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STUDY ON OPTICAL PROPERTIES OF NATURAL DYE EXTRACTED FROM ROSE FLOWERS

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Abstract

The natural dye extracted from rose flowers (red, orange, and yellow color) were studied for dye sensitized solar cells (DSSCs) applications. The natural dye was extracted from rose flowers with various solvents. deionized water, ethanol, and methanol were used as a solvent for extraction. The optical absorption spectra and energy band gap of extracted dye solutions were investigated with a UV-Visible spectrometer. The absorption spectra of the extracted were performed in the spectral range from 210 nm to 800 nm. The effects of solvents have been investigated by analyzing the optical properties of including absorbance spectrum, energy bandgap and transmittance of the cell with the best performance were investigated. For photo energy, results show in wide energy bandgap of from 3.2 eV to 3.8 eV, were used as the deionized water, ethanol and methanol solvent.

Keywords: Absorbance, energy bandgap, roes' flowers, UV visible spectrometer

Introduction

In DSSCs, the absorbed dye behaves as a sensitizer for absorbing sunlight. The conservation of solar energy into electricity in the solar cells was based on charge separation. The use of natural dyes extracted from trees, fruits, and vegetables as sensitizers for the conservation of solar energy into electricity is very interesting because it improves the economical aspect and makes an important profit from the environment. In this paper, natural dyes were extracted from rose flowers (red, orange, and yellow color), used as DSSCs photosensitizes. Roes flowers were known as decorative plants famous for their flowers and fragrance. The parts of plants were used in the manufacturing of perfumes, essence, and flower crops. Rose flowers have attractive petals in shape, size and color. The color of flowers varies, white, yellow, blue, black, and red. Dye-sensitized solar cell were energy devices for converting light energy into electricity. Dye-sensitized solar cells of fared the advantages as a new class of low cost and easy to fabricates, and can achieve high solar energy conversion efficiency. Most methods of measuring absorbance required that the compound in a liquid form or dissolved in a liquid solution. This range from 210 nm to 800 nm wavelengths. The dye sensitized solar cell appear to be highly promising and cost-effective alternatives for photovoltaic energy sectors due to its relatively cheapness to produce, environment friendly and promising effacing. In DSSCs, the dye plays an important role in harvesting solar cell energy and converting it to electrical energy with the aid of a semiconducting photo anode.

Absorption of Energy

For light, the energy of the wave was related to the frequency of particular color of light. The energy transferred through space by light obeys the Planck's relationship:

$$E = hv = hf = \frac{hc}{\lambda} \tag{1}$$

Where, h = Planck constant = 6.626×10^{-34} Js

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$$\text{Absorption coefficient}\,(\alpha) = \frac{2.303A}{t} \tag{2}$$

Absorbance (A), or optical density, is a logarithmic function of T and is expressed as:

$$A = 2 - \log(\%T) \tag{3}$$

Where A = absorbance, t = thickness

$$\%T = 10\text{^}\,(2\text{- Abs}) \tag{4}$$

Absorbance is a measure of the amount of light absorbed by a sample as a beam of light pass through it. Transmittance is the amount of light transmitted by a sample and is related to absorbance. The absorbance of light absorbing material is proportional to its concentration in solution. Transmittance was the inverse of absorbance. Absorbance is the light that the solution absorbs whereas transmittance is light passes through a solution. The value of absorption was always low and mostly less than 1 while the value of transmittance was relatively high. Transmittance depends on absorption for occurring while absorption depends on transmittance for calculation. The absorbance of a sample is directly proportional to the path length of the sample holder and the concentration of the sample. Absorbance is measured in absorbance units (Au) and are dimensionless. The natural dyes were availability abundant in nature, renewable, simple manufacturing process, and relatively low price.

Sample Preparation of Dye Solution

Natural dyes (rose flowers) were collected from local market. All sample were extracted from the deionized water, ethanol, and methanol. The raw materials were washed each flower with deionized water and left to dry at room temperature for about two weeks. After drying and crushing into a fine powder using a mixer, 2.5 g of each powder was immersed in 50 ml of deionized water, 95 % ethanol, and methanol solution at room temperature in dark for a day. The extracted were then obtained. They were filtered out to remove the remaining solids of the powders UV-Visible spectrometer was used to carry out the absorption spectra of the extracted in the range for 210 nm to 800 nm.

