ISSN 2676 – 248X

INFLUENCE OF PARAMETERS ON SILICON MONOCRYSTALLINE POLYCRYSTALLINE IN SOLAR CONVERTERS

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Received: 20 June 2019 / Revised: 8 September 2019 / Accepted: 30 September 2019 /

Abstract-PV module, monocrystalline and polycrystalline studied in a plane prototype photovoltaic sensor. Measurements of incidental illumination on the horizontal surface of the sensor taking by pyranometer and pyrheliometer for the global and the direct radiation in Tamanrasset (Algeria). PV conversion estimated according to the model at four constant parameters: photonic current IL (A), quality factor γ, resistance series Rs1 (Ω) and reverses saturation current I0 (A). Study of the temperature and illumination effect showed that the illumination intensity and solar conversion are proportional. The variation of incidental illumination and the variation in temperature estimated by numerical simulation using Matlab

Keywords- Semiconductor, Photovoltaic, Illumination, Temperature, Simulation.

1. Introduction

Semiconductor materials by having physical properties between metallic materials and materials insulating can be divided into two groups: materials with direct gap, such as the materials resulting from the elements of columns III and V in periodic table, and materials with indirect [1], gap such as silicon (column IV). The concept of direct and indirect gap is related to the representation of the energy dispersion of a semiconductor: Diagram E (Energy) - K (Vector of wave).

The functionality of these types of materials is the generation of electrical current when it is in contact with the visible light in a photovoltaic panel. The produced current depends on the incidental radiation, the temperature of the cells, the incidence solar angle and the resistance of load.

Silicon material is the principal element used for the manufacture of photovoltaic solar cells assembled in solar panels for the generation of electricity [1].

2. Methodology

Study in this project is the influence of the incidental solar radiation on a material single-crystal and polycrystalline silicon surface by considering the site of Adrar (27.88°,-0.28°) with altitude 246 m by the measurements of the solar radiation (direct, diffuse and total), temperature measurements and characteristics I(V), P(V) of photovoltaic conversion by using appropriate equipment such as: pyranometer, pyrheliometer and the thermocouple.

The four parameters appear in the equation (1), to estimate the four parameters we have to find four independent relations IR, I0, γ and RS. Simultaneous solution could be obtained by solving the system of equations; this was done by Townsend [3].

$$I = I_L - I_0\left(\exp\left(\frac{q(V + IR_s)}{\gamma K T_C}\right)\right) \qquad 1)$$

2.1. Used data

In this work, we are use data forPolycrystalline silicon MSX60,Monocrystalline silicon SQ-150, the variation of incidental illumination and temperature Data for the two regions.

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Figure 1. Monocrystalline silicon SQ150, (b) polycrystalline silicon MSX60.

2.2. Polycrystalline silicon MSX60

These modules are tested, labeled and shipped in 12V configuration. These data represent the performance of typical 12V modules as measured at their output terminals [2], and do not include the effect of such additional equipment as diodes and cabling. The data are based on measurements made in a solar simulator at Standard Test Conditions (STC), which are:

- Illumination of 1 kW/m2 (1 sun) at spectral distribution of AM 1.5;
- Cell temperature of 25ºC or as otherwise specified (on curves).

Table 1. The MSX-60 Characteristic

Module	Reference
Number of cell N_s	36
Current of Saturation I_{sc} (A)	3.8
Voltage of over circuit U_{oc} (V)	21.1/Ns
Current of Maximum power I_p (A)	3.5
Tension of maximum power U_p (V)	17.1/Ns

Table 2. The four parameters of the module MSX-60

Parameter	Reference
Photoniccurrent I_L (A)	3.8
Qualityfactor γ	1.55
Seriesresistance $R_{s1}(\Omega)$	0.1017/Ns
Reverse current of saturation I_0(A)	$1.566e^{-6}$

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2.3. Monocrystalline silicon SQ-150

The Shell SQ150-PC module contains 60 series connected; it can generate a peak power of 150 Watts at 34.0 volts. This module has been designed for trid connected and industrialist applications [2].

