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The Study of the Efficiency of Silicon Solar Cell

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ABSTRACT
In this work, we examined the influence of temperature on the mean power out of silicon solar cell. Sensitive digital ammeter and voltage were connected in series and parallel across the silicon solar cell housed in a plastic encasement with clean anti –reflection with 100W electric heater to provide variation of temperature which was kicked started with 25^0C and increased in step up to 100^0C . Open circuit, reverse bias current and voltage were taken at various temperatures and the mean power computed from the values of shunt resistance for all temperature values.
Keywords; Silicon Solar cell, Temperature, Open circuit, Voltage, Current, Reverse bias Mean power,

INTRODUCTION
Based on energy crises that evolved as a result of technological development on the recent time, alternative mechanism of developing a means that would enable harness of energy from the sun which is an alternative source of renewable energy is on course [1]. Efforts have been dedicated to the development of solar cells of different form from semiconducting elements, other novel elements like polymer thin film [2] with focus on performance of the cell as its surrounding temperature increases [3][4]. This is common because it is clear that amount of photo generated current increase a lightly with increasing temperature which is a result of increase in the number of thermally generated carrier in the cell [5]. Lot of scientist have studied the variation in output of solar cell system with ambient temperature over years [6][7]. Radzimska has gone further to study the influence of temperature on the spectral characteristics of open circuit voltage of single crystalline solar cell during this, he found that the radiation rate coefficient of short circuit current limit of solar cell lead to a decrease in output power performance as a result of its effect on the conversion efficiency[8][9].
In this paper, we want to examine the short circuit current I_{sc} , open circuit voltage V_{oc} of Silicon Solar Cell and their influence on the maximum power output performance at different temperature
Keywords: silicon solar cell, Temperature, open circuit, current, voltage, mean power, electric heater, influence, reverse bias.

EXPERIMENTAL PROCEDURE
The apparatus used for this research include the following: 6V50mA solar cell that consists of 3.0 volt silicon cells connected in series. The cells were housed in a plastic with a clean plastic anti-reflection corner and the positive and negative protruded at the end of the cells. Connection wire for connection, lamp holder for holding the 100watts electric bulb, 100watts electric bulb used for illumination, volt meter, and ammeter used to measure the voltage (0-1) and current (0-2v) respectively. Thermometer used to measure the surface temperature of the cell. Room heater was used to provide the temperature.
6V50mA silicon cell were connected in series to form 3.0 Volt solar cells. This was housed in an anti- reflective plastic encasement in which a provision for protrusion of both positive and negative terminals at the end of the cell respectively. Sensitive digital ammeter and voltmeter were connected in series and parallel across the cell for measurement of open circuit current and voltage I_{osc}, V_{osc} respectively. The variation of the temperature was achieved by using 100W electric heater. Reading was taking starting from temperature of 25^0C sequently repeated at every step of 5^0C up to 100^0C. The temperature was measured using digital thermometer. From the readings, we computed shunt resistance which is the inverse of the of reverse bias current against reverse bias voltage. The mean power output was calculated for the temperature accordingly.

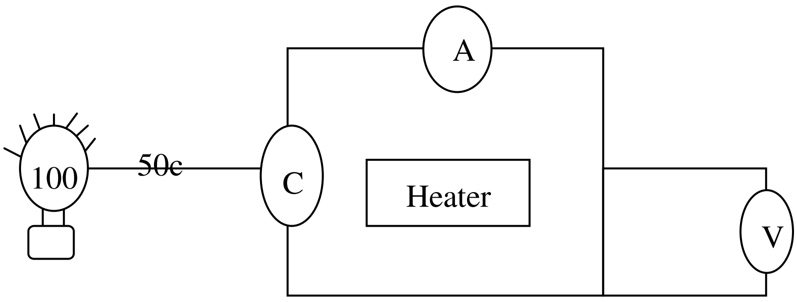

Fig.1:Circuit diagram used for the experiment

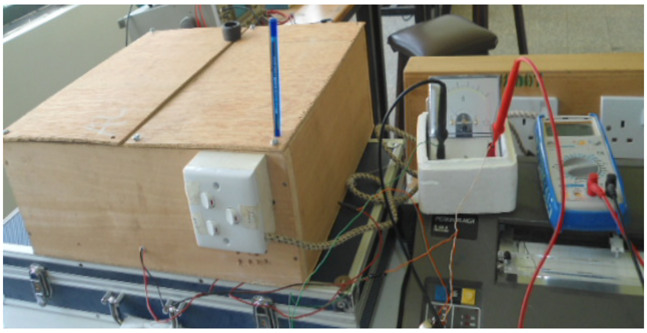

Fig 2; Outside view of the experimental set up

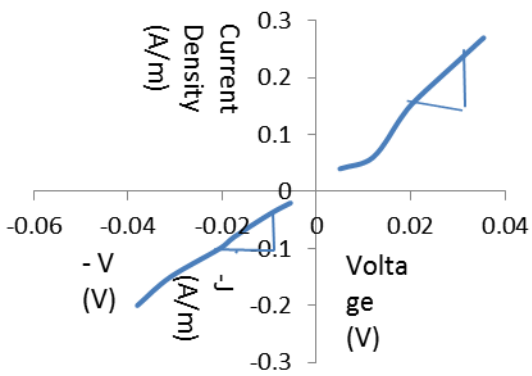

Fig. 3: A graph of current density against voltage

RESULTS:

