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High-efficiency Solar Power supply Design

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Abstract. In order to improve the efficiency of solar module, we have designed the Fresnel lens concentrated system and charging system, their schematic diagrams are depicted detailed in this paper. The experimental data show that adding Fresnel lens parts can improve the solar panels' power from 130% to 200% and incident angle can affect solar panels' voltage current characteristic deeply. All of these results can give some support to design the tracking system.

Introduction

As the traditional energy decreasing, energy problem becomes one of the most important problems during human developing. Solar energy, as the one of significant and clean energy resources, is drawed more people's attention [1]. Solar energy is a way that can transform light power to electric energy. At present, solar power module is flat type. This way takes vast solar panels and money. In order to change this problem, we always use concentrating lens to save solar panels. Concentrated system has many types, such as parabolic type, Fresnel lens type, and dish type. Fresnel lens type is a mature technology and widely used in concentrated solar power. Because its structure is simple and light, less spherical aberration, short focal length. And its module structure has many advantages, such as compact, high-efficiency, low cost, could encapsulate solar battery into block, protecting the solar battery during the process of concentrated. This paper is based on optical theory to design the concentrated system and circuit part to improve the efficiency of solar module. We also design a system that can track sun. And then we did some experiments on that system.

The compose of system

In this section we discuss how to format the title, authors and affiliations. Please follow these instructions as carefully as possible so all articles within a conference have the same style to the title page. This paragraph follows a section title so it should not be indented.

Concentrating system. The concentrator of solar cells is based on solar cells array. To improve solar panels' efficiency, adding concentrating part is a good way. And Fresnel lens is a popular way to use in real situation. Fig.1 is the Concentrating system**.**

Charging system. Charging part's battery has two common types, which are "lead-acid cell" and "lithium cell". As the lead-acid cells feature that initial charging time is related to charging speed. When charging rate beyond the limitation and the battery capacity reach 80%, the lead-acid battery will be overcharged. So a stable charging speed is strongly required for charging battery.

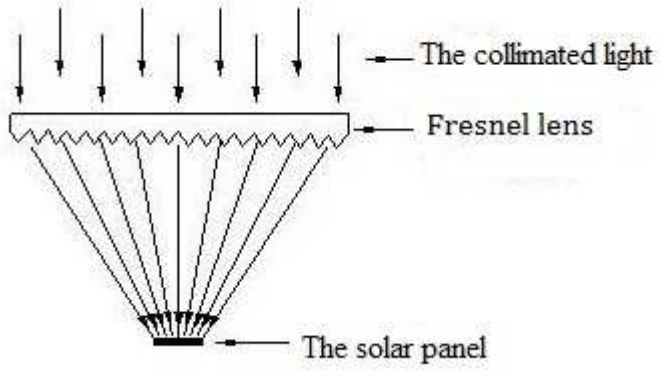

Figure 1 Concentrating system.

By detecting the battery's voltage current and environment temperature, we use MCU to know the state of battery and PMW signal to control charging speed. And in this way, the battery can use more times.

This project uses IC LM2596 to make the VRM, and IRF3205S to make battery management module. In consideration of concentrated system can provide 30V power supply, and solar panels are easy effected by environment. We use IC LM2596 to stable VOUT to 18V. Fig.2 is the circuit diagram of circuit system.

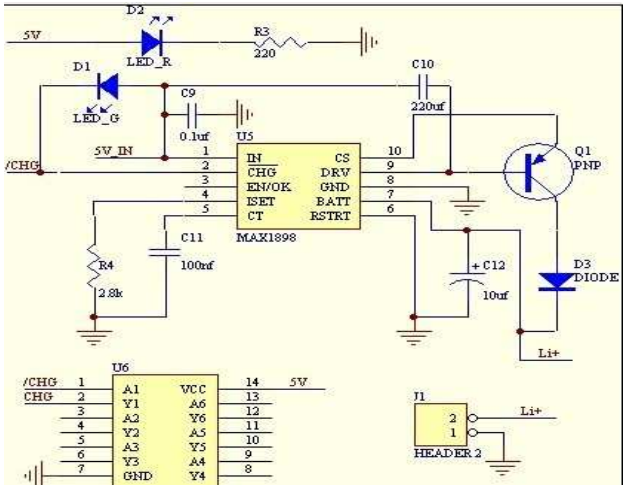

Figure 2 LM2956 VRM & IRF power management module

Experiment analysis

The influence of concentrated part to the power of solar panels. We add solar panels on the focus point of Fresnel lens under the stable light source. And by changing solar panels' loads, we found that adding Fresnel lens parts can improve the solar panels' power from 130% to 200%. Fig.3 and Fig.4 show the result.

