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RESEARCH ARTICLE

The Effect of MGO Nanoparticles on Structure and optical Properties of PVA-PAAm Blend

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ABSTRACT:
The films of PVA-PAAm-MgO were prepared with various content (0, 0.02, 0.04) of 30 nm particle size MgO by casting solution method. The structure of PVA-PAAm-MgO composite was examined via FT-IR to determine the activation groups, while the diffusion of MgO nanoparticle inside the prepare blend and the homogeneity were examined using the optical microscope. UV-Visible spectrophotometer that used to recording the transmittance spectra in the range of 300-900 nm. The transmittance decreased with the increasing of MgO nanoparticles content in the PVA-PAAm-MgO composite, while the absorbance increased. The optical constants are determined and the optical energy gap decreased with the increasing of MgO nanoparticle content in the PVA-PAAm-MgO composite.

KEYWORDS: Nanocomposites, agglomeration, sonication.

INTRODUCTION:
Polymer composites have unrivaled properties like high flexibility, light weight, and possibility to be produced at low temperature and low cost [1]. Polyvinyl alcohol (PVA) is a non-toxic, water-soluble, highly crystalline, biodegradable, and biocompatible polymer. It has interesting physical and chemical properties and good film-forming ability due to the abundance of hydroxyl groups [2]. Polyvinyl alcohol is a representative water soluble polymer that is widely investigated as a host material for nanocomposites [3], here we used MgO as a nanomaterial to fabricate the composite with the polymers.

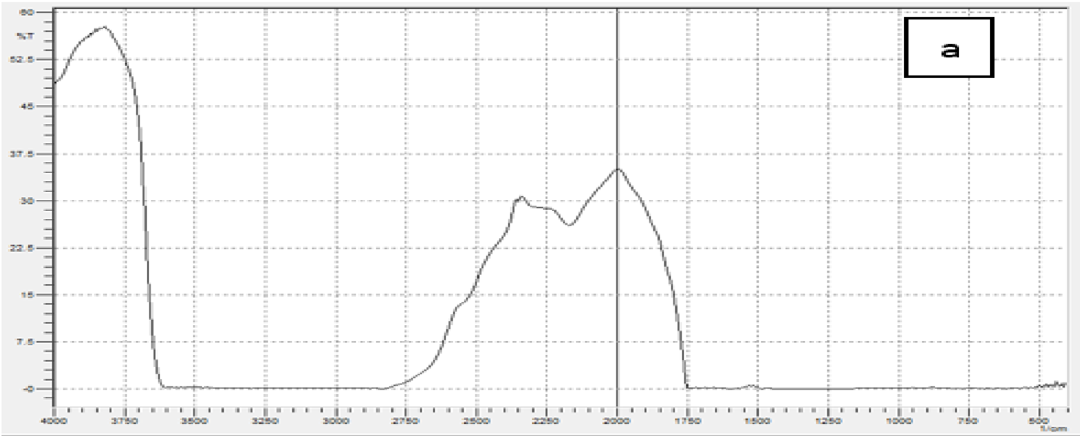
PVA is an artificial polymer that has been used during the first half of the 20th century worldwide, it has been applied in the industrial, commercial, medical and food sectors and has been used to produce many end products, such as lacquers, resins, surgical threads, and food packaging materials that are often in contact with food [4-6]. Many researchers are studied the improvement of optical, electrical, and mechanical properties of PVA polymer in blend with adding nanomaterial [7,8].

The optical properties of polymer films are very necessary for many technological applications, in this work, the structural and optical properties of PVA-PAAm-MgO films are studied with various content of 30 nm MgO.

