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IMPROVEMENT THE PERFORMANCE OF POLYCRYSTALLINE SOLAR CELL BY COATING WITH MIXTURE OF POLYMER (NITRO CELLULOSE) AND BLUE VICTORIA DYE

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ABSTRACT

Silicon solar cells are one of the broadest sources of clean energy. One of the big problems we face is the low efficiency of solar cells due to high temperatures and therefore this problem was addressed using materials that help to resisting high temperatures and increasing the efficiency. This research study the electrical properties for Silicon solar cells, and focused on enhance the efficiency for these solar by adding an active layer sensitive to the light which is consist of mixture of polymer (Nitro Cellulose) and blue fluorescent dye named victoria where the blue dye work on Expansion of absorption range and the polymer Resists high temperatures. The experimental sequels represent that painting the cell surface with blue dye (victoria) increase the amount of efficiency by (0.673 %).The solar cells was tested under steady intensity of irradiation (I=1000 W/m^2), and variety of temperatures in range (33-70).

Key Words: photovoltaic (PV) , improve efficiency, coating the PV cell

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1. INTRODUCTION

Solar cells convert the optical power of the sun light into electrical power. The sun supplying our planet with more than 10,000 times the energy humans presently used, solar cells which is clean and safe environmentally [1] some materials can be up converting and have the ability to generate photons with a higher energy level from greater number of lower energy level photons

.One of the most important essential device use these type of materials is photovoltaic cells .it is very important to reduce the cost of fabrication increment the efficiency of the solar cells. Silicon is the main component that enters the manufacture of commercial solar cell. However; silicon solar cells not absorb more than 45% from the visible part of sun spectrum because the energy of the coming photons has less band-gap energy of silicon. These photons hold about 20% from the overall energy of sun's radiation. As a result, conversion these sub band gap photons into higher energy photons that can be utilizing by the solar cell to increase the performance of the solar cell. [2][3][4].many ways have been used to enhancing the efficiency of the solar cell where accumulated aluminum oxide (Al_2O_3) was exercised, as back ward surface passivation Insulation layer the best result was obtained by using layer of Al_2O_3 30 nm thickness the efficiency of energy conversion is 20.6%. [5] The incorporated TiO_2 and Al_2O_3 in the active layer of the Polymer solar cell increased the absorbance of the polymer. Solar cells were constructed with coating, and the efficiency was enhanced using a laser. The efficiencies that contain Al_2O_3 before using a laser at 3.7% and after using a laser at 5.6% also the solar cell that contain TiO_2 before irradiate with a laser at 10.052 and 12.3% were investigated [6] novel technique used to increasing the efficiency include coating the solar cell surface with chlorophyll only one time and coating these solar cell surface with chlorophyll and polymer mixture another time gives a perfect solution to get a wide range of solar temperature array with a remarkable efficiency enhancing . The results clear up that the coating of solar cell surface with chlorophyll only increases the efficiency by 5.5 % which is the maximum increase, while coating solar cell surface with chlorophyll and polymer mixture increases its efficiency by 3.1 % only [7]

In this work we study effect of coating the silicon solar cell with mixture consist of victoria dye and Nitro Cellulose polymer on the efficiency of these solar cells.

2. EXPERIMENTAL PART

The experimental work of this study include many essential steps the first step is preparation process of victoria dye and nitro cellulose polymer ,testing the optical properties of the mixture (victoria dye and nitro cellulose polymer)with fluorescence spectrum device, coating the solar cell with the mixture (victoria dye and nitro cellulose polymer)then testing the cell surface by microscope and measure the electrical properties and efficiency of the solar cells with and without coating in different temperatures from the rang (0-70)c^{o} and variable load.

2.1. Dye and Polymer Preparation Process

The mixture (victoria dye and nitro cellulose polymer) was prepared by adding 4.05g of nitro cellulose polymer to 100 ml of ethanol ,then 0.05g of victoria powder has been add to the solution (polymer and ethanol) as shown in fig. 1.

Figure 1 victoria dye and nitro cellulose polymer

2.2. UV–VIS Spectrophotometer Test

The absorbance of the mixture (victoria dye and nitro cellulose polymer) was tested for the rang (190 to 900) nm, the behavior of the victoria could be found by measuring the energy level and the peak of absorption which was got between (400 and 700) nm as shown in fig. 2.

