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Research Article

Energy Gaps, Donor and Accepter Levels for Polymer Solar Cells Doped with Different Dyes

Enam Izeldin Ibrahim Elsayd†, Mubarak Dirar A. Allah†, Asim Ahmed .Mohamed Fadol‡ Sawsan Ahmed Elhouri Ahmed‡* and Rawia Abd. Algani†

†Department of Physics, Faculty of Science, Sudan University of Science & Technology, Khartoum-Sudan
‡Department of Physics, Faculty of Applied & Industrial Sciences, University of Bahri, Khartoum-Sudan

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Abstract

In this work the energy levels and energy gaps of polymer solar cells values were found when there are doped with Coumarin, Lawsonia, Rohdamin B, Blue 8GX, Roselle, DDTTC and Ero-Chrom black, by means of the values of absorption and transmission spectra, beside values of absorption coefficient- intensity relations of them. The results obtained for shows that the absorption spectra which relates intensity and emitted wave lengths for them gives the values of donor and acceptor levels which are 5.07 eV , 4.41 eV , 5.08 eV, 5.12 eV, 4.57 eV, 4.88 eV, 5.54 eV respectively 2.43 eV 2.25 eV, 2.45 eV, 2.84 eV, 2.32 eV , 2.41 eV, 2.33 eV respectively. The transmission spectra for Coumarin, Lawsonia, Rohdamin B, Blue 8GX, Roselle, DDTTC and Ero-Chrom black is closely related to their energy gaps which were found to be 1.17 *eV*, 3.58 *eV*, 1.10 *eV*, 1.08 *eV*, 3.06 *eV*, 1.52 *eV*, 1.11 *eV these values are in conformity with the results obtained by the absorption coefficient - intensity relations which predicts the energy gaps* 3.55 *eV*, 3.30 *eV* 3.27 *eV*, 3.15 *eV*. 3.08 , 2.94 *eV and* 2.59 *eV which are in agreement with the standard values.*

Keywords: *Polymer, Absorption, Transmitting spectra, Energy levels and Energy gaps.*

Introduction

Today, PV is one of the fastest growing renewable energy technologies and it is expected that it will play a major role in the future global electricity generation mix [René Janssen *et al* 2005]. Solar PV systems are also one of the most "democratic" renewable technologies, in that their modular size means that they are within the reach of individuals, A polymer solar cell is defined by applying semiconducting conjugated polymers as active components in the photocurrent generation and power conversion process within thin film photovoltaic devices that convert solar light into electrical energy [Wang, L., Kang *et al* 2006]. The progress in the field of the polymer based solar cells has been promising with the recently reported power-conversion efficiency of ~6%. Although it is still ineffective to be the technology utilized in commercial products, there could be plenty of room for the improvement in the power-conversion efficiency of the polymer based solar cells[Li G, Shrotriya *et al* 2005] Incident light that is absorbed within the photoactive layer of a polymer solar cell leads first to the creation of a bound electron–hole pair—the "exciton". These excitons diffuse during their lifetime with diffusion lengths generally limited to about 5–20 nm in organic materials [C. J. Brabec, *et al* 2010]. This consideration is important to the design of active layer architectures [Knupfer M 2003]. If an exciton does not eventually separate into its component electron and hole, it eventually recombines by emitting a photon or decaying via thermalization (non radiative recombination). Hence, an exciton dissociation mechanism is required to separate the excitons which have binding energies ranging between 0.1 and 1 eV [Peet, J. *et al* 2010].

*Corresponding author: **Sawsan Ahmed Elhouri Ahmed**

Experimental Work

The absorption spectrum and transmittion of Coumarin, Lawsonia, Rohdamin B, Blue 8GX, Roselle, DDTTC and Ero-Chrom black dyes is shown in figure (1) to (21). The absorption peaks in figure (1) correspond to energy levels E ($\lambda = 244$) = 5.07 ev and E ($\lambda = 508$) = 2.43 ev respectively. in figure (2) the transmission spectrum shows energy gap of $E_g(1050) = 1.17$ ev and the optical energy gap (E_g) 3.55 ev is shown in figure (3).