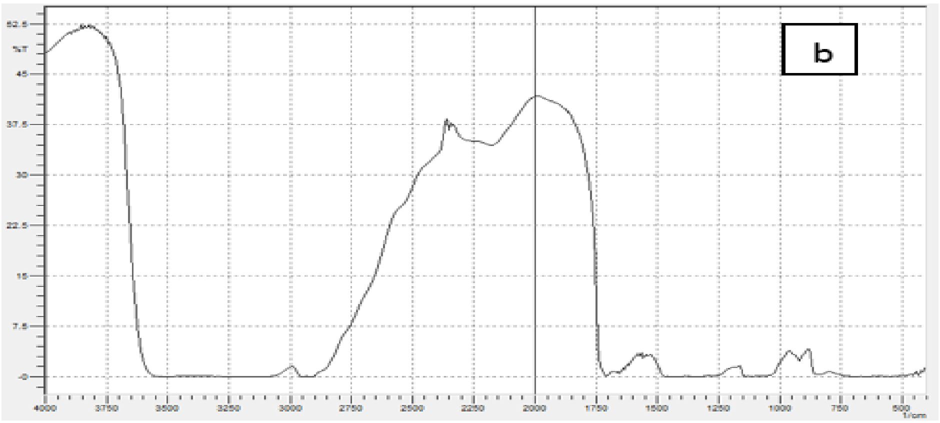
MATERIALS AND METHOD:
The 0.8 g of PVA are dissolved in 30 ml of distilled water with stirring at 80 ºC, and 0.2 g of PAAm dissolved in 30 ml distilled water with stirring 40ºC. The two solutions were mixed with stirring at 70ºC. After words, MgO were added to the solution with various content (0.02, 0.04) at same particle size (30nm) to form the samples. In order to prevent the agglomeration of MgO, the sonication that used at 35 Hz and 25ºC for 5

minutes. Then the solution were casted in Petri dish and leave it for 10 days to deride at room temperature. Thickness were measure for the prepared films via micrometer to be 700 µm. FT-IR and optical microscope were used to determine the activation groups and the distribution of MgO nanoparticle in the PVA-PAAm-MgO films respectively. The UV-Visible spectrophotometer that used to determine the absorption spectra in the range of 200-1100 nm.

RESULTS AND DISCUSSION:



The activation groups that determined using FT-IR as represented in Fig.1. PVA-PAAm blend that formed from mixing 80% PVA with 20% PAAm. The finger print region (wave number = 1500-500 cm^{-1}) in the figure (parts a,b,c) refer to the changes in the PVA-PAAm structure after various additives of MgO nano particle (NP).



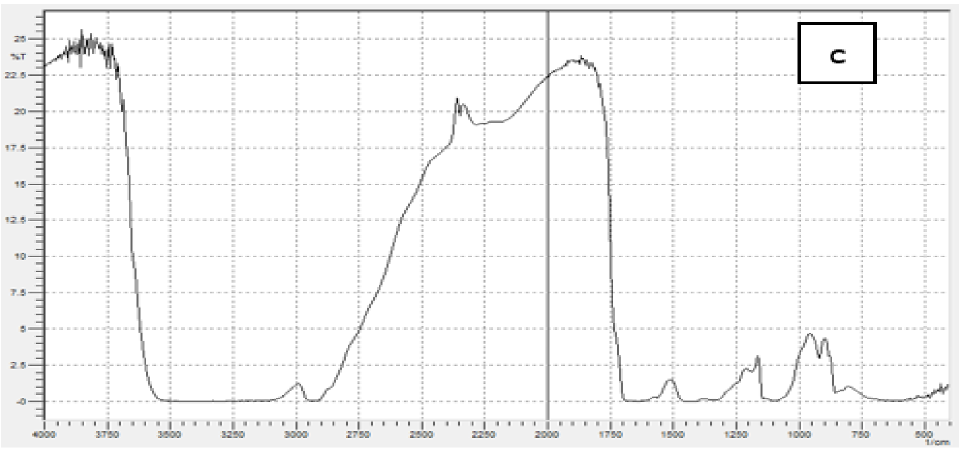


Fig.1: FT-IR spectrum of PVA-PAAm-MgO composite for various content of MgO a) 0%, b) 2%, and 4%.

The optical microscope device that used to determine the homogeneity and the distribution of MgONP in the PVA-PAAm-MgO composite as shown in Fig.2. The Fig.2a represent the PVA-PAAm blend, it can show from the figure, the homogeneity that successfully prepared from the suitable conditions used to prepare these films (PVA, PAAm ratios and the temperature). While the Fig.2b represent the good distribution of 30 nm particle size of 0.02% MgO in the PVA-PAAm films. The good network that formed from 0.04% MgO as shown in the Fig.2c, make this additive is the best.

