SPECTROSCOPIC STUDIES OF (PMMA- CD (NO3)2 .4H2O) COMPOSITES

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ABSTRACT
Composites consisting of an poly (methyl methacrylate) matrix and Cd(NO4)2.4H2O as filler are designed. The optical properties were measured in the wavelength range from (190-850) nm. The experimental results showed that the absorption coefficient, extinction coefficient, refractive index and real imaginary parts of dielectric constants are increasing with increase the addition of Cd(NO4)2.4 H2O content.

Keywords: poly (methyl methacrylate), Optical constants, Composites.

INTRODUCTION
Composites are a class of materials consisting of a mixture of two or more components to produce a multiphase system with different physical properties obtained from the constituents [1] The typical advantages of organic polymers are flexibility, toughness, formability, and low density, whereas ceramics have excellent mechanical, thermal, and optical properties, such as surface hardness, modulus, strength, heat resistance, and high refractive index. The combination of organic polymers and ceramics promises new hybrid materials with high performance. Numerous technological applications have been identified for these composite materials, such as electromagnetic and radio frequency interference shielding for electronic devices (for example, computer and cellular housings), over-current protection devices, photothermal optical recording, and direction-finding antennas [2]. Poly (methyl methacrylate) (PMMA) is a polymer with several interesting physical properties, which are very useful in technical applications. PMMA, as semicrystalline material, exhibits certain physical properties resulting from the crystal-amorphous interfacial effect [3]. Al-Ramadhan et al, 2011 studied the optical properties of the PVC- Zn (etx)2 composites. Results show that the absorption coefficient, extinction coefficient, refractive index and real and imaginary parts of dielectric constants are increasing with increase Zn (etx)2 concentrations [4]. This paper deals with results of the effect of Cd(NO4)2.4 H2O on the optical properties of poly(methyl methacrylate).

EXPERIMENTAL WORK
The materials used in this work of poly (methyl methacrylate) and Cd(NO4)2.4 H2O. The weight percentages of Cd(NO4)2.4 H2O are (0,1,2 and4) wt.%. The casting technique is used to prepare the samples with thickness ranged between (70-83) μm.

The transmission and absorption spectra of PMMA- Cd(NO4)2.4 H2O composites have been recording in the length range (190-850) nm using double-beam spectrophotometer (UV-210oA shimedza ).

RESULTS AND DISCUSSION
Figure (1) shows the variation of the optical absorbance with the wavelength of the incident light for (PMMA- Cd(NO4)2.4 H2O) composites.
The figure indicate that the absorbance increases with increase of $\text{Cd(NO}_3\text{)}_{2.4}\text{H}_2\text{O}$ concentration, this attributed to the high absorbance of $\text{Cd(NO}_3\text{)}_{2.4}\text{H}_2\text{O}$.

The variation of the absorption coefficient, $\alpha$, as a function photon energy are presented in figure(2). It was calculated from equation[5]:

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

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

The values of the absorption coefficient are less than 104cm–1 in the investigation spectral range. The fundamental absorption, which corresponds to electron excitation from the valence band to conduction band, can be used to determine the nature and value of the optical band gap, $E_g$. The relation between the absorption coefficient, $\alpha$, and the incident photon energy, $h\nu$, can be written as[6]:

$$(ah\nu)^n = A(h\nu) - E_g \quad (2)$$

Where A 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, $h \nu$, 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 $E_g$ will be given by intercept on the $h \nu$-axis as shown in figures (3, 4).

The attenuation coefficient ($k$) is directly proportional to the absorption coefficient ($\alpha$):

$$k = \frac{\alpha \lambda}{4\pi} \quad (3)$$

Where $\lambda$ is the free space wavelength of light.
Figure (6): shows the variation of the refractive index \( n = \frac{1 + \sqrt{R}}{1 - \sqrt{R}} \) of composites a function of photon energy. It has been found that the value of refractive index increases with increasing the concentration of Cd(NO₄)₂.₄ H₂O which is a result of increasing the number of atomic refractions due to the increase of the linear polarizability in agreement with Lorentz - Lorentz formula.

Figures (7, 8) show the variation of real and imaginary parts of dielectric constants \( \varepsilon_1 = n^2 - k^2 \) and \( \varepsilon_2 = 2nk \) of (PMMA- Cd(NO₄)₂.₄ H₂O) composites. It is concluded that the variation of \( \varepsilon_1 \) mainly depends on \( n^2 \) because of small values of \( k^2 \), while \( \varepsilon_2 \) mainly depends on the \( k \) values which are related to the variation of absorption coefficients[7].
CONCLUSION

1. The absorbance increases with increase the weight percentages of Cd(NO₄)₂.₄H₂O.

2. The absorption coefficient, extinction coefficient, refractive index and real and imaginary parts of dielectric constants are increasing with increase the weight percentages of Cd(NO₄)₂.₄H₂O.

3. The forbidden energy gap decreases with increase of the filler wt. % content.
REFERENCES