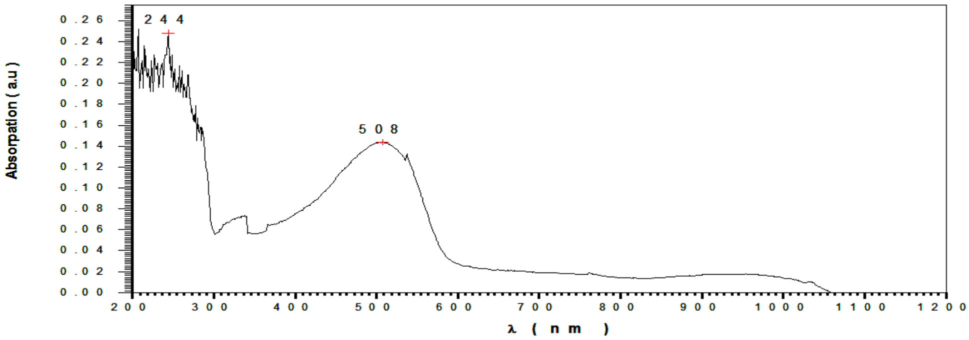

Fig (1): The spectra of Coumarin 500 Absorption in room temperature

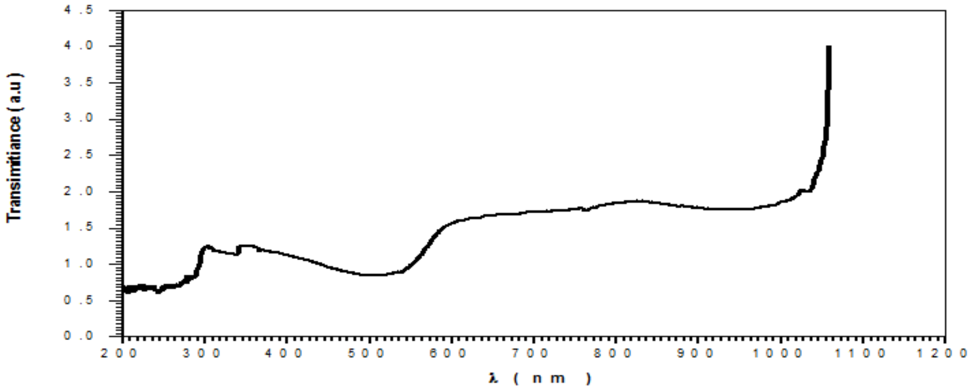

Fig (2): Shows the relation between transparent and wavelength of Coumarin 500

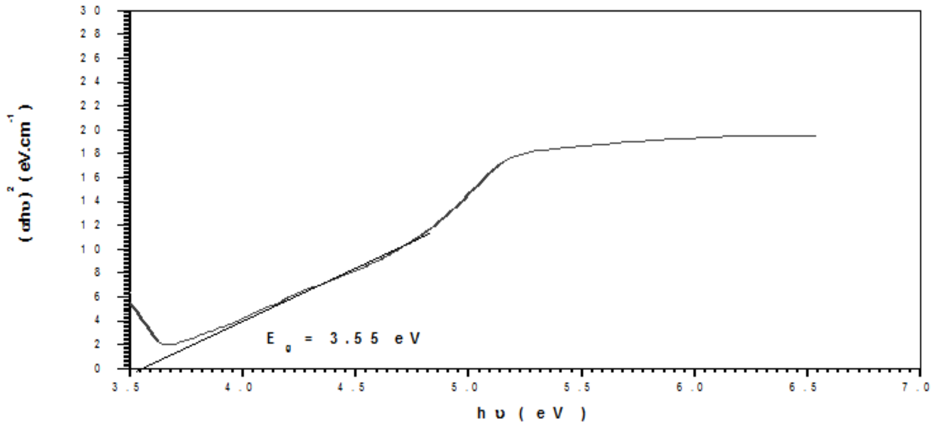

Fig (3): The optical energy gap (E_g)value of Coumarin 500.