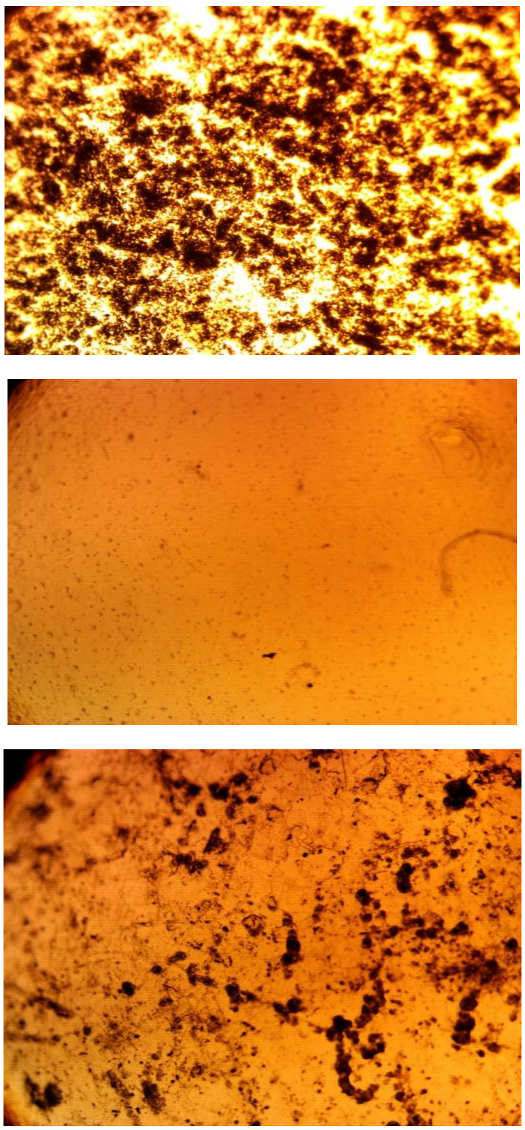


Fig.2: Optical microscope images of PVA-PAAm-MgO composite for various content of MgO a) 0%, b) 2%, and 4%.

The optical properties can calculate from recording the absorbance spectra as a function of wavelength via UV-Visible spectrophotometer for PVA-PAAm-MgO with various content of MgO. Fig.3 represents the relationship between the absorption spectra and the wavelength. From the figure, the absorption of PVA-PAAm-MgO films increasing with the increases of MgO content, this attributed to the formation of network inside the PVA-PAAm blend as it seen in the optical microscope images.

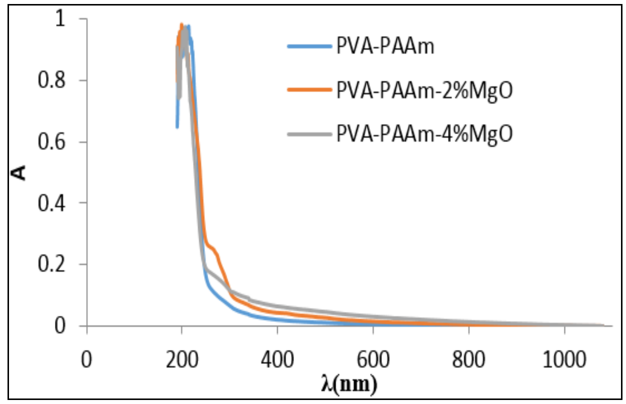


Fig.3: Absorption spectra of PVA-PAAm-MgO composite for various content of MgO.

The transmittance spectra (T) of PVA-PAAm-MgO films are calculated form the following relation [9]:
T = log A

The transmittance decreased with the increasing of MgO in the PVA-PAAm-MgO films, this attributed to the more collisions of incident photons with the MgO particles.

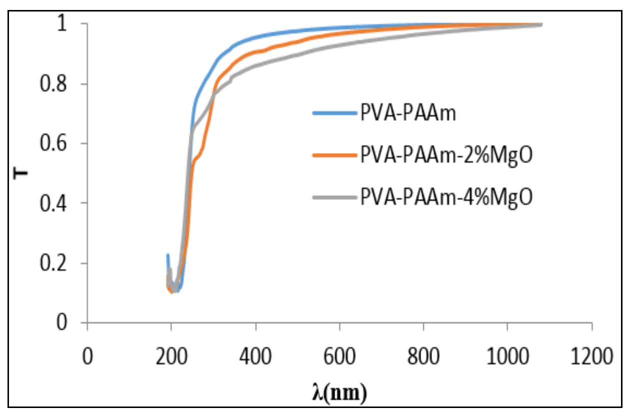


Fig.4: Transmittance spectra of PVA-PAAm-MgO composite for various content of MgO.

