태양광 시스템의 일사량에 따른 전압-전류 특성

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I-V Characteristics According to Irradiation for Photovoltaic Systems

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Abstract - Solar, as an ideal renewable energy, it has inexhaustible, clean and safe characteristics. However, solar energy is an extreme intermittent and inconstant energy source. In order to improve the photovoltaic system efficiency and utilize the solar energy more fully, and the DC current varies with the irradiation, it is necessary to study the characteristics of photovoltaic I-V according to the external factors. This paper presents the analysis of characteristics of photovoltaic I-V according to the irradiation.

1. Introduction

Along with the rapid consumption of fossil fuels such as coal, oil and natural gas, the energy crisis and the environmental pollution are intensified day by day. And regulation of the exhaust gases from combustion engines has become strict in recent years [1]. In view of the limitation of the fossil fuel and the upward tendency of energy demand due to the raise of the living standard, the alternative energy must be developed without delay [2]. Researchers are seeking and developing a new, clean, safe and renewable energy. Solar cell is a kind of device which using the interaction of sunlight and materials to generate electrical energy [3].During the process of using solar energy, no exhaust gases release such as CO_2, NO_x and SO_x. The photovoltaic (PV) energy, as a renewable and harmless energy which offers many advantages, has vital significance to alleviate the energy crisis and reduce the environmental pollution as well as the greenhouse effect. However, because solar energy is an extreme intermittent and inconstant energy source, the electric power generated by the PV panel varies with the solar radiation and temperature [4].

In order to improve the photovoltaic system efficiency and utilize the solar energy more fully, it is necessary to study the characteristics of photovoltaic I-V according to the external factors such as the irradiation. The radiative energy output from the sun derives from a nuclear fusion reaction [5]. So the irradiation has an important impact to the output power of the solar cell.

The objective of this paper is to analyze the characteristics of photovoltaic I-V according to different irradiation which is from 100[W/m^2] to 900[W/m^2]. What's more, from the results, we can know the factors effect the photovoltaic system efficiency and furthermore utilize the solar energy more fully.

2. Experiment

The experimental solar array consists of 8EA modules which are made in single crystal silicon. The efficiency of the module is 16[%]. The specifications of the experimental device are as follows. The device rated power is 800[W], the maximum power P_{MPP} is 100* W_p±5[%], the voltage at MPP (maximum power point) is 34.5[V], the current at MPP is 2.90[A], the open-circuit voltage is 42.5[V], the short-circuit current I_{sc} is 3.20[A]. The measured data include DC current[A], DC voltage[V].

3. Result and Discussion

Fig. 1 presents the I-V characteristics according to the irradiation which is from 100[W/m^2] to 900[W/m^2]. Fig. 1 (a) shows the I-V characteristics according to the irradiation of 100[W/m^2]. In this case, along with the increase of DC voltage from 240[V] to 288[V], the value of module temperature decreases from 24[℃] to 0[℃] and the value of DC current increases from 0.186[A] to 0.308[A].

Fig. 1 (b) shows the I-V characteristics according to the irradiation of 200[W/m^2]. In this case, along with the increase of DC voltage from 252[V] to 299[V], the value of module temperature decreases from 26[℃]to 6[℃] and the value of DC current increases from 0.45[A] to 0.67[A].

Fig. 1 (c) shows the I-V characteristics according to the irradiation of 300[W/m^2]. In this case, along with the increase of DC voltage from 264[V] to 291[V], the value of module temperature decreases from 32[℃] to 15[℃] and the value of DC current increases from 0.712[A] to 0.936[A].

Fig. 1 (d) shows the I-V characteristics according to the irradiation of 400[W/m^2]. In this case, along with the increase of DC voltage from 263[V] to 296[V], the value of module temperature decreases from 38[℃] to 12[℃] and the value of DC current increases from 0.984[A] to 1.304[A].

Fig. 1 (e) shows the I-V characteristics according

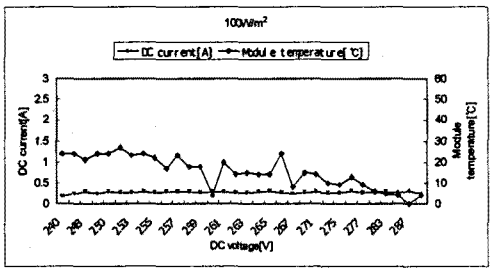
to the irradiation of 500[W/m^2]. In this case, along with the increase of DC voltage from 257[V] to 292[V], the value of module temperature decreases from 43[℃] to 12[℃] and the value of DC current increases from 1.294[A] to 1.556[A].

Fig. 1 (f) shows the I-V characteristics according to the irradiation of 600[W/m^2]. In this case, along with the increase of DC voltage from 252[V] to 292[V], the value of module temperature decreases from 45[℃] to 17[℃] and the value of DC current increases from 1.634[A] to 1.86[A].