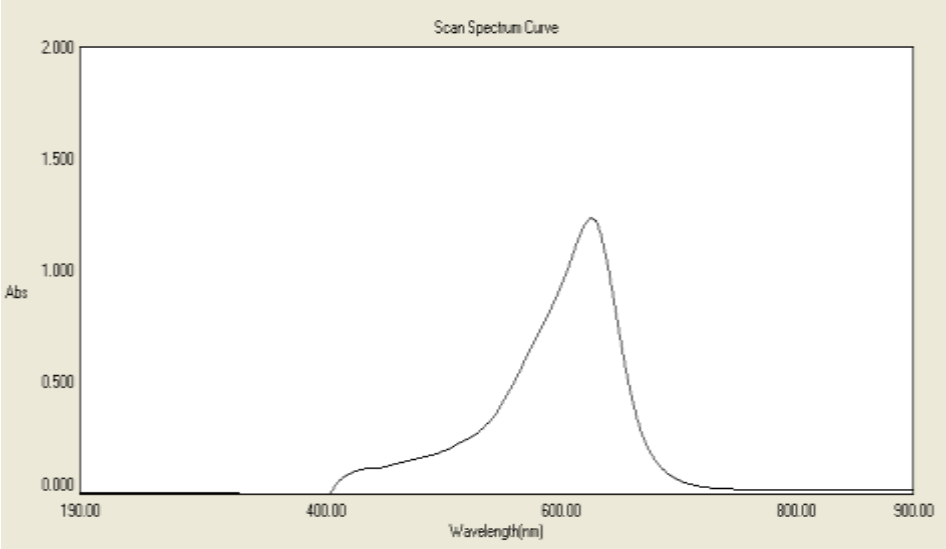

Figure 2 UV test

2.3. The Electron Microscope Test

The solar cells surfaces were coated with mixture (victoria dye and nitro cellulose polymer) by using spray technique. The solar cells was tested using electron microscope which is use abeam of accelerated electrons as sources of lighting to illuminate the surfaces of the solar cells before and after the coting as shown in figs.(3 &4).

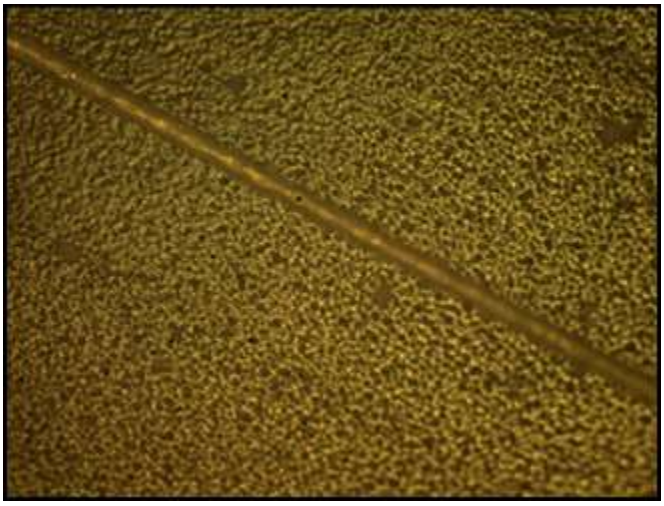

Figure 3 The solar cell without coating

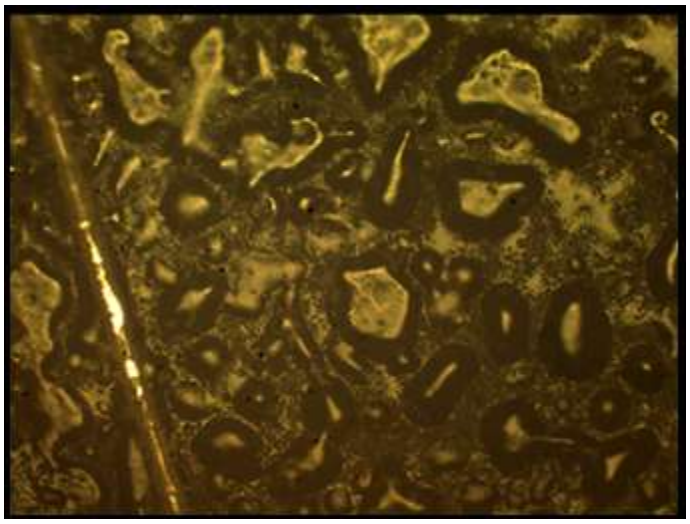

Figure 4 The solar cell with coating

2.4. The Electrical Properties Test

The solar cells dimensions 'used in this study is 39 x 31.2mm,the type was polycrystalline silicon solar cell panel, average current:0.4a , its power: 0.02w, average voltage: 0.5v, where the solar cell investigated at constant solar intensity (i=1000 w/m^2). Many devices were used for measuring the electrical properties of the solar cells as shown in fig. 5:

1. The source of illumination: halogen lamp as a source of solar irradiation.

2.the optical detectors were used to measure the solar irradiation intensity of the halogen lamp.

3.thermocouples (six) were used to measure the temperatures of the solar cells. The temperatures were recorded by data logger.

4.variable resistance device was used to change the load on the solar cells.