Table 3. The SQ-150Characteristic

Module	Reference
Number of cell N_s	60
Courant de saturation I_{sc} (A)	4.8
Voltage of over circuit U_{oc} (V)	$43.4/N_s$
Current of Maximum power I_p (A)	4.4
Tension of maximum power U_p (V)	34/Ns

Table 4. The four parameters of the module SQ-150

Parameter	Reference
Photoniccurrent I_L (A)	4.8
Qualityfactor γ	1.873
Seriesresistance $R_{s1}(\Omega)$	0.505/Ns
Reverse current of saturation I_0(A)	$1.435e^{-6}$

2.4. Solar illumination measurement

For the calculation of solar radiation We chose the model (Bernard et all., 1980; Bertrand, 1980) calculated that allows diffuse solar radiation, direct, and global (total Radiation) [4].Data were collected solar radiation on the Adrar and Tamanrasset sites during 2013-2014 for solar radiation received [1][4].To calculate the energy for a clear day on a horizontal plane G_h, D_h, and I_h model used is [5][6][7]:

$$G_h = I_h + D_h \qquad (2)$$

$$D_h = 120 . \Gamma . \exp\left(-\frac{1}{(0{,}4511 + \sin(h))}\right) \quad (3)$$

$$I_h = I_0 . C_t . \Gamma . \exp\left(-\frac{0{,}13}{\sin(h)}\right) . \sin(h) \qquad (4)$$

$G_h$total Radiation on horizontal surface (W/m²)

I_hDirect Radiation on horizontal surface (W/m²)

D_h Diffuse Radiation on horizontal surface (W/m²)

The geographical coordinates of the position study are mentioned in Table 5.

Table 5. The geographical coordinates of the position.

	Latitude	Longitude	Altitude
Adrar URER.MS	27.88 N	0.28 W	264 m
Tamanrasset VAG	22.79 N	5.53	1400

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3. Results and discussions

Irradiation data were taken from two sites URER.MS of Adrar and VAG of Tamanrasset. The results showed that the photovoltaic conversion (intensity of the photocurrent produced) for silicon semiconductor material in single or in polycrystalline are different and vary according to the intensity of the illumination and the variation of temperature. (The current is proportional to the radiation). A cell tension decreases with the increase in the temperature. Results for photovoltaic conversion in single crystal silicon are a power peak Pmax : 150 W, and a current of 4.8 A under a tension of 43.4 V. For polycrystalline silicon Pmax : 60 W , Isc : 3.8 A and Voc : 21.1V

3.1. Solar illumination measurement

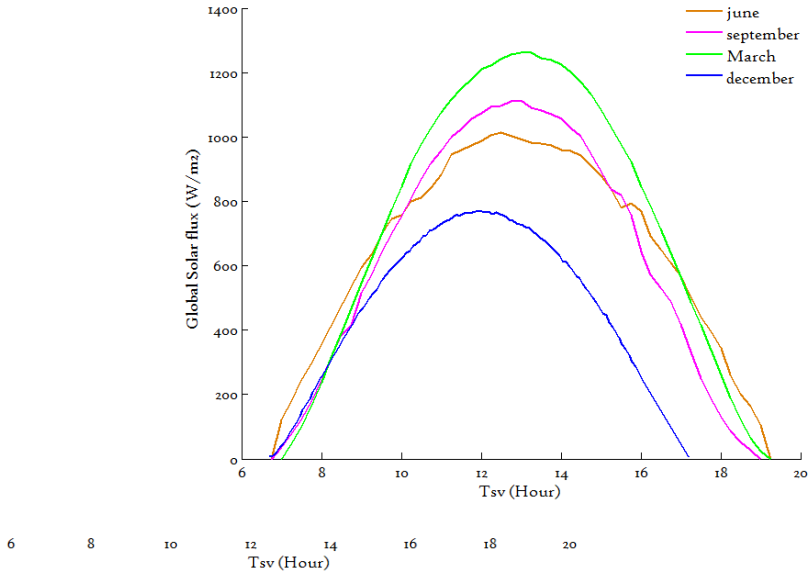

Figure 2. Evaluation of the total radiant intensity measured from Adrar site for horizontal surface of silicon

