

101_Performance and Analysis of nanomaterial with organic fruit derived dye materials based Sensitized Solar Cells.

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Performance and Analysis of nanomaterial with organic fruit derived dye materials based Sensitized Solar Cells.

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ABSTRACT

Dye-sensitized solar cell (DSSC) which is an alternative to the conventional p-n junction devices. The key difference of the DSSC over traditional single junction solar cells is the use of an organic dye, which enhances the absorption rate of the wide band gap semiconductor and thereby increases the efficiency of the working electrode. The natural dyes as sensitizers are the emerging sources due to their availability, low cost and environmentally safe. Moreover, absorption field of the dye and their adherence to the surface of the nanostructured TiO₂ are important parameters related to the efficiency of the cell. To have uniformity of layers and precision, the cells are manufactured in house using fully automatic special purpose machine. This study examined the performance of DSSC by using organic dyes with organic and synthetic electrolyte. For testing, natural dyes were extracted from dried black currant, java plum as both this fruit contains large amount of Anthocyanin which is responsible for absorption of light. Parsley extract was also added to both the fruits as it has excellent amount of Chlorophyll which helps in absorption of sunlight as in natural photosynthesis. The concentration level of black java, black currant and parsley were added in the ratio of 2:2:1. The counter electrode used was graphite and the electrolytes used were concentrated vinegar as organic electrolyte and ethylene glycol-potassium iodide as synthetic electrolyte. The performance characteristic of both DSSCs being observed throughout the day of the cell. The performance parameters such as power output and maximum efficiency are plotted and analyzed.

Keywords: dye sensitized solar cell, organic dye, solar energy, non-conventional energy.

INTRODUCTION

The technique of harvesting solar energy is a long time research area and many different technologies were introduced and commercially been adopted for harnessing the maximum solar energy. Some of those are silicon Photovoltaic cell, Perovskite solar cell were introduced and largely been utilized for conversion of solar energy to electrical energy. In accordance to it, further the research focus upon the nano material based solar cell using dye as sensitizer called as dye sensitized solar cell(DSSC). DSSC is quite similar to natural photosynthesis in respect of the mechanism of energy and electron transfer. Gratzel et al. used dyes blended with nanocrystalline TiO₂ which are perfect for charge injection, which led to the expansion of solar cell to a new generation device that surpassed conversion efficiency of 7% in 1991 and 10% in 1993[1]. Ferreira et al, explains about fresh daisy flowers namely Yellow Daisy, Purple Daisy and Wine Daisy based organic dye to be utilized which could attained efficiency of 0.88% [2]. Najm et al. were utilized pinang fruit crusts crushed in a grinder as dye and 400 mL of ethanol based DSSC were tested and attained 0.118% efficiency [3]. Chaudhari et al. manufactured the DSSC using automated special purpose machine and evaluated performance of glass based synthetic dye solar cell [4]. Perez et al. utilizes Vaccinium foribundum(fruit), Hibiscus sabdarifa as sensitizers achieving efficiency of 1.5 to 1.8% [5]. Dye-sensitized solar cells using Aloe Vera and Cladode of Cactus extracts as natural Sensitizers with TiO₂ was used by Ehrmann and Blachowicz and achieved efficiency of 7.4% using Cladode [6]. The dye extracted from papaya leaves treated with ethyl alcohol were utilized in DSSC along with Iodide/triiodide redox electrolyte by Suyitno et al. They achieve maximum efficiency of 2.1% [7]. The exhaustive literature review depict some guidelines for further work with TiO₂ nanopaste which is the most preferred semiconductor layer in DSSC. Organic dye should contain anthocyanin for better absorption of light and it has better conversion efficiency as compared to chlorophyll. The fruits which are high in anthocyanin are blackcurrant, black berries, blue berries as well as in few vegetables such as brinjal (skin), red cabbage.

The objective of this paper to prepare the dye from extract of black current, java plum and parsley. This dye will further utilized with TiO₂ semiconductor for preparation of organic DSSC. With such manufactured cell, experimentation will be performed and discussed about performance parameters under different solar intensities.

METHODOLOGY

Dye Sensitized Cell of 4cm² is prepared from glass of 20*20 mm having Specified Resistivity - ≤15 ohms/sq.cm. The conductive side of Fluorine Doped Tin Oxide (FTO) glass plate is identified using resistive test. With the help of TiO₂ paste and organics dyes and electrolytes one positive side of cell is prepared. The

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