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Natural Dye from Plant in the Application for DSSC

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ABSTRACT

This study is based on the extraction of a photonsensitizer from plant for use as a light sensor in a DSSC dye-sensitized solar cell. According to the FT IR spectra, the dye represents the existing carboxyl group corresponding to the CO=OH stretching vibrations, which is an important functional group that exhibits a reversible bond with a high equilibrium binding constant that enables the photosensitizer to be established with the TiO_2 surface in DSSC. The electrical performance of the cell, such as short-circuit current density (JSC), open-circuit voltage (VOC), fill factor (FF) and overall conversion efficiency (η), was also investigated via measurement of the current-voltage characteristic, as well as the light absorption of the dye loaded onto the TiO_2 film. The resulting study showed that a higher ratio of active compound and greater interaction between dye and TiO_2 will lead to higher conversion efficiencies.

Keywords: natural dye; solar cells; titanium dioxide, DSSC

1. Introduction

This study is based on the extraction of a photonsensitizer from plant for use as a light sensor in a DSSC dye-sensitized solar cell. According to the FT IR spectra, the dye represents the existing carboxyl group corresponding to the CO=OH stretching vibrations, which is an important functional group that exhibits a reversible bond with a high equilibrium binding constant that enables the photosensitizer to be established with the TiO_2 surface in DSSC. The electrical performance of the cell, such as short-circuit current density (JSC), open-circuit voltage (VOC), fill factor (FF) and overall conversion efficiency (η), was also investigated via measurement of the current-voltage characteristic, as well as the light absorption of the dye loaded onto the TiO_2 film. The resulting study showed that a higher ratio of active compound and greater interaction between dye and TiO_2 will lead to higher conversion efficiencies. The Chlorophyll is a bioactive compound that is widely and successfully used as a colorant. There are two main types of green pigment, chlorophyll-a and chlorophyll-b, but excessive heat, light or air can destabilize the product. This destabilization can degrade the chlorophyll product. The structure of chlorophyll is a porphyrin macrocycle with four pyrrole rings. There are four carbons and one nitrogen atom in the pyrrole ring. Nitrogen atom in the pyrrole ring. Among the results found was that methanol was the best solvent for chlorophyll extraction under optimal conditions of 40°C and 180 min.

2. Experimental

2.1 Ultrasonic extraction

This study focuses on the extraction and quantification of chlorophyll in crude extract by ultrasound) varying several factors: solvent type (ethanol, acetone, methanol), time (and temperature (30, 40, 50) [1]. The extract after different time intervals was collected and filtered, and the filtrate was evaporated using the rotary evaporator. The extract obtained after solvent recovery was solid at room temperature. This solid was resuspended in methanol instead of the other solvents used for extraction. Because of its higher proportion as an extracting agent and its polar nature, it can easily dissolve green pigments. The UV spectrophotometer was used for chlorophyll analysis, with the simultaneous equations developed for chlorophyll a and b quantification [2]:

$$\text{Ch a} = 16.29\ \text{Abs}\ 665,2 - 8.54\ \text{Abs}\ 652$$

$$\text{Ch} = 30.68\ \text{Abs}\ 652 - 13.58\ \text{Abs}\ 665,2$$

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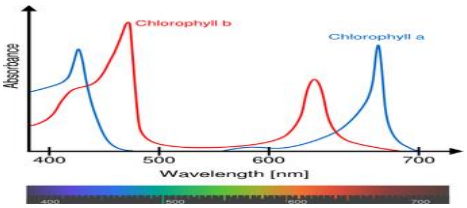
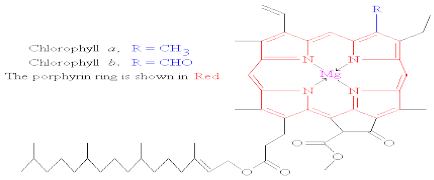
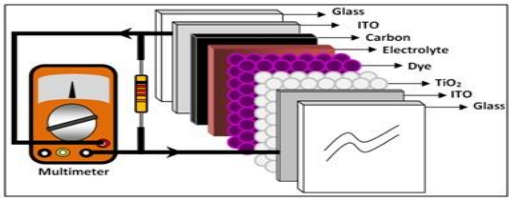




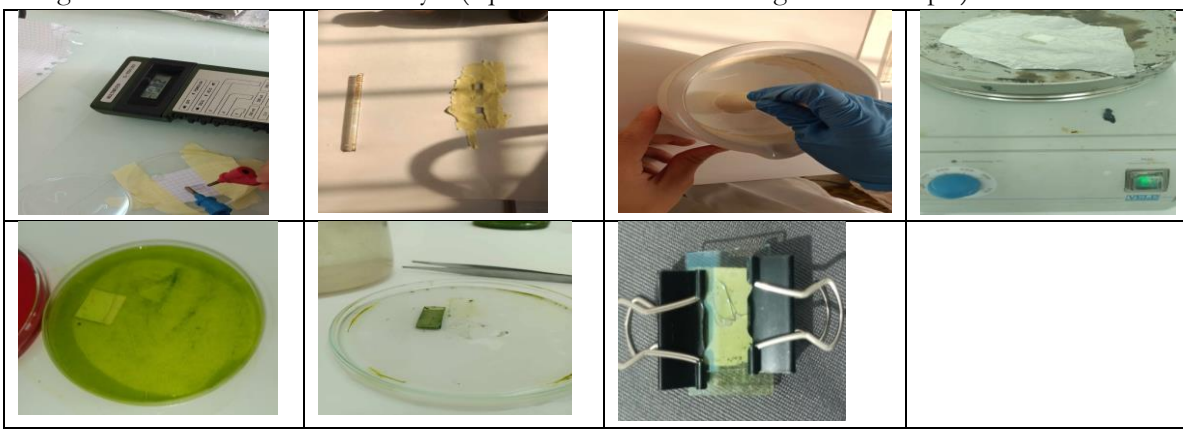
3. Results and Discussion

At 30ºC and 40ºC the yield increased linearly with increasing time, but at 40ºC and 50ºC the yield trend decreased with increasing time. Optimum conditions were observed at 40ºC and 180 min for methanol, which has excellent chlorophyll extraction capacity compared with other solvents, for which the recovery was 12.88 (µg/ml). Chlorophyll a is the main form of chlorophyll present in organisms that carry out photosynthesis. It is also found in small quantities in green sulfur bacteria.

In aqueous media, chlorophyll a has two spectral absorption maxima, at around 430 to 440 nm in the blue and 670 nm in the red. The aim of my work is to develop dye-sensitized solar cells (DSSC: Dye sensitized Solar Cells), based on nanocrystalline porous nanocrystalline electrodes made of metal oxides such as TiO_2- SnO_2- ZnO



They are commonly referred to as DSSCs (Dye-Sensitized -Solar- Cells) or Grätzel cells. In these cells, a layer of TiO_2 titanium dioxide (n-type semiconductor) is coated with a light-absorbing organic dye and brought into contact with an electrolyte (aqueous solution containing a redox couple).



4. Conclusions

In summary, the extracted dye has been successfully used as a light sensor in dye-sensitized solar cells (DSSCs). Absorption spectrum results are measured to characterize the dye's ability to absorb photons in the light spectrum .and to identify the functional group of active components present in dye-sensitized solar cells. The existing carboxylic acid group has a reversible bond with a high equilibrium binding constant that can establish the photosensitizer with the TiO2 surface in DSSCs.

References

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