Light's Influence on Optical Constants of Polystyrene Doped with Valiot Crystal

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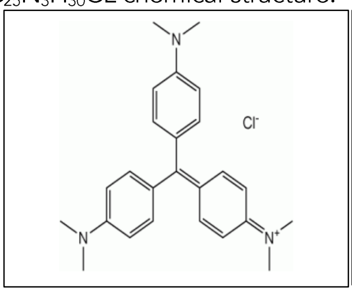
Abstract

Polystyrene (PS) doped with Crystal Valiot dye(CV) at a doping ratio of 1:1 was discovered to have optical properties, absorption, transmittance, reflectivity, and refractive index. Using the traditional casting method, the solutions were deposited on a glass base. These properties were measured with a UV-Visible dual spectrometer over a 300-900 nanometer range. The outcome of the light effect was obvious. If it causes a decrease in absorbance and an increase in transmittance when the membranes are exposed to light.

Keyword: Light effect, Polystyrene, Crystal Valiot, Reflectivity, Reflectivity.

1. Introduction

Dye are organic compounds that absorb light in a specific range of wavelengths that fall in the visible region and do not prevent the molecule from being absorbed, d the absorption of light within this UV dye is light in the ultraviolet region. Regions are accompanied by electron transitions between molecular orbitals that are supported by the dye molecule's structure [1]. The first organic dye that was prepared was dye (W.H.Perking), as it was attended in the year (1865) by the English chemist According to all sources, this is the start of the organic chemical industries, Crystal violet, one of the most important and useful laser dyes in recent years, has received a lot of attention in physical chemistry from both fundamental and applied research [2]. Crystal violet is also an atriphenyltmethane dye. It has antimicrobial properties, is mutagenic, and is used to prevent fungal growth in poultry feed .It is used as a bacteriostatic agent in medical solutions [4,5], so this property helps to treat staphylococcus aurous skin infection [6,7]. Crystal violet is one of the dyes that changes in many studies about molecular structures [8] and electronic states, so it has many applications in sensors and light emitting diodes [9,10]. In our experiment, polystyrene was mixed with the dye Crystal Valiot and then exposed to light figure(1,2) PS $(C8H8)_n$ and CV $C_{25}N_3H_{30}CL$ chemical structure.



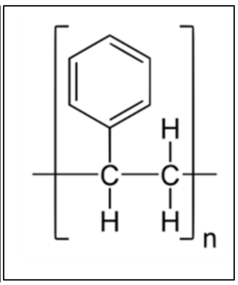


Figure (1): chemical structure of PS Figure (2): chemical structure of CV

Section of the Laboratory

PS doped CV thin films, dissolve 0.015 g of CV in 10 mL of tetrahydrofuran (THF) and stir for 30 minutes to obtain a homogeneous solution, then dissolve 2 g of PS in 30 mL THF with vigorous stirring for 2 hours to obtain a polymer solution. A 2 ml CV solution is mixed with a 5 ml PS solution and poured onto a glass substrate at room temperature to form PS-CV thin films ,as well as, Thin films of CV-stained PS were exposed for 60 minutes in an aluminum box to a TUV 30 W low-pressure mercury lamp (G30T8 Philips) at room temperature. The lamp was 10 cm away from the samples, and it emitted radiation with a wavelength of 253.7 nm and a power density of 21 mW/cm^2. A spectrophotometer was used to measure the change in the absorption spectrum of the samples at room temperature ,and Sigma-Aldrich provided all of the materials used.

2. Results and Discussion

Several factors influence the optical absorbance spectrum, including chemical composition, absorbed photon energy, thin-film thickness, and topography. Several UV-visible spectroscopies were performed in our study using a double beam UV visible laser.

At room temperature, use a spectrophotometer (CE-7200). Thickness (D) of thin films:

The Swanepoal equation was used to calculate the thickness of the thin films (D) prepared within the scope of the study(11) .

$$d = \frac{1}{2} * \left(\frac{\lambda_1 * \lambda_2}{\lambda_1 * n_2 - \lambda_2 * n_1} \right) \ldots \ldots \ldots *$$

Where is the wavelength, and Lowering and raising of the sample.

Absorption

It occurs when the frequency of light scattered within the medium is resonant with the transition frequency of the atoms within the medium, in which case the light ray will suffer from Attenuation in intensity, and it is obvious that light passing through the medium is related to absorption, so light passing through the medium is absorbed.

It is the absorbed light that remains inside the medium, and it is the absorption that determines the color of the material[12]. Figure (3) depicts the relationship between wavelength and absorbance, and it shows that when the thin films were exposed to light, their absorbance began to decrease.