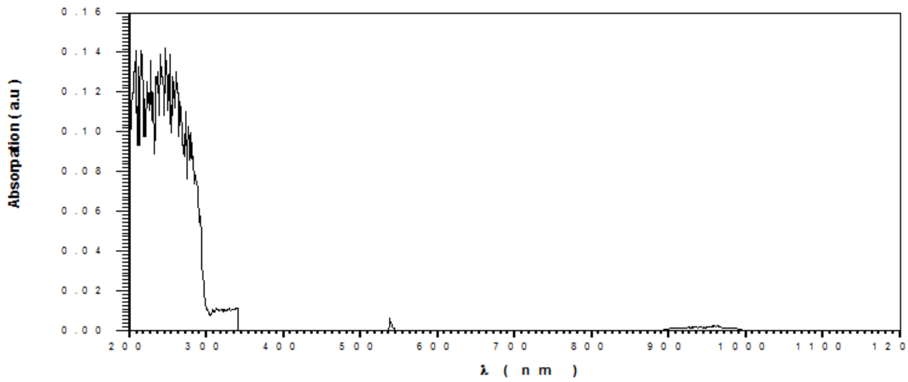

Fig (4): Spectra of Lawsonia Absorption in room temperature

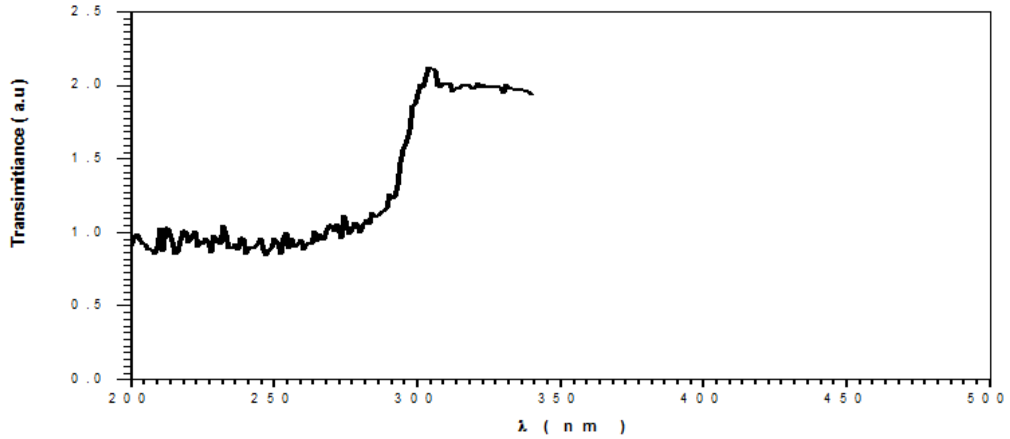

Fig (5): Shows the relation between transparent and wavelength of Lawsonia

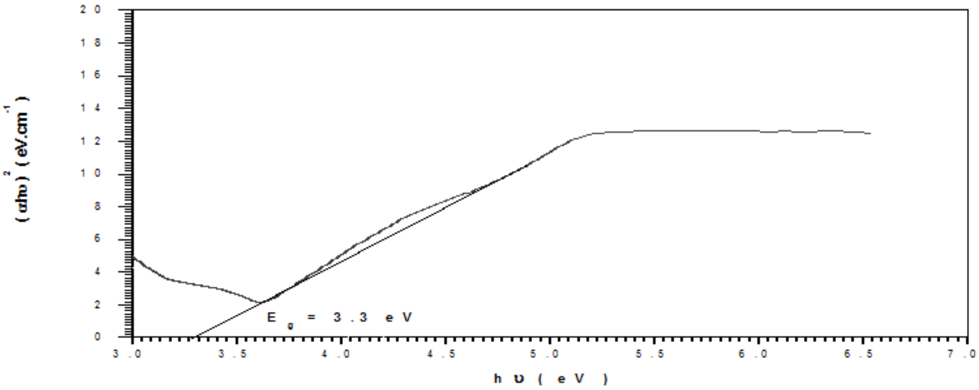

Fig (6): The optical energy gap (E_g)value of Lawsonia

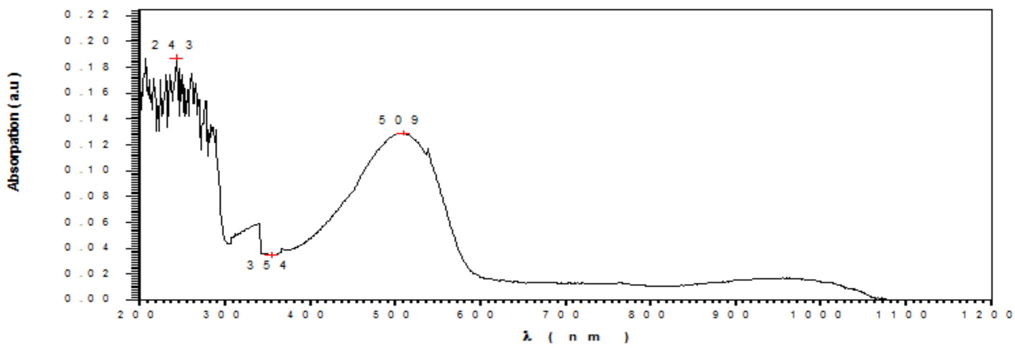

Fig (7): Spectra of Rohdamin B Absorption in room temperature

