Dry Leaf Litter Extraction as Natural Dye for Dye-Sensitized Solar Cell

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Abstract. Currently, many dry leaf litters are still being futile. Dry leaf litters burning is a bad solution for health and environment. One alternative used is for dye. Natural dye from dry leaf litter extraction can be applied in dye-sensitized solar cell (DSSC). Titanium Dioxide (TiO_2) is deposited onto transparent conductive oxide (TCO) glass by the doctor blade method. Meanwhile, natural dyes are dripped into dry TiO_2. Electrolytes and carbon as auxiliaries for electron flow in TCO. The parameter responses of DSSC with dry leaf litter extract dye following: Voc: 52.8 mV, Isc: 6.8 uA, FF: 0.31 and Pmax: 113,30 nW.

Keywords: Dry Leaf Litter, Natural Dye, DSSC.

1 Introduction

Waste is a problem that often occurs in various sectors. The general environment around the house every day produces leaf litter[1]. The large number of trees makes a lot of leaf litter and left alone. Leaf waste management is still not effective. Large and diverse amounts of waste have grown into complex waste management[2].

According to the Energy Outlook of Indonesia, alternative fuels inflict oil and natural gas down to 60% [3]. One of alternative energy is solar cells. Solar cells develop rapidly with the price of energy growing large in seconds [4]. Dye-sensitized solar cell are modern solar cells with low prices.

DSSC has a big problem which is efficiency. Until now, dye from leaf chlorophyll were used at DSSC as photocatalysts. Another parameter is TiO2 thickness[5]. Characterization needed to see the ability of TiO2 in producing strength and binding dyes. Now, many DSSC fabrications use leaf chlorophyll, such as from Carica Papaya L. Sp., Ricinus Communis Sp.,[6]. The amount of dye, solvent concentration and chlorophyll immersion time affect the rate of light absorption[7]. In this study, the method of coating dyes using dry leaf litter will be discussed to determine its impact on DSSC power. The coating will be used with ultrasonic atomization. This deposition technique is generally used to coat polymeric materials on the surface of the gas sensor[8].

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2 Material and Method

This research is based on a problem that is applicable, that is planning and realizing the research so that it can work as planned. The steps that need to be taken to realize the research designed are how to design a dye-sensitized solar cell (DSSC), how to obtain data or measurements, analysis models and conclusions.

A. DSSC Design

In the DSSC manufacturing process, the first step is to prepare the material to be used. The tools that will be used are washed first using distilled water to remove impurities. For the manufacture of dye the dry leaf litter extraction principle is used. Dry leaf litter is weighed first 30 grams for the ratio of the number of leaves compared to the solvent is 30 grams: 50 ml.

In making TiO2 paste, 1.5 gram Polyvinyl Alcohol (PVA) is added to 13.5 ml of distilled water, then the mixture is stirred with a magnetic stirrer at 40 ° C for approximately 30 minutes until the solution thickens and is homogeneous. PVA functions as a binder in making TiO2 paste. TiO2 powder weighed 0.5 grams, then the suspension that was made was added to the TiO2 powder slowly until a paste with the desired viscosity was obtained.

After obtaining the desired TiO2 paste, the paste is then coated on a TCO glass on the conductive layer using the doctor blading method. The TCO glass which has been coated with paste is then fired at a temperature of 450 ° C for 30 minutes so that the paste is perfectly adhered to the glass. Then the extract of dried leaf litter was coated by ultrasonic onto the TCO glass which was coated with TiO2.