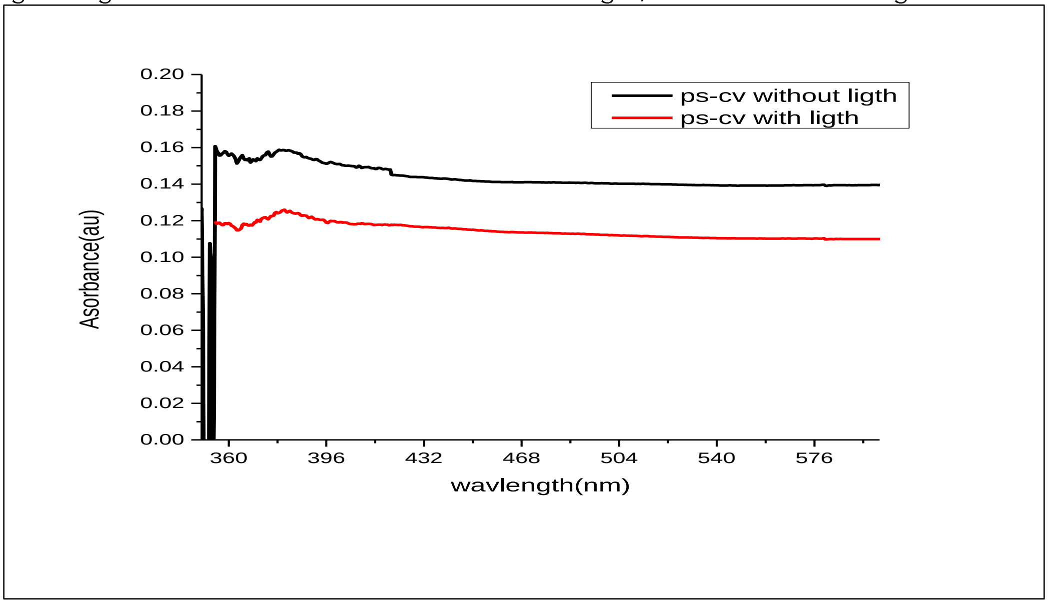
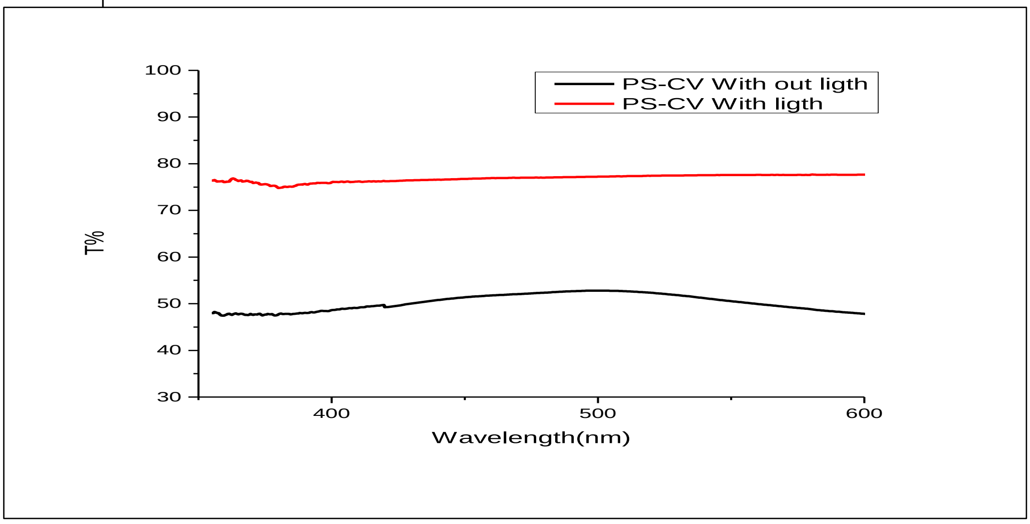


Figure (3): depicts the relationship between wavelength and absorbance.

Transmittance

It is a common optical measurement technique that involves passing a single-wavelength light through a thin solid film and measuring the transmittance intensity as a function of wavelength. The refractive index must be independent of the film thickness for these methods to work(13). Figure 4 depicts this relationship, The transmittance curves are clearly within the range of 47 to 77 percent, stating that the transmittance increases when the membranes are highlighted.



Figure(4): depicts the relationship between wavelength and T%.

Reflectance

When light strikes a material, several reactions occur as a result of the incident rays' interaction with the material, including the absorption process, in which part of the incident light is absorbed by the material and converted into heat, another part passes through the material and is known as penetrating light, and the remaining part undergoes a reflection process and is known as reflected light. The ratio of reflected light energy to incident light energy is defined as reflectance. The equation gives the value of reflectivity with respect to vertical incidence at the angle of incidence[14,15,16]:-

$$R = 1 - \sqrt{T/e^{-a}} \ldots\ldots\ldots *$$

The reflectivity values of a mixture of PS-CV before and after illumination were calculated using equation (*). Figure 8 depicts how the reflectivity decreased after illumination. This is due to the small number of polymer molecules in the solution, and thus the low density of the solution, as the reflectivity depends entirely on the density The figure also shows that after the light is illuminated, the reflectivity values decrease. This is due to the dissociation process that occurs between the particles, which leads to a decrease in the amount of rays reflected by the polymer particles dissolved in the solution[17].