From the calculation the series resistance is -5.886Ω while the shunt resistance is 5.33Ω. Also from the graph, it can be shown that the minimum value of short circuit current (I_{SC}) is 0.04A and the minimum value open circuit voltage (V_{OC}) $is\ -0.001V$

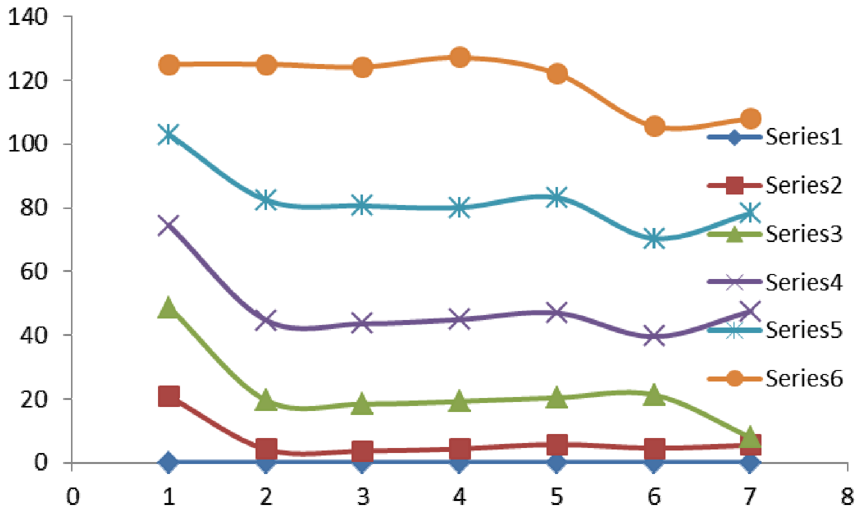

Fig.4: Graph of Current as a function of power output for various Temperatures

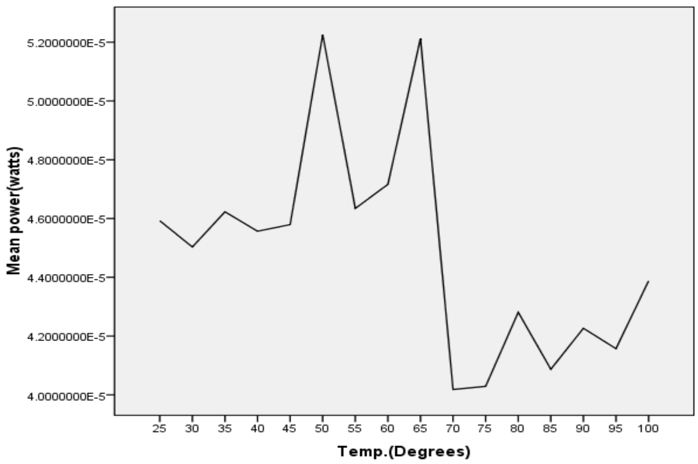

Fig. 5: Mean power output against temperature

Result and Discussion

The solar cell has the highest output performance at the temperatures of about 43^0C *and* 63^0C. Fig.1 depicts the experimental set up of the work while fig.2 is the circuit lay out of the experiment. A plot of current density verses voltage as shown in fig.3 explored the behaviour of the current density for various voltages in both reverse bias and forward bias section when the series resistance is found be -5.886Ω and when the shunt resistance is 5.33Ω. Also, from this it is observed that the minimum value of short circuit current (I_{SC}) is 0.04A and the minimum value open circuit voltage (V_{OC}) *is* $-0.001V$. From fig.4, it is seen that power output for different temperature varies with current with a clear indication that the output increases with increase in temperature. This is as a result of dependency of Fermi level on temperature and because of the creation of electron capture by the vibration of impurity ions of the crystals particularly the doping element. Fig.5 is a plot of mean power verses temperature confirms the result in fig. 4. This is favorably compared with the result obtained by Sanusi. They observed that there is direct proportionality between the power output performance of the system and the ambient temperature. In this work we also observed that there is direct proportionality between the power output performance of the cell and the cell temperature. The cell has the highest output performance at the temperatures of 45^0C .The first peak is the area of optimum or maximum performance of the cell and the second peak is due to physical factors like point defect and hole and cannot be taken as an area of maximum performance of the cell. Similar observation was also reported by Sanusi.

It was confirmed that power output of the system was correlated with the ambient temperature. The results also indicate that the cell temperature must be taken into account when designing and predicting the performance of the silicon solar cell in the area of the study.

CONCLUSION

It is observed from this work that the performance of the silicon solar cell is influenced by temperature since the highest power output performance is noticed to be optimally maximum at 45°C.This makes it imperative to consider attainable temperature when designing silicon based solar cell.

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