thin Films.
9. Soliman . L. I and Sayed. W. M,2002,"Some physical properties of Vinylpyridine Carbon-Black composites", Cairo, Egypt.
10. Thangaraju B. , Kalianna P. ,Cryst. Res. Techon.,2000, vol. 35, No.71.
11. Tauc J. ,"Amorphous and liquid semiconductors", Plenum Press, London, New York, 1974.

تأثير Ni على بعض الخواص البصرية لمتراكبات(PVA-Ni)

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الخلاصة :-

تم في هذا البحث دراسة تأثير إضافة النيكل على بعض الخواص البصرية للبولي فاينيل الكحول . ولهذا الغرض تم تحضير نماذج بإضافة النيكل إلى البولي فاينيل الكحول وبنسب وزنية مختلفة من النيكل مع البوليمر وبسمك مختلف.تم تسجيل طيفي الامتصاص و النفاذية و لمدى الاطوال الموجيةnm(900-300). و حساب معامل الامتصاص، معامل الخمود و فجوة الطاقة للانتقال غير المباشر المسموح و الممنوع.