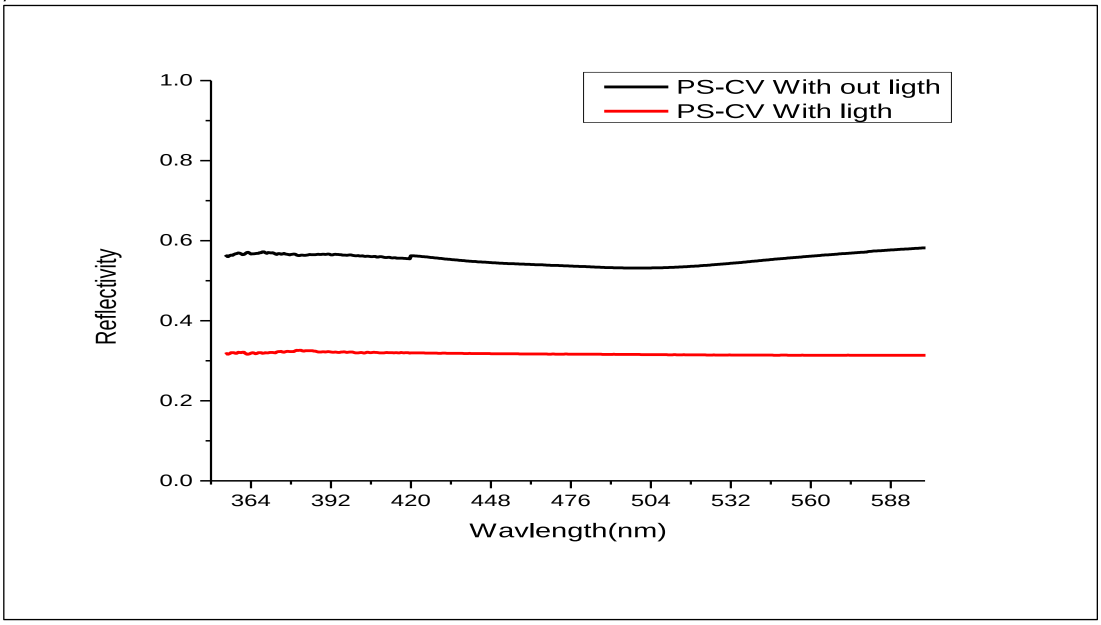


Figure (5): depicts the relationship between wavelength and R

Equation (**)is used to calculate the refractive index corresponding to T_{max} and T_{min} for the same wavelengths. The linear refractive index of the polystyrene polymer with the Valiot crystal dye is shown in Figure 3. It has a lower refractive index and has become more regular than before. This decrease is caused by polymer particle breakage and a lack of density in the resulting mixture. Photo catalysis acts as a catalyst for the dissolution of bonds between compounds in this case [18].

$$n = \sqrt{1+R}/\sqrt{1-R} \ldots\ldots..**$$

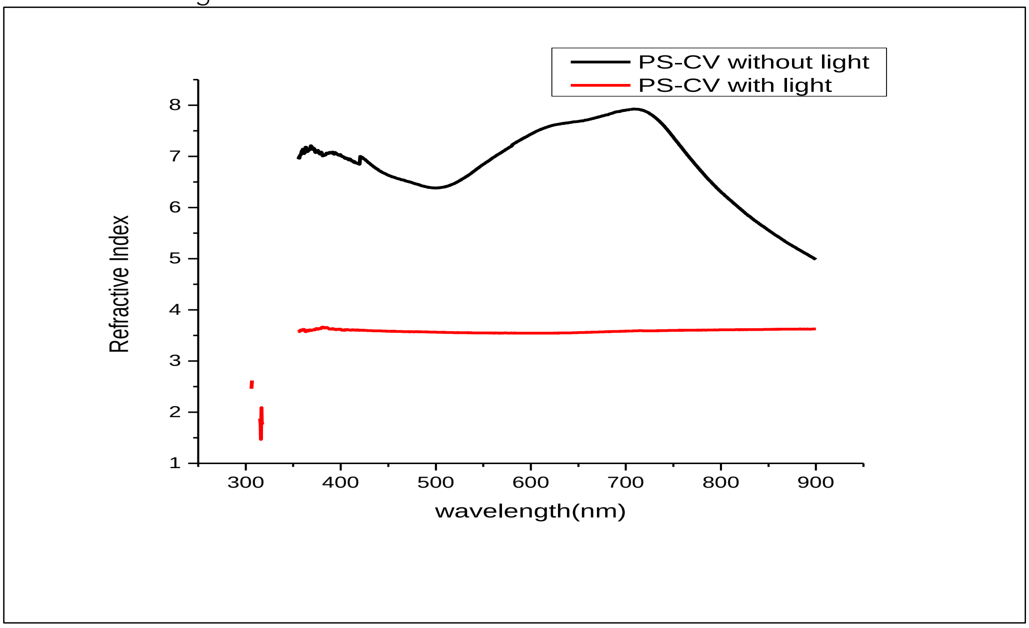


Figure (6): depicts the relationship between wavelength and Refractive index

3. conclusion

When focusing the thin films used in this study. It was concluded that light works to reduce absorption rates, which is useful for the purification of stagnant water, and that these materials can be used in water purification processes. This property is also confirmed by increasing the transmittance and decreasing the refractive index values, resulting in the tendency of these materials to lose color as the duration of illumination increases.

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