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CHARACTERIZATION OF CHLOROFORM EXTRACT OF CORDIA MACLEODII LEAF FOR POSSIBLE APPLICATION IN DYE SENSITIZED SOLAR CELL

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ABSTRACT

Dye synthesized solar cells have received intensified research efforts in the past decades in both academia and industry, due to the increasing demand for sustainable clean energy. Dyes play an important role in the high performance of solar cell. Dye sensitized solar cells are a viable alternative to the conventional silicon based photovoltaic devices due to their remarkable conversion efficiencies. As a relatively new class of photovoltaic devices with a photoelectrochemical system consisting of a dye-sensitized semiconductor film and an electrolyte, dye-sensitized solar cells (DSSCs) have been regarded as a promising alternative to conventional solid-state semiconductor solar cells. In this work, we have extracted the natural dye from Cordia Macleodii leaf and the chloroformic extract was further subjected to characterization studies using FTIR spectroscopy to understand the nature of the dye and to find its suitability for dye sensitized solar cell application.

KEYWORDS: Dye synthesized solar cell, Natural dyes, Renewable energy, Sensitizer, Cordia Macleodii.

INTRODUCTION

After more than one decade of development, the photosensitization of wide-band gap nanocrystalline semiconductors by adsorbed dyes has become a realistic option for solar cell applications, and dye-sensitized solar cells (DSSCs) currently present the most promising alternative to the conventional solar cells [1-5]. DSSCs have a very important features in the photoelectrode, which includes mesoporous wide-band gap oxide semiconductor films with an enormous internal surface area, typically a thousand times larger than that of bulk films[6-8]. Dye sensitized solar cells (DSSCs) is considered as a modern photovoltaic (PV) technology for energy production at low cost and a promising alternate to the conventional silicon based PV cells[9]. By using porous TiO_2 electrodes with a roughness factor of ca. 1000 Ru based on a synthesized dye and iodine I^-/I_3^- redox couple in an organic solvent that Gratzel and O'Regan reported a solar cell with efficiency of 7 to 10 % [10]. The dye injects an electron into the conduction band of TiO_2, ZnO or SnO_2, which are also used in DSSC solar cells. The injection of the electrons may occur from the singlet state or the triplet state.

Recently fabrication of low cost and environmentally friendly devices by using a natural dye obtained from the various parts of the plants has a wide application in photosensitizers. Plant pigments such as chlorophylls, anthocyanins, tannins, β-carotene and betalains have been widely investigated in this unique technology. The importance of green chemistry is emphasized in recent days to protect our environment. In this work, spectrochemical investigations of natural dye extracts from *Cordia Macleodii* leaves are carried out to find its suitability as a photosensitizer for possible application in dye sensitized solar cells. *Cordia Macleodii* is a medicinal plant commonly known as Dahi palas belonging to the boraginaceae family. The various parts of the plant have been reported for their antimicrobial activities. The extracted dye solution was further subjected to absorption spectra and Fourier Transform infrared (FTIR) techniques.

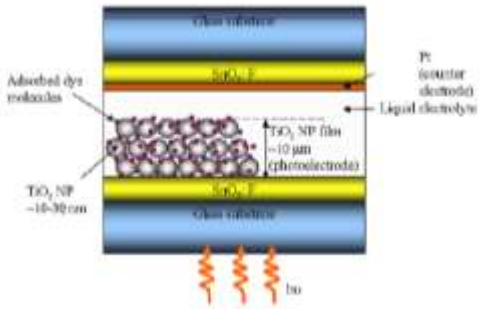


Figure 1. Typical design of Dye-synthesized solar cell

MATERIALS AND METHOD

Preparation and Characterization of dye

The leaves of the selected plant were collected in December 2015 from pusla village which is 110 km away from Amravati. The collected leaves were washed with deionised water to remove the impurities present on its surface. The leaves were then sundried for 10 days to removes moisture content. The leaves were then crushed in mortar and pestle. Then crushed 10 gram of leaves was taken in reagent bottle and 100 ml of chloroform were added into it and left in dark for 48 hr. The crude extract was filtered with a Whatmann filter paper number 41 to remove the solid material and to obtain a clear natural dye solution. The clear chloroformic extract was stored without exposure to sunlight and subjected to the basic characterization studies to be used as a sensitizer for DSC application. Figure 2 shows the chloroformic extract of the leaves. UV-Vis absorption spectra and Fourier transform infrared spectra of the freshly extracted dye were recorded.