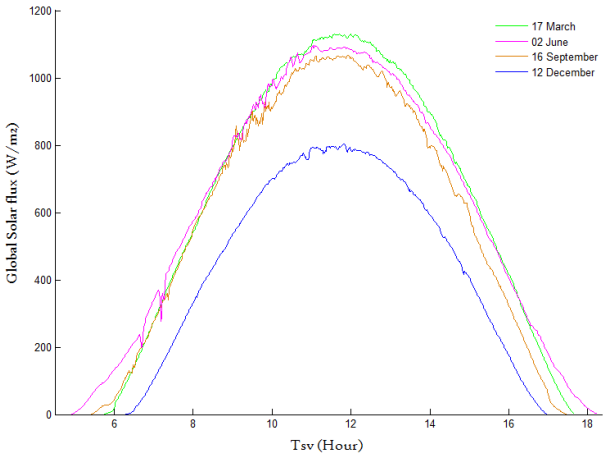

Figure 3. Evaluation of the total radiant intensity measured from Tamanrasset site for horizontal surface of silicon

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3.2. Temperature and illumination influence on I(V) Characteristics of a module SQ-150

The illumination is an important parameter in the solar cells, for that We did this experience with change the lighting in each step, then we observe the effect of illumination on the characteristic I(V) to the SQ-150 Module with a fixed temperature T = 25 ° C.The effect of illumination on the characteristics I (V) is shown in Figure 4 [8].

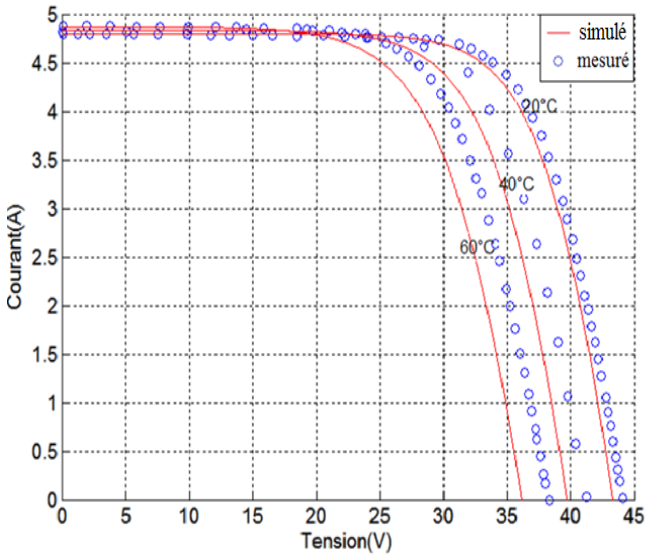

Figure 4. Temperature influence on I(V) characteristics of the module in monocrystalline silicon SQ-150

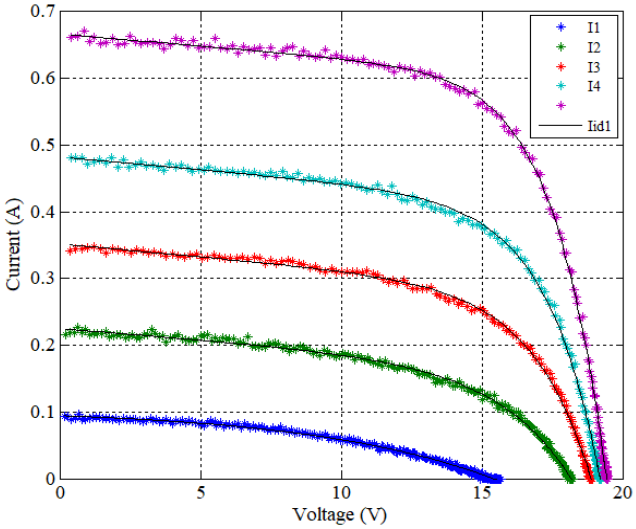

Figure 5. Illumination influence on I(V) characteristics of the module in monocrystalline silicon SQ-150

