

Study The Effect Of Grooves density On The Fresnel lens Performance

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(Received 1 / 6 / 2008 , Accepted 15 / 12 / 2008)

Abstract

In this work , the effect of grooves density on the Fresnel lens performance was studied by comparing the results of two Fresnel lens different with their grooves number density . The results show that there is an upward compatibility between grooves density and lens performance

Introduction

Sun light is concentrated by Fresnel lens which designed to minimize the spread of sunlight and concentrate it in plane perpendicular to lens axis . [1]

A. J. Fresnel developed the first fresnel lens in the early nineteenth century. Today his invention can be found in optical systems where design criteria call for light weight or small size .It is flat on one side and rigged on the other. Unlike traditional lenses , A Fresnel lenses do not employ smooth – surface contours to focus rays of light .Instead , the surface of a Fresnel lens is molded into many circular . Concentric ridges

. These circular ridges give the Fresnel lens a zigzag or sawtooth cross – section. Each sawtooth creates a tiny prism. By choosing appropriate power for these prisms . [2]

A Fresnel lens of a geometrical concentration ratio of 1.5-2 in an evacuated tube type collector offers high optical and thermal performance . The collector is not tracking the sun. A larger Fresnel lens concentrator with higher concentration ratio could be used for photovoltaic application. If a secondary concentrator and a diffuser are provided, non –tracking operation is possible, and the irradiance should be well distributed over the photovoltaic panel . [3]

Fresnel prism has the optical properties of luminous prism like the total reflection ,refraction and scattering . let α , γ head angles , to find diffraction angle δ the incident beam will make angle θ perpendicular on back surface , then δ is calculated by the following equation 2:

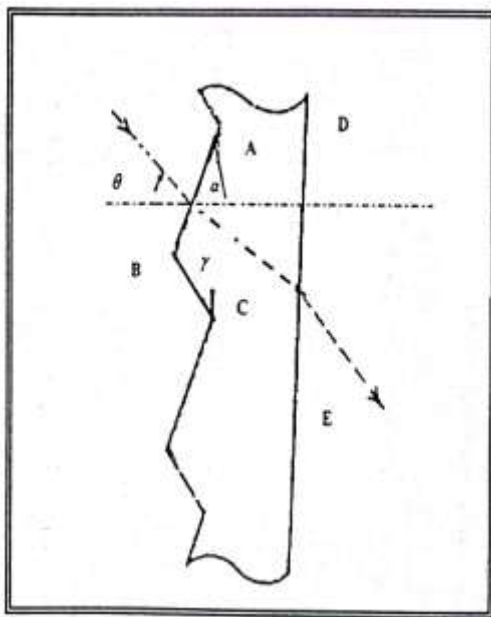


Fig (1)

$$\sin \delta = n \sin \left[\alpha + \arcsin \left(\frac{1}{n} \sin \theta - \alpha \right) \right] \text{-----}(1)$$

In case that if θ was larger than critical angle , the total reflection would appear at back surface , the critical angle is defined as :

$$\sin(\phi - \alpha) = n \sin(\psi - a) \text{-----}(2)$$

$$\psi = \arcsin \frac{1}{2}$$

If $\phi < \theta$ the beam will reflect totally , and if $\phi > \theta$ the beam will refract and transfer through the matter [8]

The work and the results

The Idea was calculating the parameters of silicon solar cell like : " I sc , Voc , P max , I , η " when it supplied by two different Fresnel lens and compared the two results First Fresnel lens took rectangle shape , made of plastic with circular grooves have combined center , grooves density is 2 grooves / mm .This grooves is measured by microscope with magnification power (30) supported from PHYWE company . Its focal length is 40cm and refraction index 1.498 . this lens has linear focus . Second Fresnel lens was circular and point focus. It was made from plastic, its diameter 40 cm, notches density is 5 grooves / mm with focal length 47 cm and refraction index 1.4896.