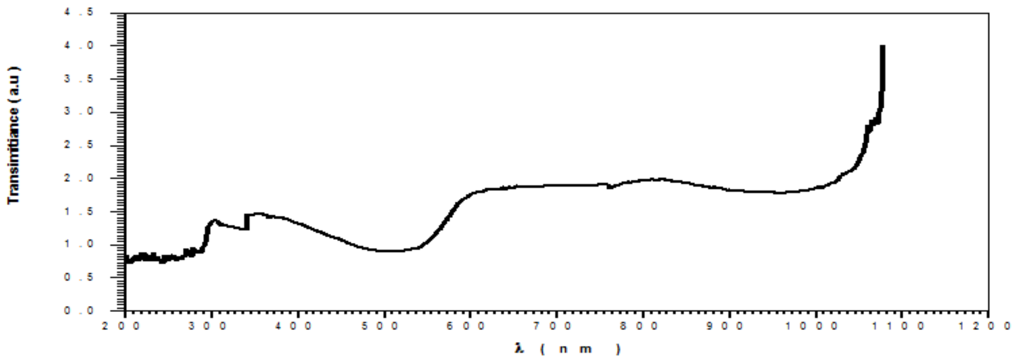

Fig (8): Shows the relation between transparent and wavelength of, Rohdamin B

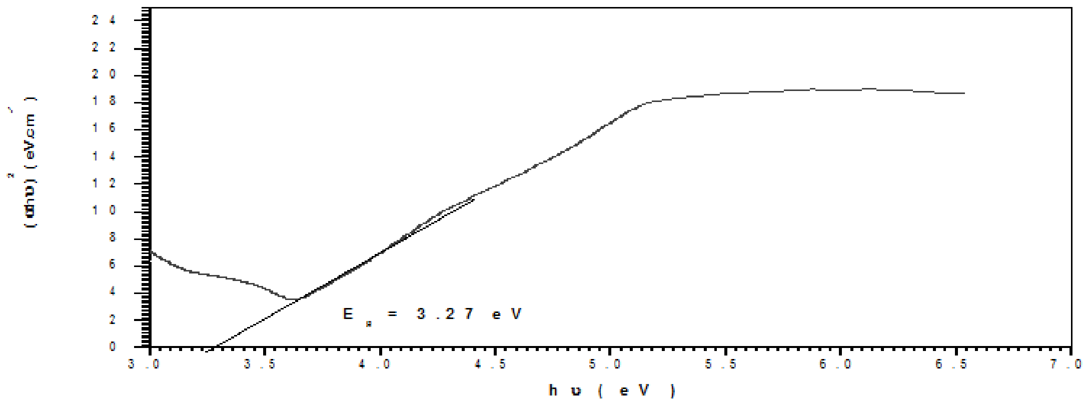

Fig (9): The optical energy gap (E_g) value of Rohdamin B

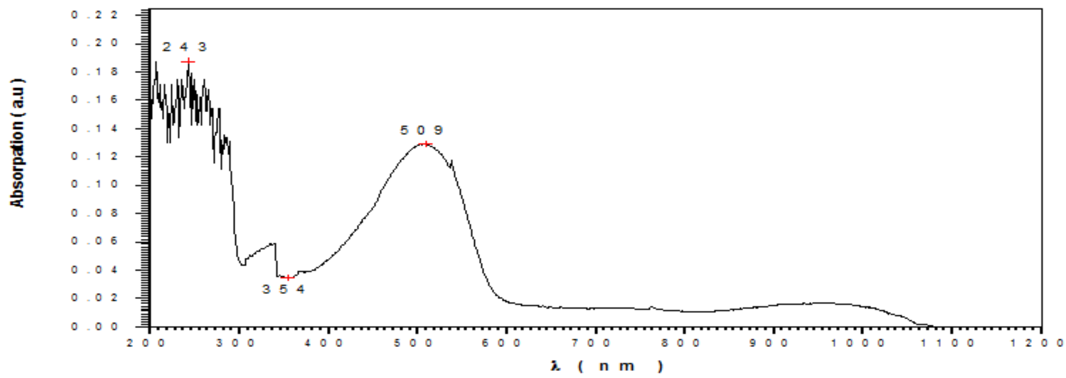

Fig (10): Spectra of Blue 8GX Absorption in room temperature

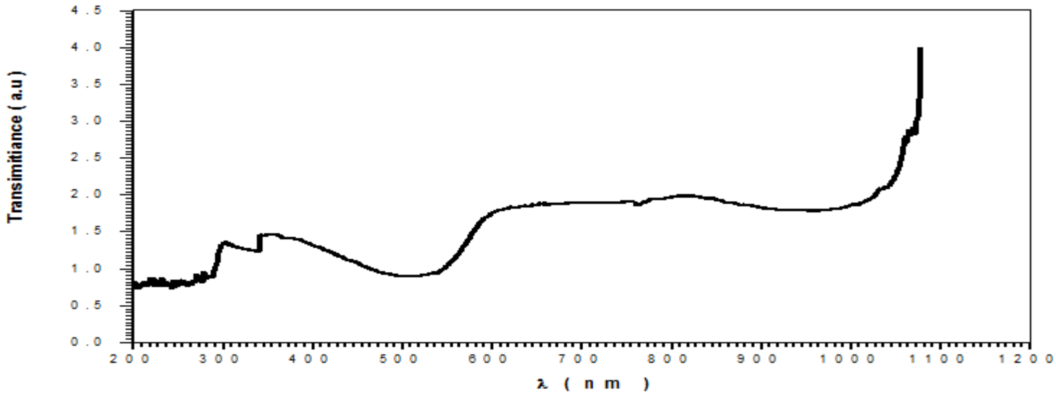