Result and Discussion

In DSSCs, the dye plays important roles to absorb the visible light and to inject the electrons. The absorbance spectra of the dye were measured between 210 nm to 800 nm. The UV-Vis absorption spectra for the dye solution extracted using different solvents deionized water, ethanol, and methanol solvent were shown in Figure (1), (2), and (3) below. A plot of $(\alpha(h\upsilon))^2$ versus photon energy $(h\upsilon)$ showed intermediate linear region the extrapolation of the linear part can be used to calculate the energy from intersect with $(h\upsilon)$ axis as shown in figure (4), (5), and (6). The resultant value of energy bandgap for red, orange, and yellow rose flowers were found to be about 3.2 eV to 3.8eV for extracted with various solvent. The absorption coefficient of liquid was increased with increasing photon energy, the concentrated dye was the highest absorption coefficient. The dye between the valence and conduction beams work to absorb photon with wide energies. Figure (7), (8), and (9) showed in UV-Vis optical transmittance spectra of all samples the wavelength was in the range between 210 nm to 800 nm. The relation between absorbance and transmittance is all the light passes through a solution without any absorption, then absorbance is zero, and percent transmittance is 100 %. Optical properties as absorbance and transmittance were very important properties for semiconductors tool as detectors and solar cell, and can be calculated from equations (3) and (4).

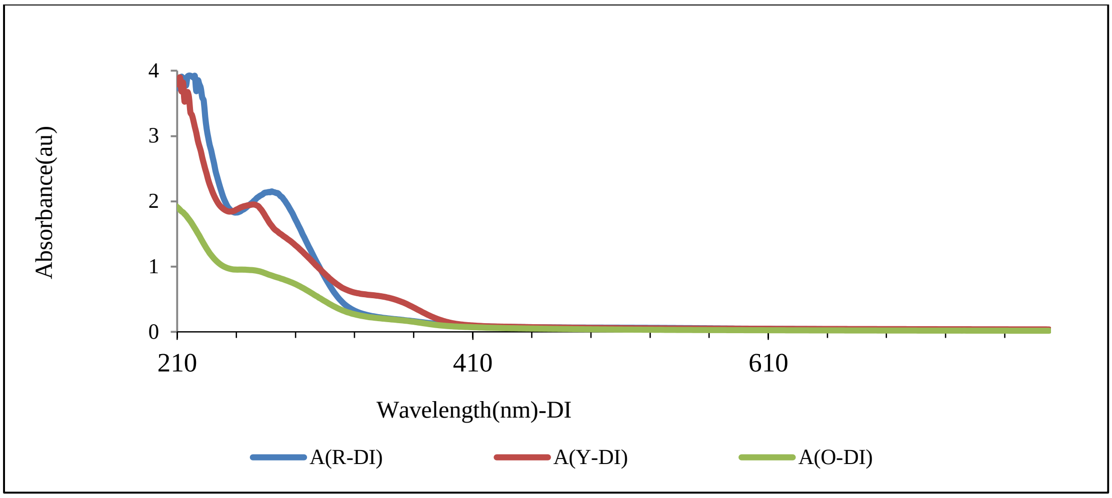

Figure 1 Comparison of UV-Vis absorption spectra for deionized water of dye from rose flowers