The tow dimension V- trough concentrator built from 4 plane mirrors .Its height was 45 cm and Aperture area is 37.5 x 35 cm² , Absorber area is 10x10 cm² . slope angle is 22 ° . For keeping the silicon solar cell in temperature in 25±2° C it supplied with cooling system consist of a copper cylinder with 9 cm height and 16 cm diameter . the average of water flow is 0.006 cm³ /sec .

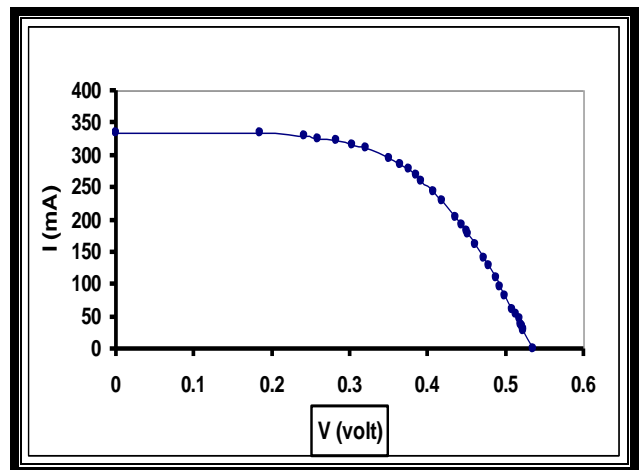


Fig (2):Parameter of The Fresnel lens

Table number (1)

Solar cell parameters	F ₀	F ₂	F ₃
Isc "mA"	334	420	579.0
ΔIsc "mA"	/	85.5	245.5
Voc "V"	0.5346	0.5460	0.5531
ΔVoc "mV"	/	114	185
% η	13.3	16.93	24
Δ% η	/	27.29	80.45
Pm (W)	0.10447	0.13289	0.18898
Δ% Pm	/	27.175	80.894
C	1.00	1.25	1.73

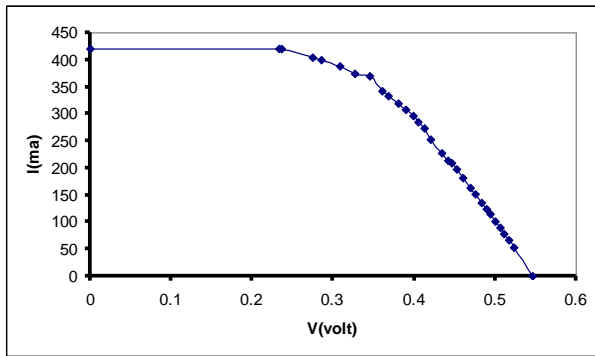


Fig (3): The effect of first Fresnel lens on solar cell efficiency

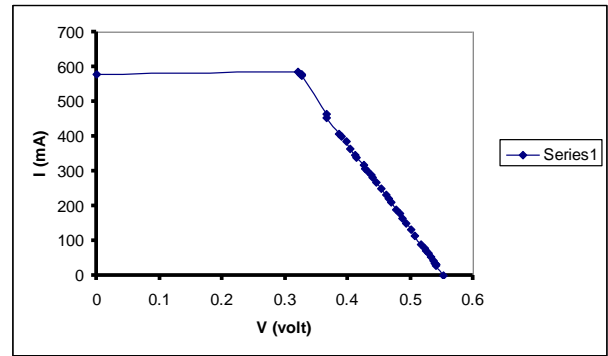


Fig (4) :The effect second Fresnel lens on solar cell efficiency

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دراسة تأثير كثافة الحزوز على اداء عدسة فريزل

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(تاريخ الاستلام: ٢٠٠٨ / ٦ / ١ ، تاريخ القبول: ٢٠٠٨ / ١٢ / ١٥)

المخلص

في هذا البحث تم دراسة تأثير كثافة الحزوز على كفاءة عدسة فريزل بالمقارنة مع النتائج لعدستي فريزل مختلفتين في كثافة عدد الحزوز . بينت النتائج ان هناك توافق كبير بين كثافة الحزوز وكفاءة العدسة.