RESULT AND DISCUSSION

The absorption spectrum of the dye was recorded to understand its light absorption behaviour. Figure- 3 shows the recorded spectra of the chloroformic extract of the leaves. The dye exhibited a broad absorption peak between 400-500nm. *Cordia Macleodii* leaves is identified to contain β-carotene. The peaks observed in the present work closely matches with the reported absorption spectra of β-carotene in the literature [11-12].

Figure 2. Choroformic extract of leaves

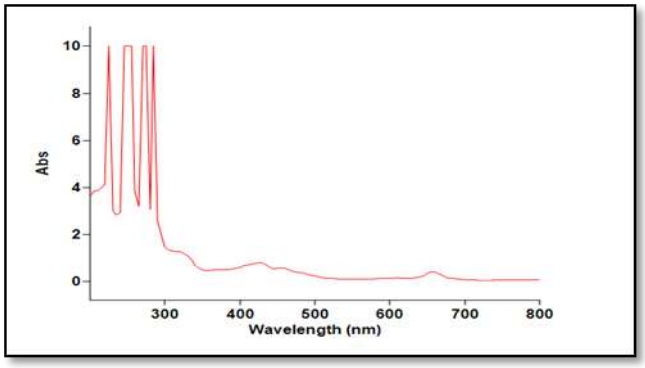
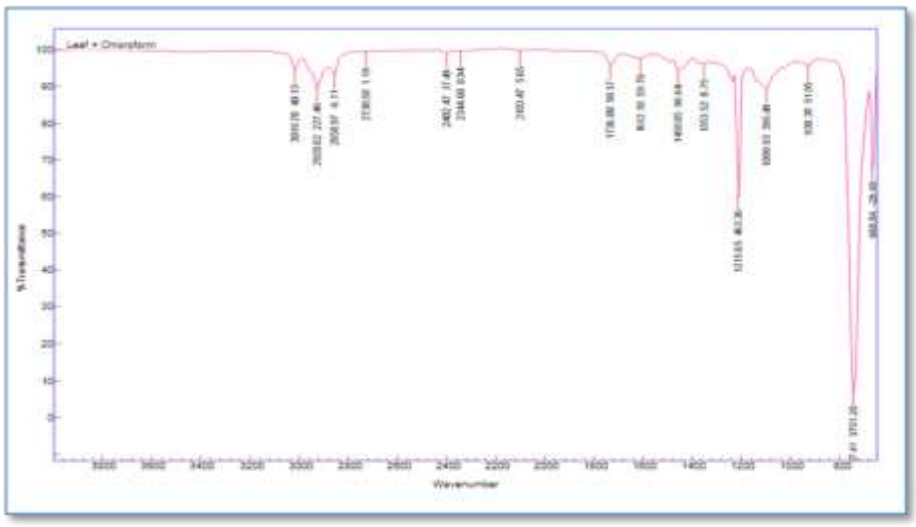


Figure 3. Absorption spectrum of the dye

FTIR Spectrum

The FTIR spectrum is recorded to observe the nature of the bonds in the extracted natural dye. In Figure 4 shows the recorded FTIR spectrum of the dye .The spectrum is observed to closely match with the characteristic peaks of β-carotene reported [13]. The peaks observed at 3019 cm^{-1} corresponds to = CH stretching of alkenes, 2928 cm^{-1} corresponds to -CH stretched of alkanes, 1459 cm^{-1} corresponds to C-C ring, 1353 cm^{-1} corresponds to C-H rock alkane.



CONCLUSION

The dye-sensitized nanocrystalline electrochemical photovoltaic cell in case of global power conversion efficiency of energy to electricity conversion efficiency (η) and cost needed to manufacture such cell has been proven to be serious competitor to today widely used conventional solar systems. The dye was extracted from the *Cordia Macleodii* leaves and subjected to UV-Visible and FTIR characterization studies. The studies carried out reveal the light absorption characteristics and its suitability as a photosensitizer for dye sensitized solar cell applications. Though the efficiencies exhibited by the natural photosensitizers are low compared to the synthetic ones, the results are interesting and emphasis the need for exploring more natural sources for DSSCs applications

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