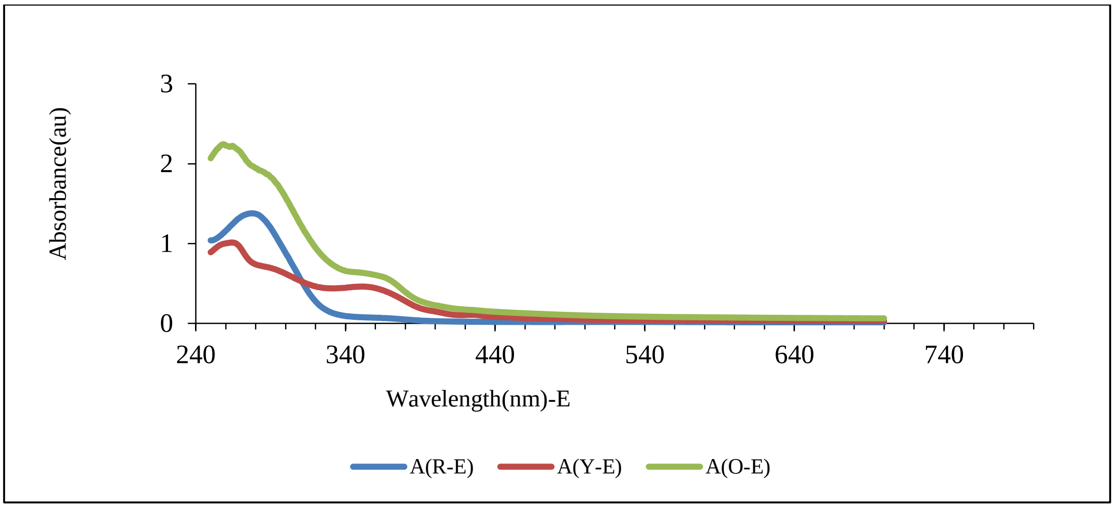

Figure 2 Comparison of UV-Vis absorption spectra for ethanol of dye from rose flowers

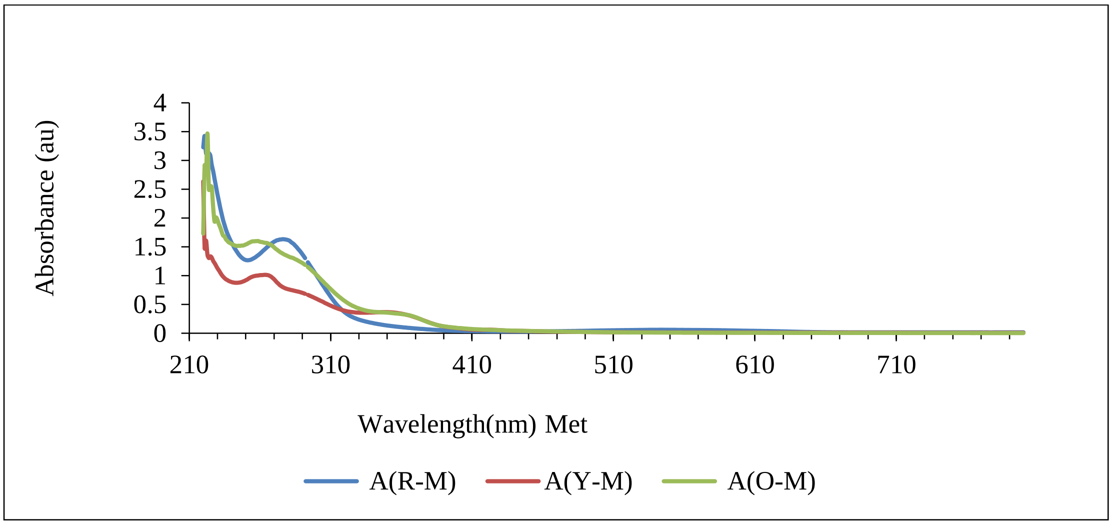

Figure 3 Comparison of UV-Vis absorption spectra for methanol of dye from rose flowers