Fig (11) The relation between transparent and wavelength of Blue 8GX

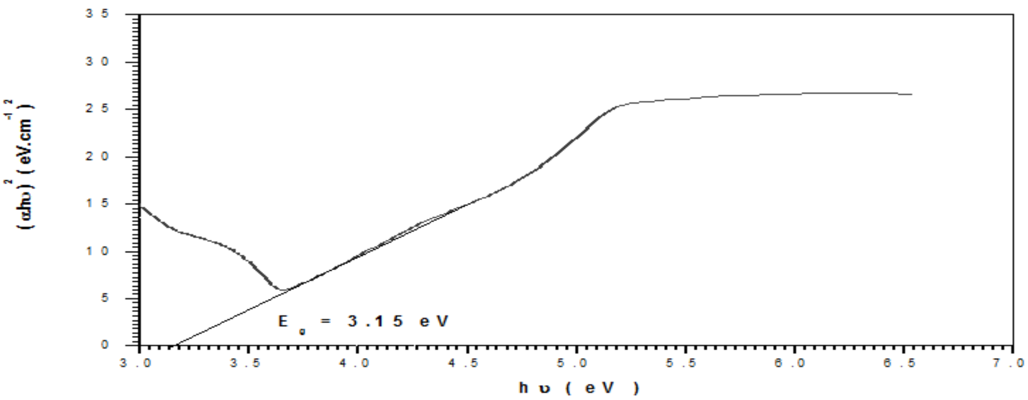

Fig (12): The optical energy gap (E_g)value of Blue 8GX

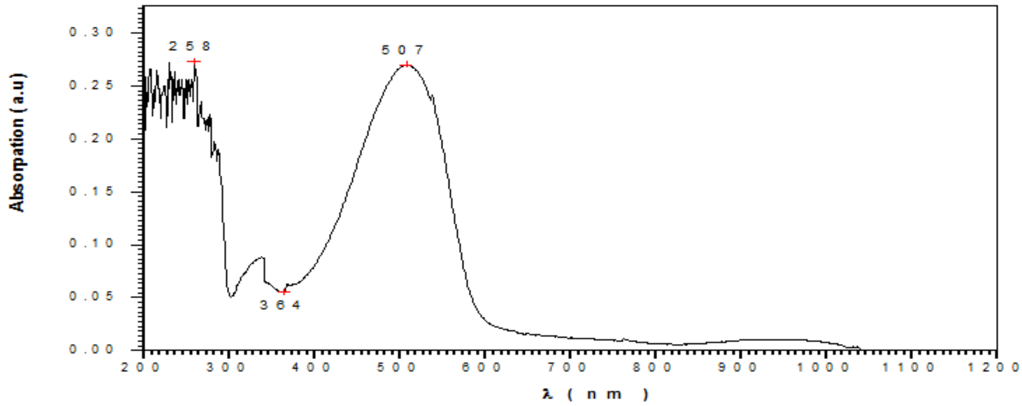

Fig (13): Spectra of Roselle Absorption in room temperature

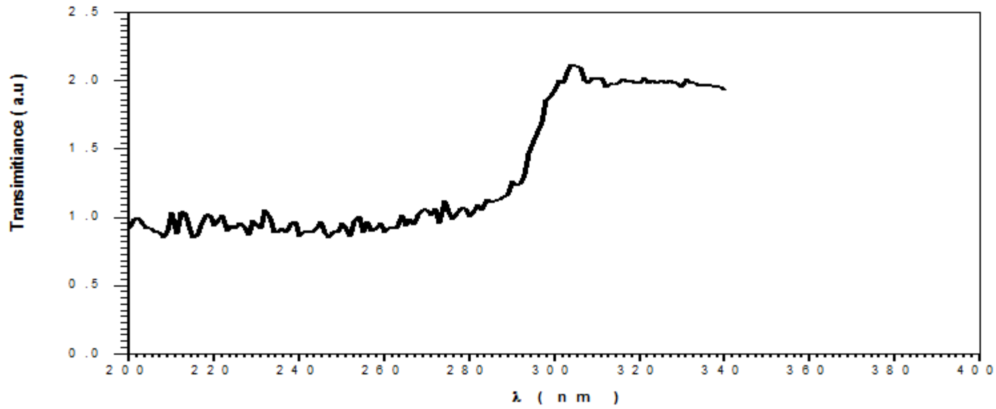

Fig (14): Shows the relation between transparent and wavelength of Roselle.