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3.3. Temperature influence on I(V) P(V) characteristics of MSX60 module

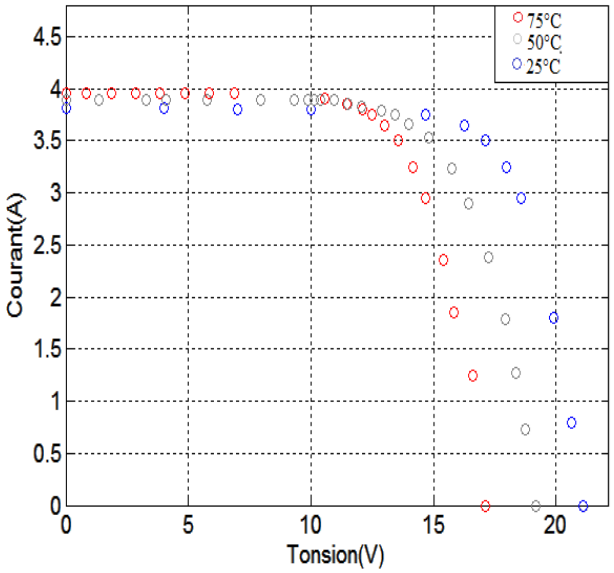

Figure 6. The temperature influence on I(V) characteristics of the module MSX60

The temperature effect on the characteristic P (V) on the module in monocrystalline MSX40 with the illumination set:
G = 1000w / m^2.
The effect of temperature on the characteristic P (V) is shown in Figure 7.

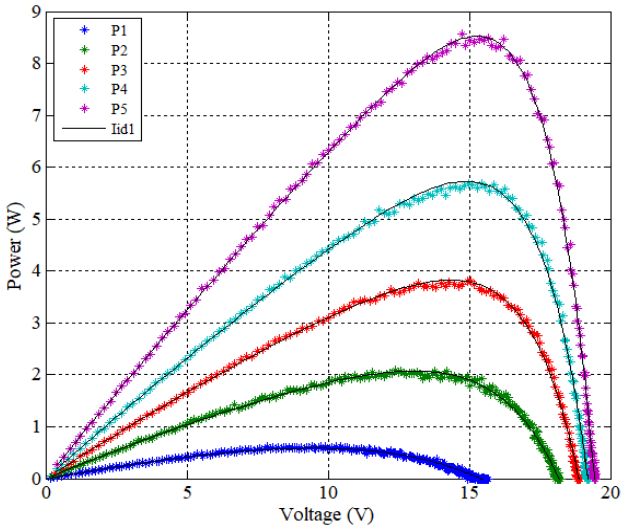

Figure 7. The temperature influence on P(V) characteristics of the module MSX60

4. Conclusion

This work concerned photovoltaic solar conversion to two sites Adrar and Tamanrasset by using a prototype of plane sensor and the effect of the incidental solar radiation on various conducting semi materials: monocrystallinesolid of type SQ 150 and Polycrystalline of type MSX 60.
The objective of note work is the study the influence of the solar radiation on conducting semi material (photovoltaic effect) and the production of electrical energy according to the parameters influencing like illumination and the temperature.

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The method of extraction is validated by the parameters measured using selected solar modules. The experimental data is extracted from the data sheet of the manufacturer. Three different modules of brands are used; those include polycrystalline (MSX60), monocrystalline (SQ150). The experimental data are collected with:

- Three levels different of illumination: 1000 W/m2, 600 W/m2, and 200 W/m^2.
- Three values different of temperature: 25°C/50°C/75°C.

5. Acknowledgements

This work was elaborate in Unit of research in Renewable energies in Saharan Medium (URER .MS), in Adrar, we thank sincerely the following researchers Mr. K .Bouchouicha, N. Aoun, Prof. A.Benmoussat and all those which contributed of meadows or by far to the realization of this work.

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