5. Digital voltmeter and ammeter was used to measure the output voltage and current of the solar cells.

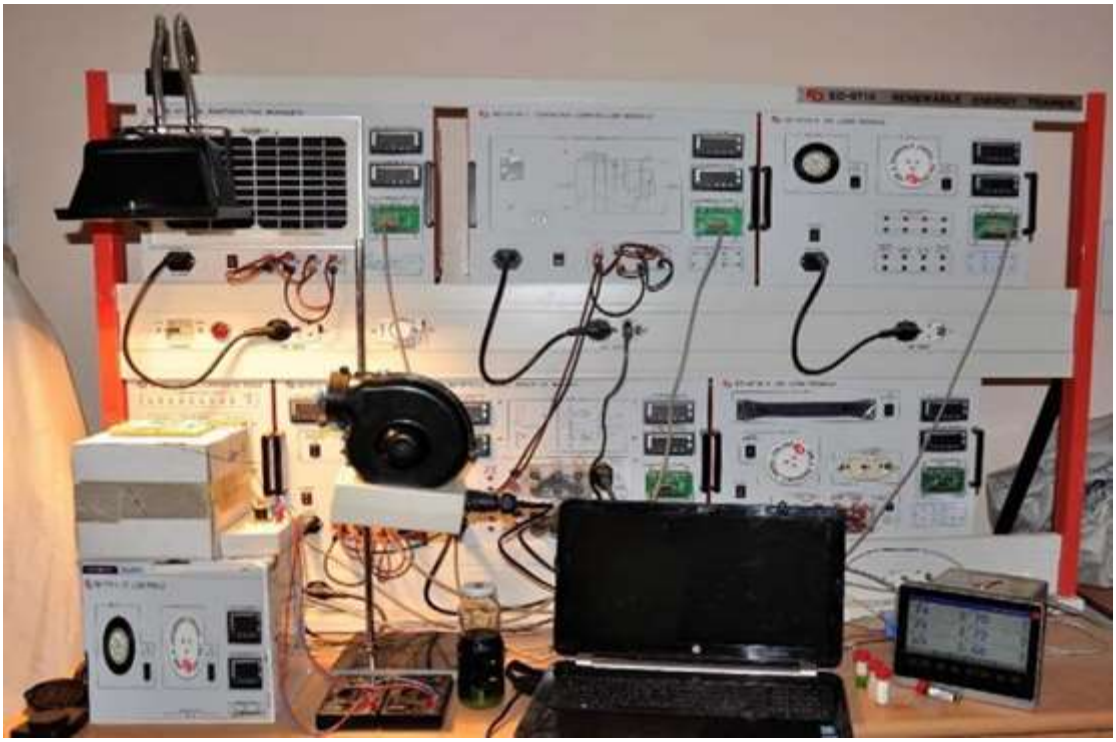

Figure 5 The experimental set up

3. RESULTS AND DISCUSSIONS

The sequel that found in this work analysis of the performance of the solar cells with and without coating with the mixture, the fluorescence spectrum for the used mixture and the electron microscope test for the solar cell before and after coating.

As observed from figs. (6, 7, 8) the performance of the solar cells became better, the cause is refer to adding the blue dye victoria where coating these dye to the surface of the cell increasing the amount of absorbance and the range of it in the visible region where the peak of the measured absorbance is in wave length (625) nm was (1.24) which is very suitable for solar cell because the principle work of solar cell is convert the visible part of the electromagnetic spectrum to electrical power[7][8]

Adding the polymer (nitro cellulose) to the dye is to increase dye resistance to high temperature where the polymer (nitro cellulose) was add for many reasons: low cost, high temperatures resistance where mixing the polymer with the dye increase the dye to the high temperature, the intensities mass lost for nitro cellulose was began from 180c^{o} which was very suitable for solar cells because the temperature is one of the main factor of decreasing the efficiency of solar panels also it help prevent dust accumulation on the surface of the solar panels.[9][10].

It is clear from the figs. (3 &4) the observed change of the surface of the solar cells after coating where the figure observed change in the shape of the surface and the distribution of the mixture on the solar cell.