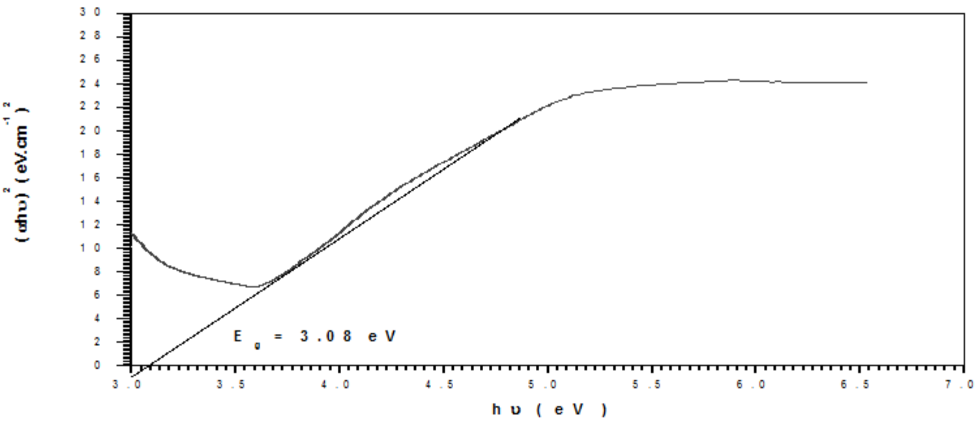

Fig (15): The optical energy gap (E_g)value of Roselle

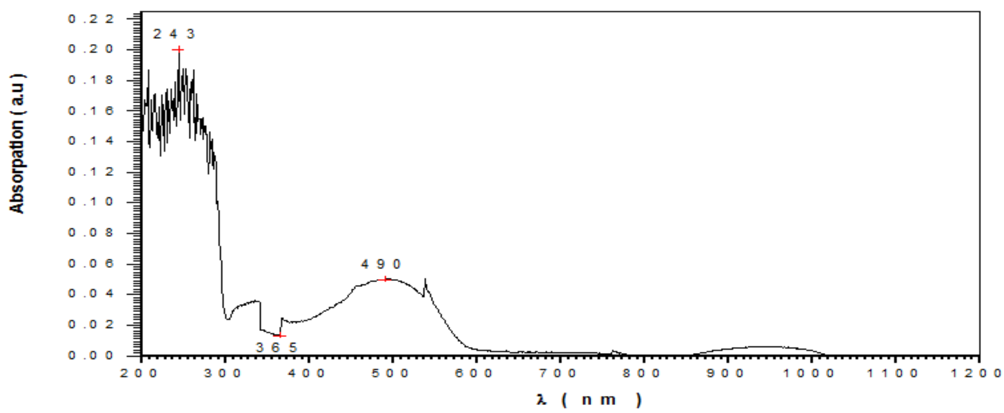

Fig (16): Spectra of DDTTC absorption in room temperature

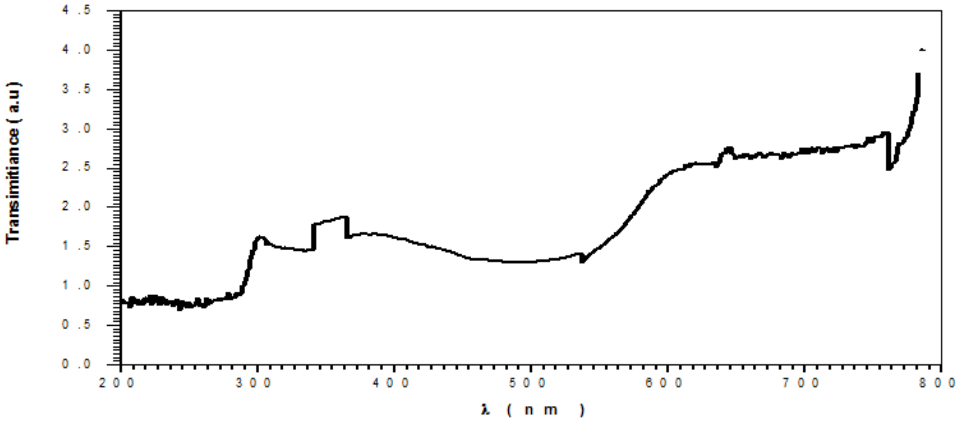

Fig (17): Shows the relation between transparent and wavelength of DDTTC

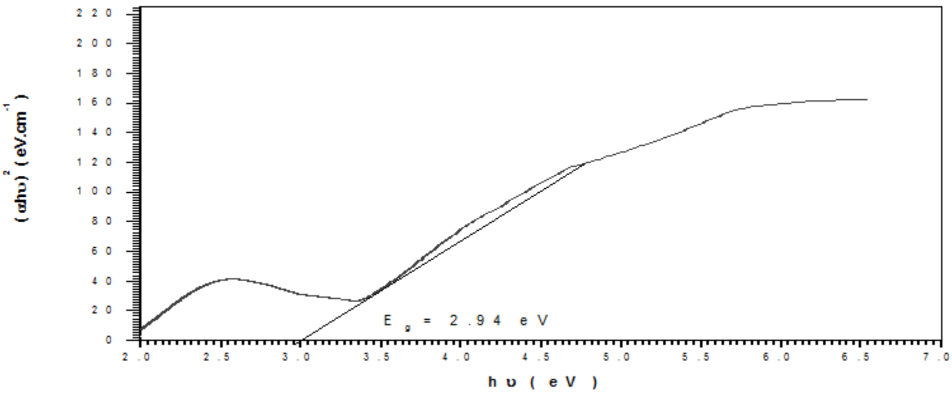

Fig (18): The optical energy gap (E_g)value of DDTTC

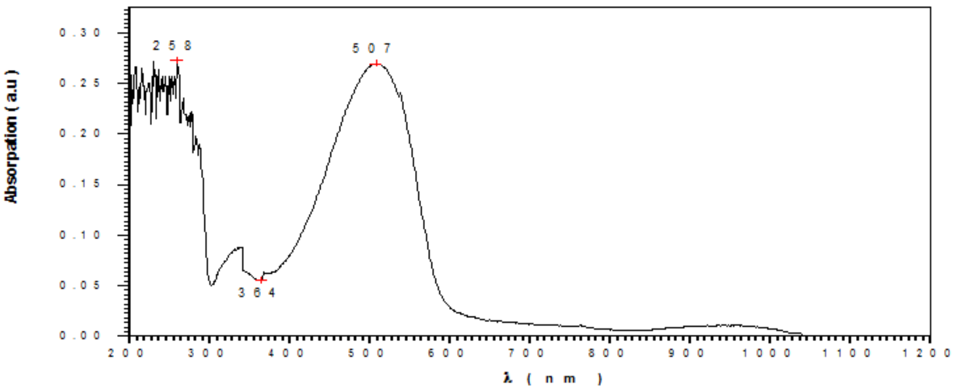

Fig (19): Spectra of Ero-Chrom black absorption in room temperature

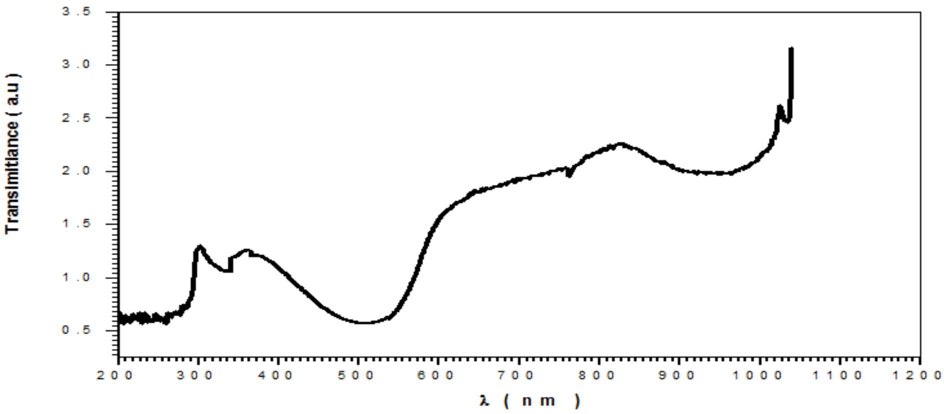

Fig (20): Shows the relation between transparent and wavelength of Ero-Chrom

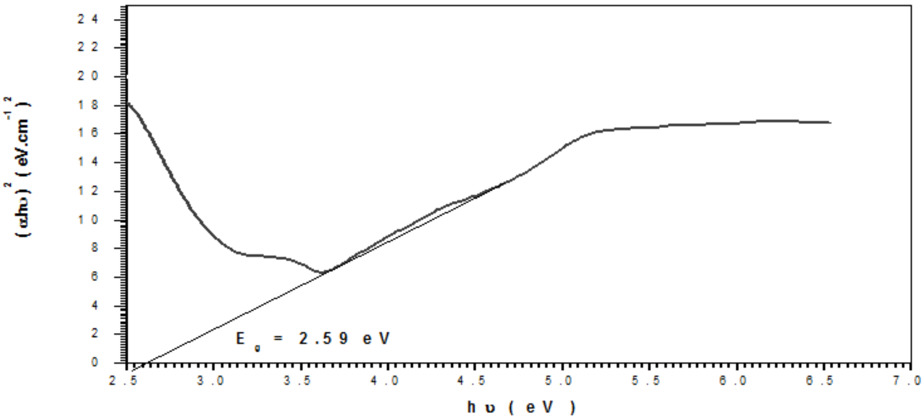

Fig (21): The optical energy gap (E_g)value of Ero-Chrom black

The absorption peaks in figure (4) correspond to energy levels E (λ = 280) = 4.41 ev and E (λ = 550) = 2.25 ev respectively. in figure (5) the transmission spectrum shows energy gap of $E_g(345) = 3.58$ ev and the optical energy gap (E_g) 3.30 ev is shown in figure (6).