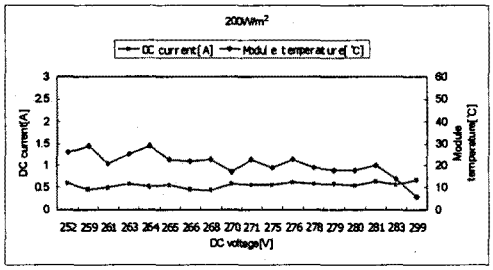
Fig. 1 (g) shows the I-V characteristics according to the irradiation of 700[W/m^2]. In this case, along with the increase of DC voltage from 250[V] to 284[V], the value of module temperature decreases from 53[℃] to 20[℃] and the value of DC current increases from 1.956[A] to 2.148[A].

Fig. 1 (h) shows the I-V characteristics according to the irradiation of 800[W/m^2]. In this case, along with the increase of DC voltage from 242[V] to 277[V], the value of module temperature decreases from 45[℃] to 27[℃] and the value of DC current increases from 2.212[A] to 2.402[A].

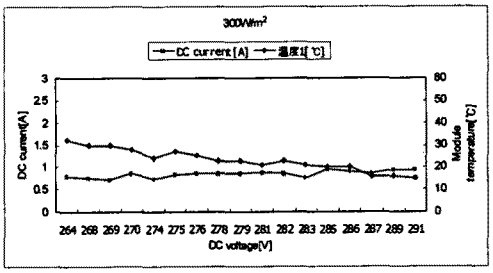
Fig. 1 (i) shows the I-V characteristics according to the irradiation of 900[W/m^2]. In this case, along with the increase of DC voltage from 240[V] to 277[V], the value of module temperature decreases from 58[℃] to 25[℃] and the value of DC current increases from 2.526[A] to 2.722[A].



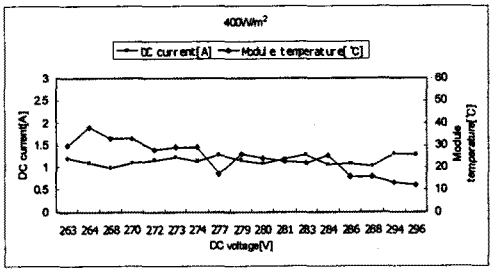
(a) 100[W/m^2]



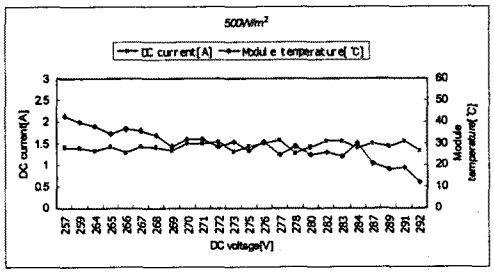
(b) 200[W/m^2]



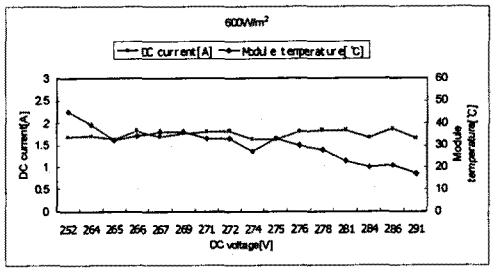
(c) 300[W/m^2]



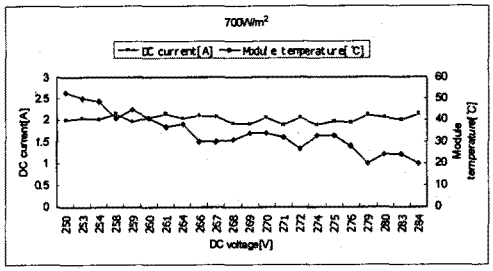
(d) 400[W/m^2]



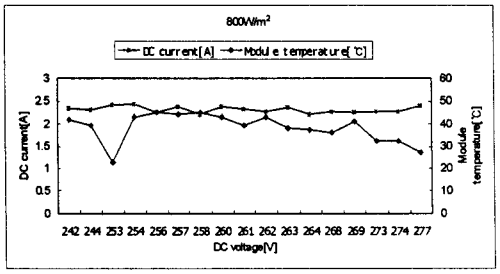
(e) 500[W/m^2]



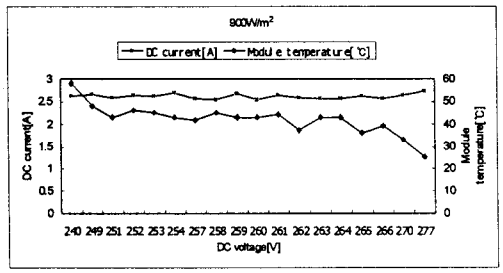
(f) 600[W/m^2]



(g) 700[W/m^2]



(h) 800[W/m^2]



(i) 900[W/m^2]

Fig. 1 I-V characteristics according to irradiation

Fig. 1 indicates that when the irradiation increases, the DC current increases. The area under the line of DC current presents the DC power, so it can be obtai ned that when the irradiation increases, the DC power is also increasing.

4. Conclusion

I-V characteristics of photovoltaic according to the irradiation have been presented in this paper. It indicates that when the irradiation increases, DC current is increased.

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