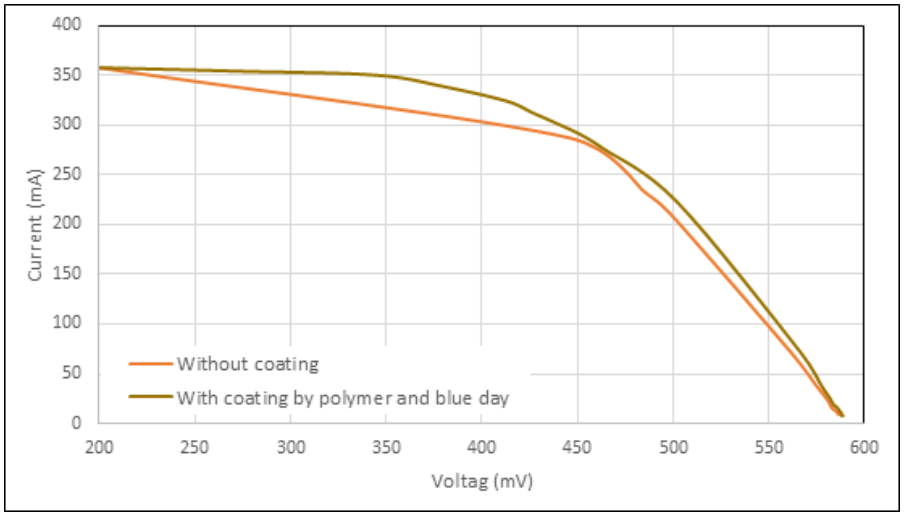

Figure 6 The relationship between voltage and current with and without coating.

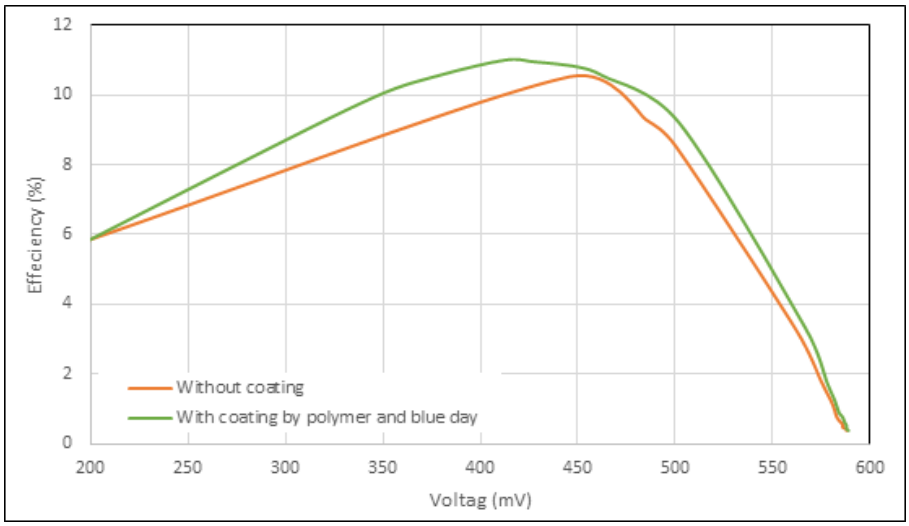

Figure 7 The relationship between efficiency and voltage with and without coating.

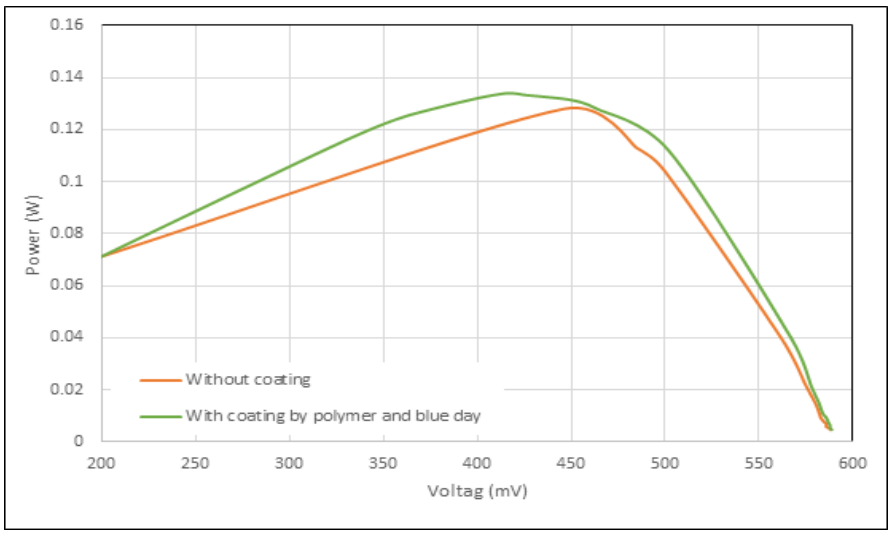

Figure 8 The relationship between power and voltage with and without coating.

4. CONCLUSIONS

The result that shown in this study, was clarified that the performance of the solar cells was advanced after coating the surface of the solar cell with a mixture consists of (victoria dye and Nitro Cellulose polymer) where the efficiency was increased with amount (0.673 %) ,the solar cell's absorbance was increased because of using the victoria dye, the polymer Nitro Cellulose was used for increasing the solar cell to the high temperature resistance and it help prevent dust accumulation on the surface of the solar cell.

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