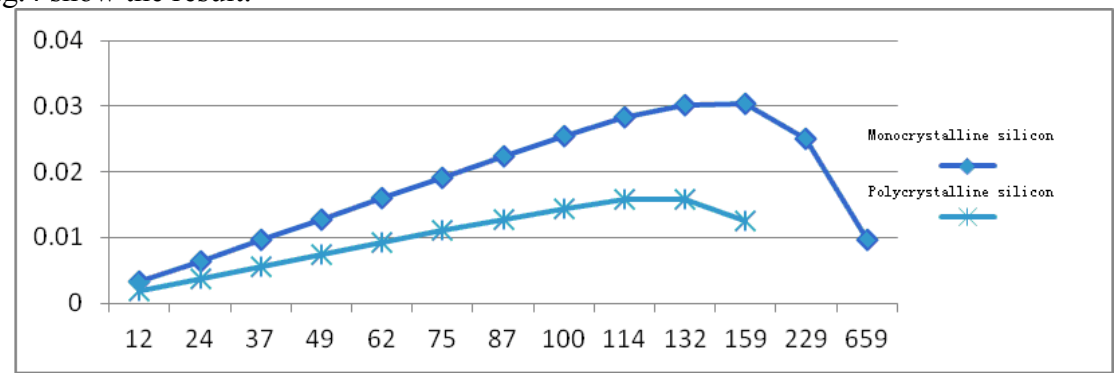

Figure 3 Non-Fresnel lens part's power output

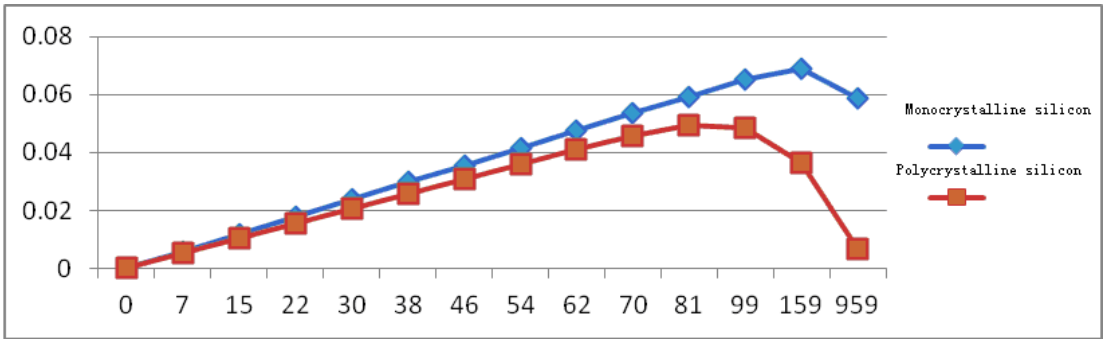

Figure 4 Fresnel lens part's power output

The influence of incident angle to Solar panels' output. As the adage said that everything has two sides. When we added the Fresnel lens, we have to consider the movement of light point on the solar cells in accordance with the moving sun. Thus, we have to figure out the light incident angle to solar panels' output efficiency. Thus we used a rotating platform and put a Fresnel lens on it first, Fixing the light source, solar panels' location second; changing incident angle by rotating the platform finally; Fig.5 describes the solar panels' output power with different incident angle.

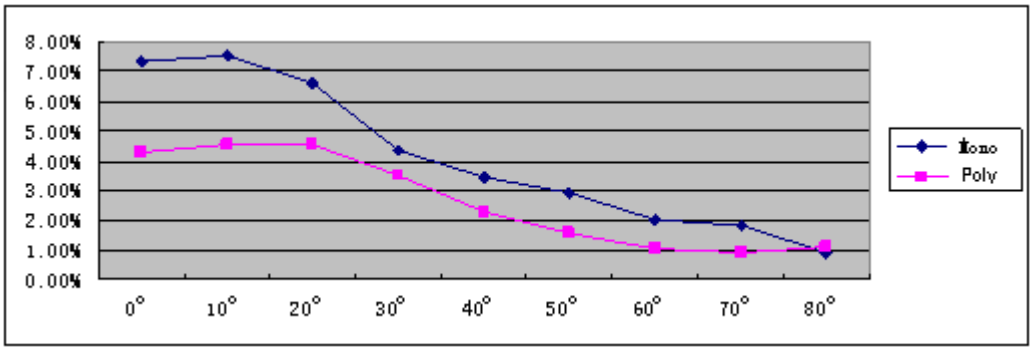

Figure 5 Exchanging efficiency of different incident angles

The data shows that incident angle can affect solar panels' voltage current characteristic deeply. When the incident angle below 40, the efficiency of mono crystal silicon solar cells decrease from 7.32% to 3.45% and the efficiency of polycrystalline silicon solar cells decrease from 4.32% to 2.28%. Thus the result shows the importance of tracking system.

Outdoors experiment. In order to figure out the effect that light's incident angle brings to the power of solar panels in natural condition. We measured the adding Fresnel lens solar panels' output by using PASCO data collecting system during 12:30 ~ 13:00. And the solar panels' initial position was perpendicular to the sun. We separately measured solar panels' open-circuit voltage and short-circuit current and the sampling frequency was 1Hz. Fig. 6 and Fig.7 show the data.