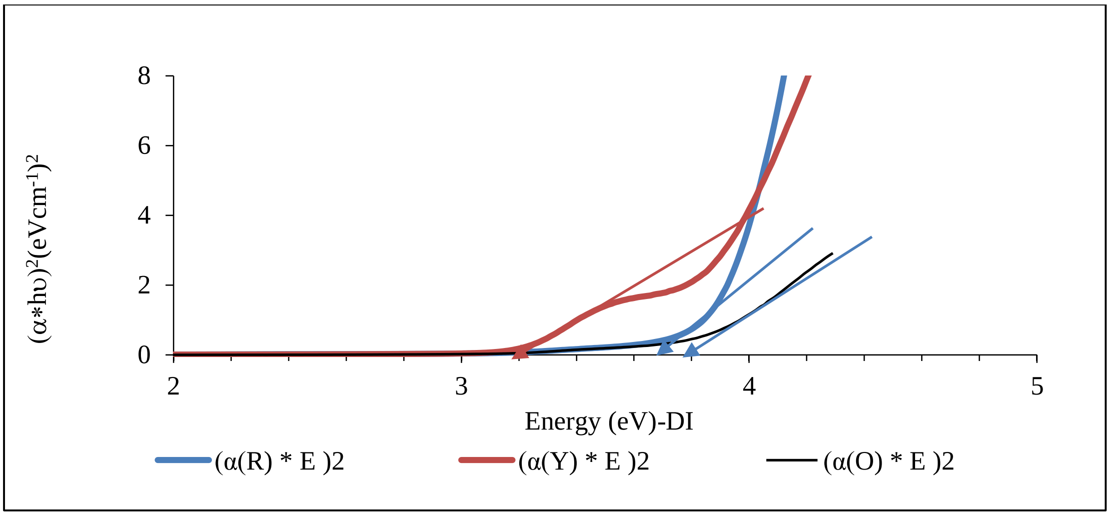

Figure 4 Comparison of $(\alpha(h\upsilon))^2$ versus photon energy (hυ (DI)) of rose flowers

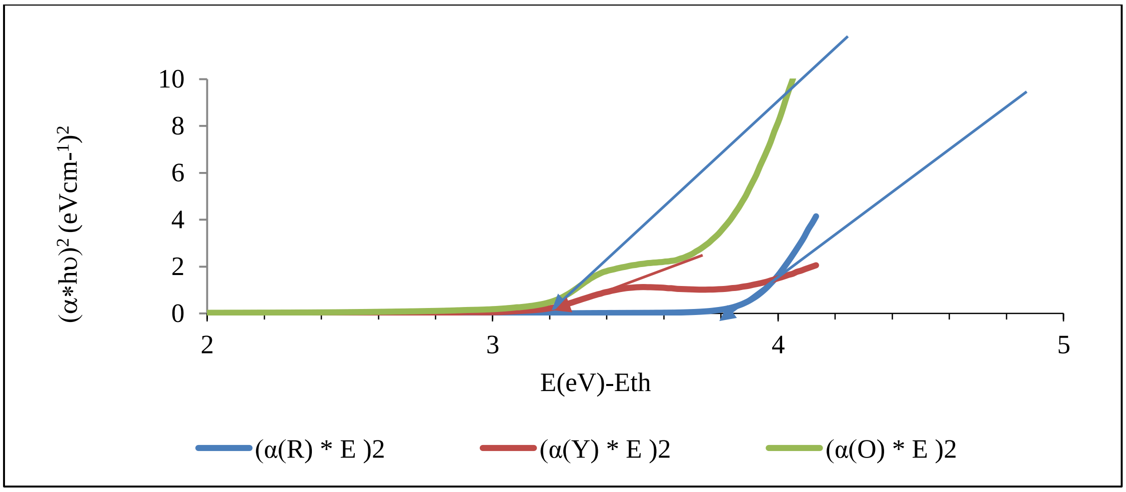

Figure 5 Comparison of $(\alpha(h\upsilon))^2$ versus photon energy (hυ (ethanol)) of rose flowers