The absorption peaks in figure (7) correspond to energy levels E (λ = 243) = 5.08 ev and E (λ = 509) = 2.43 ev respectively. in figure (8) the transmission spectrum shows energy gap of $E_g(1070) = 1.10$ ev and the optical energy gap (E_g) 3.27 ev is shown in figure (9).

The absorption peaks in figure (10) correspond to energy levels E (λ = 233) = 5.12 ev and E (λ = 415) = 2.84 ev respectively. in figure (11) the transmission spectrum shows energy gap of $E_g(1090) = 1.08$ ev and the optical energy gap (E_g) 3.15 ev is shown in figure (12).

The absorption peaks in figure (13) correspond to energy levels E (λ = 258) = 4.57 ev and E (λ = 507) = 2.32 ev respectively. in figure (14) the transmission spectrum shows energy gap of $E_g(385) = 3.06$ ev and the optical energy gap (E_g) 3.08 ev is shown in figure (15).

The absorption peaks in figure (16) correspond to energy levels E (λ = 253) = 4.88 ev and E (λ = 490) = 2.41 ev respectively. in figure (17) the transmission spectrum shows energy gap of $E_g(790) = 1.52$ ev and the optical energy gap (E_g) 2.94 ev is shown in figure (18).

The absorption peaks in figure (19) correspond to energy levels E (λ = 258) = 4.54 ev and E (λ = 507) = 2.33 ev respectively. In Figure (20) the transmission spectrum shows energy gap of $E_g(1060) = 1.11$ ev and the optical energy gap (E_g) 2.59 ev is shown in Figure (21).

Conclusion

The application of conducting polymers to optoelectronic devices such as solar cell. Dyes Structure showed high optical absorption in the range of (200 to 537) nm. To increase power conversion efficiency, structures of the solar cells should be optimized.

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