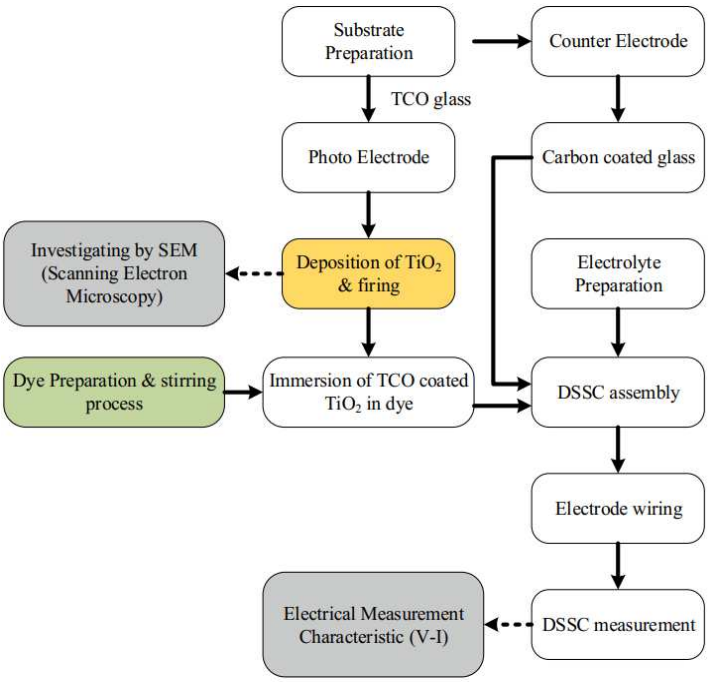

Fig 1. DSSC Manufacture and Measurment

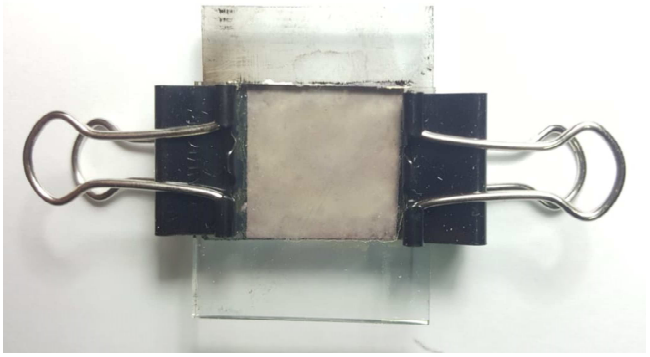

Fig 2. The DSSC Module

B. DSSC Manufacture

The intended design and manufacture are the methods and stages carried out in the design and manufacturing process of the equipment. DSSC design is carried out using a multi-layered structure between DSSC compiler components. The constituent components referred to include substrate, TiO2 paste, dye, electrolyte and carbon. While the preparation steps are coating TiO2 paste on the substrate, drying the paste, shooting the dye using ultrasonic, applying electrolytes, and finally the joining of the substrate with other substrates that have been coated with carbon. The result of DSSC module is shown in Fig 2.

3 Result and Discussion

A. The Layer of TiO_2

Measurements of TiO2 were carried out in the laboratory using a Scanning Electron Microscope (SEM). Thickness measurements were taken at one random point. The measurement results are shown in Fig 3.

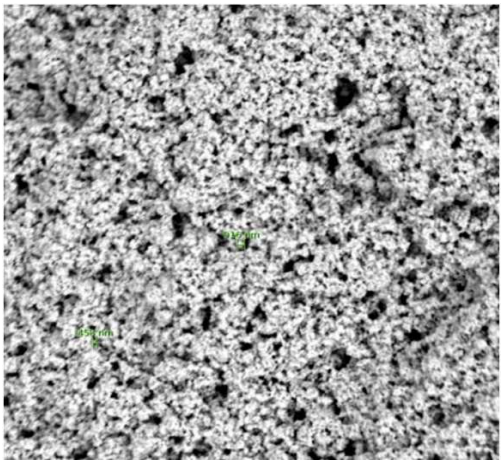

Fig 3. TiO_2 Layer from SEM

B. DSSC Measurment

The module is carried out the Voltage-Current (I-V) characterization. Open circuit voltage (Voc), short circuit current, current and maximum power voltage (Imp and Vmp) are needed to calculate the fill factor (FF) and maximum power output (Pmax) formulated as:

$$FF = \frac{Vmp \times \mathrm{Im}\, p}{Voc \times Isc}$$

$$P\max = Voc \times Isc \times FF$$

After DSSC module done, examination do in sun light. Voc and Isc are shown in Fig 4a and 4b.

(a)

(b)

Fig 4. Measurment Voc and Isc of DSSC module.

Table 1. Measurment Result of DSSC Module

Voc (mV)	Isc (mA)	FF	Pmax (nW)
52.8	6.8	0.31	113,3

C. Discussion

In this research, Module has been design and charactirized. The next reseach is what methode will used for design of module. Another idea was which cloroophyl or dye will used for DSSC.

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