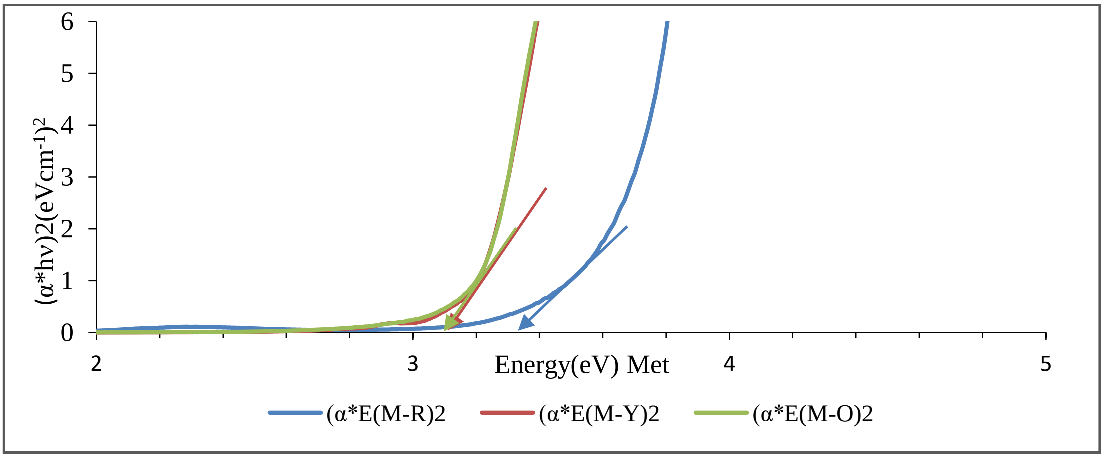

Figure 6 Comparison of $(\alpha(h\upsilon))^2$ versus photon energy (hυ (methanol)) of rose flowers

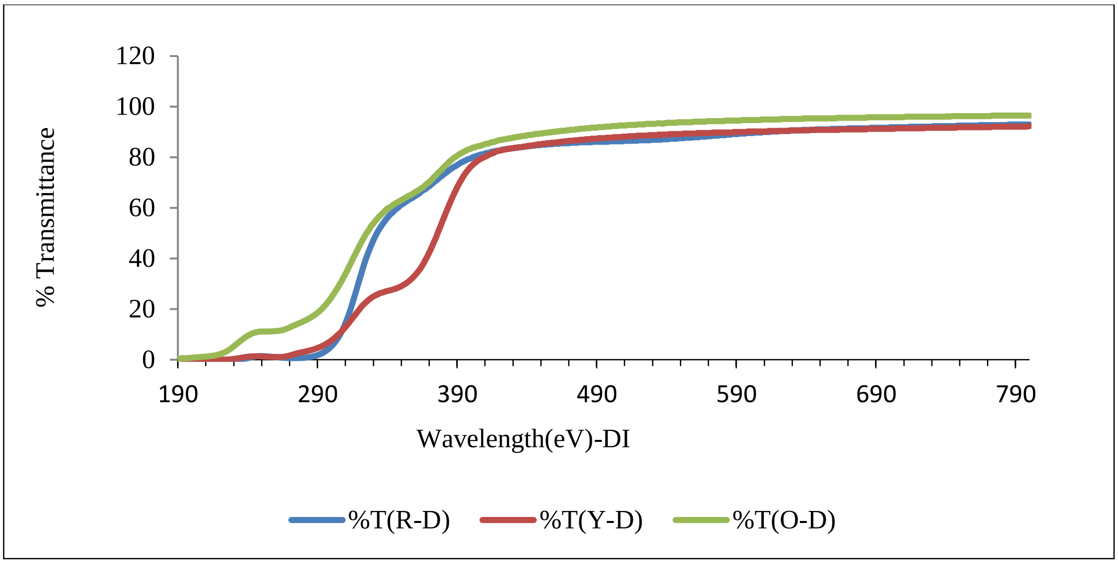

Figure 7 Comparison of transmittance of dyes for rose flowers by deionized water solvent