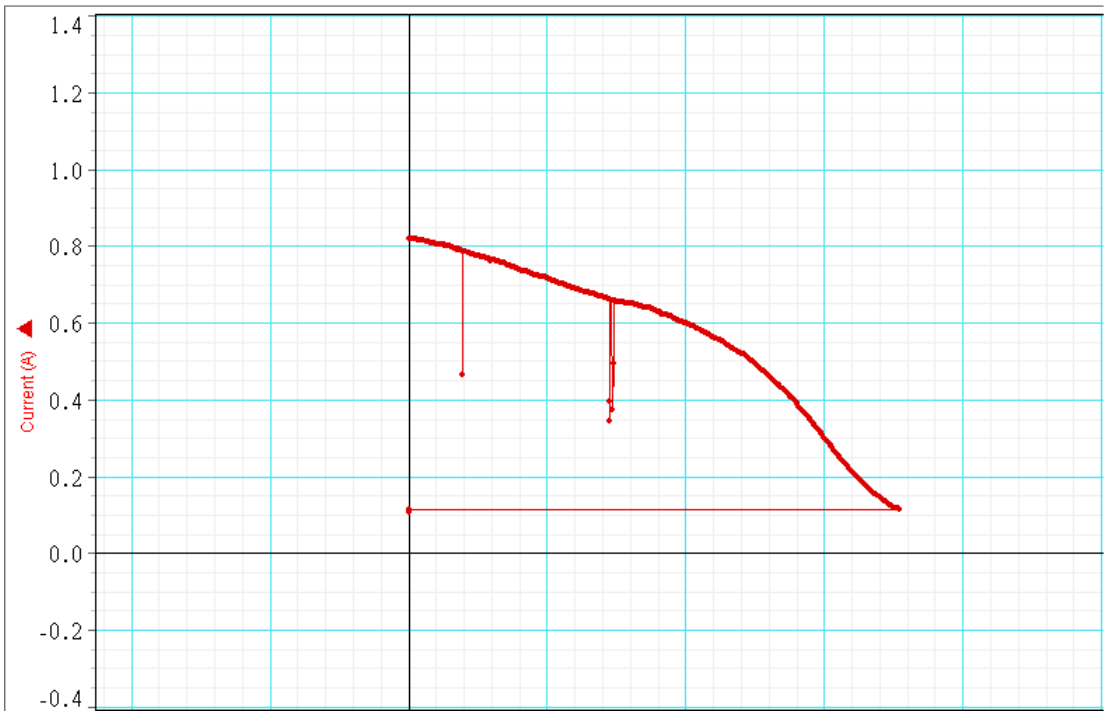

Figure 6 Output short-circuit

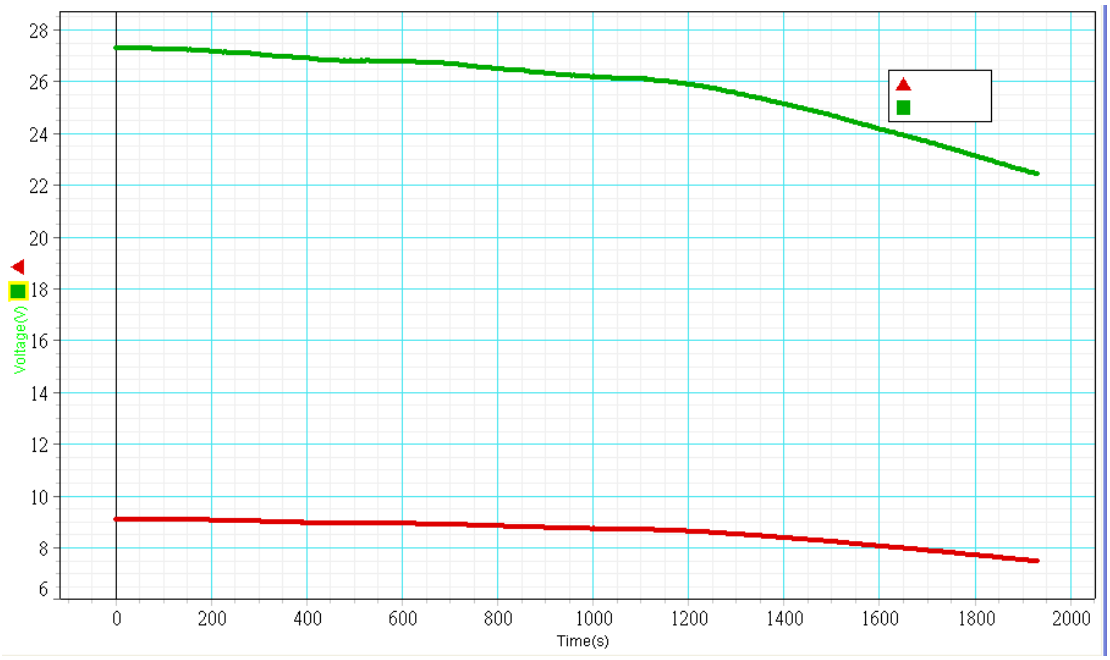

Figure 7 Output open circuit votage

Conclusions

This system combines with the concentrated system, solar cells charging system and control system together. And we figure out the relation between light's incident angel and system efficiency. We figure out that the light source incident the solar panel in vertical way, the whole system's efficiency improves a lot. The data, achieved from experiments, can give some support to design tracking system.

Acknowledgements

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