The absorption coefficient (α) of PVA-PAAm-MgO films for various content of MgO are calculated using the relation [10]:

$$\alpha = 2.303\,\frac{A}{t} \qquad (2)$$

where (A) is the absorption and (t) is the film thickness. The absorption coefficient is determined from the plotting α versus wavelength as shown in Fig.5. The absorption coefficient was increased with the increasing of MgO content in the PVA-PAAm-MgO films. The values of absorption coefficient refer to the indirect energy gap.

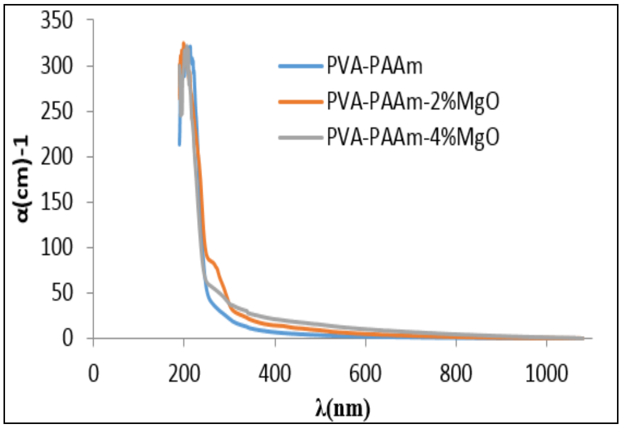


Fig.5: Absorption coefficient of PVA-PAAm-MgO composite for various content of MgO.

The optical band gap of the PVA-PAAm-MgO films was determined by applying the Tauc model [11]:

$\alpha h\upsilon = B\,(h\upsilon - E_g)^n$

where (B) is a constant, α is the absorption coefficient, hυ is the photon energy, E_g is the optical energy gap, and n represents the transition type (n= 2 and 3 for indirect allowed and forbidden transitions respectively). The optical energy gap can determine from plotting $(\alpha h\upsilon)^{1/2}$ versus hυ, the extrapolated from the straight line at α=0 represent the energy gap [12] as shown in Fig.6. The values of energy gap of PVA-PAAm-MgO films are decreased from 4.4 eV for PVA-PAAm film to 3.9 eV for the film PVA-PAAm-4%MgO.

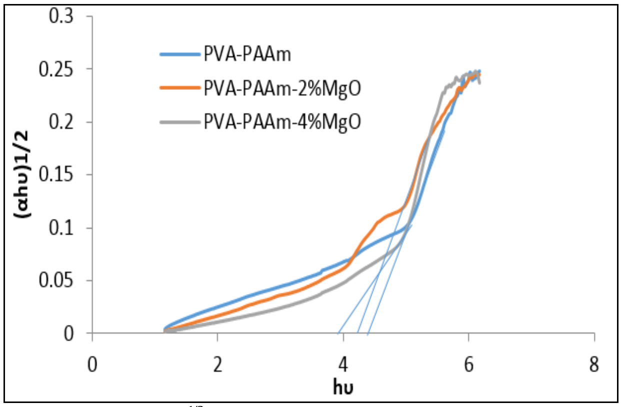


Fig.6: Plot of $(\alpha h\upsilon)^{1/2}$ versus photon energy of PVA-PAAm-MgO composite for various content of MgO.

CONCLUSION:

The films of PVA-PAAm-MgO prepared by casting solution method with various content of MgO. The homogeneity was satisfied from dissolved PVA and PAAm spiritually and the MgO were added. The optical properties were studied from recording the absorption spectra via UV-Visible spectrophotometer, and then the transmittance and absorption coefficient are calculated. The absorbance and absorption coefficient are increased with the increasing of MgO content in the PVA-PAAm-MgO films, while the transmittance decreased. The optical energy gap was decreased from 4.4 eV for PVA-PAAm film to 3.9 eV for the film PVA-PAAm-4%MgO.

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