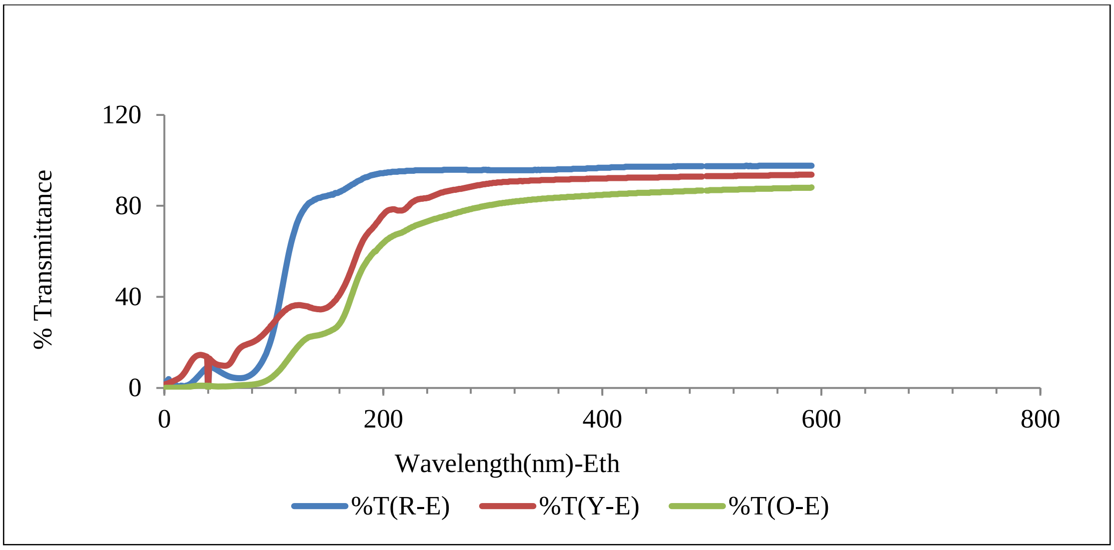

Figure 8 Comparison of transmittance of dyes for rose flowers by ethanol solvent

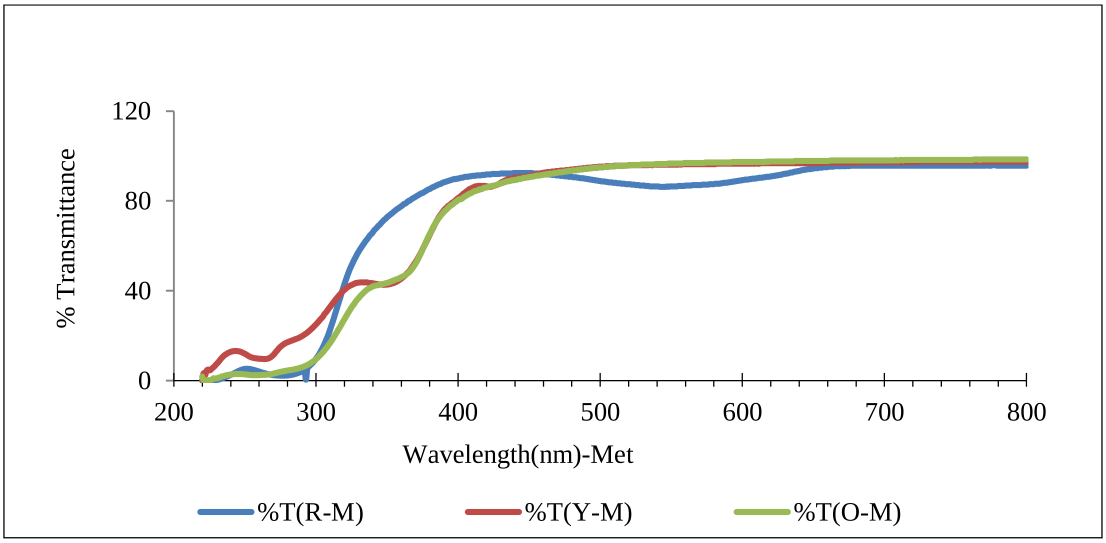

Figure 9 Comparison of transmittance of dyes for rose flowers by methanol solvent

Conclusion

The result was carried out with the aim of fabricating a dye sensitized solar cell, a low-cost solar cell using rose flowers extracted. The natural dye extracted from rose flowers of red, orange, and yellow color were used to build dye-sensitized solar cells. These natural dyes used as a light harvesting material were extracted using different solvents. The optical absorption spectra and energy bandgap of extracted dye solutions were investigated with UV-Vis spectrophotometer. The results from this work for orange, yellow, and red color of rose flowers were 3.2 eV to 3.8 eV with various solvent. It was possible to understand that the dyes extracted from orange and yellow color of rose flowers by using deionized water, ethanol and methanol solvent showed low bandgap. A low bandgap of dye helps the electron move fast from the valence band to the conduction band and only need less energy to the recombination of electrons and resulted high efficiency. Natural dyes as sensitizers, low-cost production, and simple manufacturing technique. According to UV data have low absorbance and high transmittance in the UV and visible regions. Therefore, can be used in DSSCs. The dye extracted in this research work may be applied in use for a part of dye sensitized solar cells.

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