THE 7TH ANNUAL CONFERENCE OF THE THAI PHYSICS SOCIETY

PROCEEDINGS

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Past, Present and Future of Physics 2012

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Phra Nakhon Si Ayutthaya, Thailand
SIAM PHYSICS CONGRESS 2012  
MAY 9-12, 2012  
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Reproduced Solar Radiation Derived from Electric Current of Solar Cell for Daytime Meteorological Study

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Abstract

On daytime, the variation of electric current generated by the solar cell mainly depends on the variation of solar radiation intensity that incident onto the solar cell. From the experiment, it was illustrated the good agreement of the linear relationship between the variation of generated electric current and the variation of solar radiation with $R^2 = 0.99$. We computed the linear relationship index from the relation between the one day cumulative electric current and the one day cumulative solar radiation. All of the data used in the experiment to compute the index was from Jan 1-30, 2012. The index was 0.11. By using this index, we were successfully reproduced the solar radiation from the electric current generated by solar cell. The results showed good agreement with $R^2 = 0.95$ of the relationship between the reproduce solar radiation and the original one. This might be served the new technical use of solar cell in the daytime meteorological purpose in the area without the solar radiation data.

Keywords: Solar Cell, Solar Radiation, Meteorology

Introduction

It is well know that solar cell is one of the clean energy equipment that can generally be used to generate electricity from the sunlight. During the daytime, the electricity is generated when the solar radiation incidents onto the solar cell. The amount of generated electricity from the solar cell is mainly direct controlled by the intensity of the incident solar radiation onto the solar cell [1-4]. In everyday, the intensity of the incident solar radiation onto the solar cell is varying. Cloud and rain are the major factors that affect on the incident solar radiation [5-6]. The electric current that generated by solar cell is low in the cloudy and rainy conditions. Otherwise, it is high in the sunny condition. These phenomena served the very useful technique to use solar cell as the meteorological tool for the daytime weather study especially for the variation of solar radiation in the area that has no any solar radiation devices but solar cell. In this paper, we illustrated the relationship between the electric current obtained from the solar cell and the solar radiation. Moreover, the reproduced solar radiation computed form the electric current was also demonstrated.

Materials and Methods

The experimental setup

In the experiment, we used the data from two instruments, solar radiation sensor and solar cell, respectively. The solar radiation data was from the Silicon pyranometer solar radiation Sensor which was installed on the top of the Faculty of Science and Technology building, Rajamangala University of Technology Thanyaburi as shown in Fig. 1. The solar radiation data was recorded by the HOBO U30 weather station in every 15 minutes. We setup the experimental time period of ten-hour daytime from around 7.00 LT to around 17.00 LT. 40 solar radiation data per day were collected. Total experimental days were 30 days from January 1, 2012 to January 30, 2012. The example plotted of solar radiation on January 1, 2012 was illustrated in Fig. 2.

Figure 1. Silicon Pyranometer solar radiation Sensor (in the circle).

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According to the number of the solar radiation data, we selected the Ipv data from the solar cell with corresponding solar radiation-time. Figure 4 illustrated an example plotted of Ipv data with time corresponded to solar radiation on January 1, 2012.

Results and Discussion

In the period of 30 experimental days, we compared the solar radiation data and the Ipv data of each day. Figure 5 demonstrated some examples plotted of the comparison between the solar radiation and Ipv on January 12, 2012 to January 15, 2012.

The plot of the Ipv and the solar radiation on January 12, 2012 in Fig. 5a illustrated well-correlation tendency. Both of the data slightly increased in the morning. The maximum values of both data reached at the same time of about 11.13 LT. The other days shown in Figure 5b to Figure 5d were also illustrated well-correlation tendency respectively. To investigate how well of the correlation tendency, we compared both cumulative solar radiation and the cumulative Ipv of each day. The comparison between both cumulative data was shown in Fig. 6. Figure 6a illustrated an example of the comparison between both cumulative data on the January 12, 2012 while Fig. 6b illustrated the correlation between both data. It was shown that both data had good agreement of its correlation with $R^2 \approx 0.998$. We also made an investigation on all of the experimental 30 days. We found that they had good agreement among their correlations with an average $R^2$ about 0.99.

Based on the well-correlation tendency of both data, we could analyze the linear relationship index from the correlation between them from all of 30 days. The index was shown in Table 1.

Table 1: The relation Index of January 2012

<table>
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<th>Date</th>
<th>Index</th>
<th>Date</th>
<th>Index</th>
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</tr>
<tr>
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</tr>
<tr>
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<td>0.137</td>
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<tr>
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<td>30</td>
<td>0.112</td>
</tr>
</tbody>
</table>

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Figure 5. The comparison between the solar radiation data and Ipv data on January 12 to 15, 2012.

Figure 6. The comparison between cumulative Ipv and cumulative solar radiation on January 12, 2012.

Figure 7. Comparison between the reproduced solar radiation and the original solar radiation on January 12, 2012.

The index of all 30 days illustrated that the Ipv data which were generated by the solar cell and solar radiation data observed by the solar radiation sensor could have linear relationship. The average linear relationship index from table 1 is about 0.11. By using the average index, we computed the solar radiation from Ipv data, and compared the solar radiation with the reproduced solar radiation as shown in Fig. 7. The reproduced solar radiation obtained from Ipv was agreed quite well to the solar radiation obtained from

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solar radiation sensor. We also plotted the correlation between the reproduced solar radiation and the original one but it is not shown in this paper. The results showed that the $R^2 = 0.95$. It could be confirmed that the solar radiation was successfully reproduced from $I_{pv}$ obtained from solar cell.

Conclusions

The amount of generated electric current from the solar cell depended on the incident solar radiation. From the experiment, the linear relationship between the generated electric current and solar radiation was found. Because of the linear relationship, it is capable to use its linearization index to reproduce the solar radiation from the electric current. The results from the experiment were showed that we were successful to reproduce the solar radiation from the $I_{pv}$. This might be the useful application of the solar cell in the area where is no any solar radiation instrument but solar cell for daytime meteorological study.

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References