



## Study of mirror uses on electricity generation of solar cell

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### Abstract

The electricity generation of solar cell with increasing light intensity by using the mirror is investigated in this work. In this experiment, there are two cases: the electricity generation of solar cell with and without the mirror. The solar cells install at lifted angle of  $15^\circ$  with the horizontal plane and turned on the south. In the 2<sup>nd</sup> case, the mirror can increase the light intensity by light reflection from the mirror only in low intensity period. The results show that the light intensity and the current of solar cell with the mirror increase about 22.6 and 14 %, respectively. However, the voltage of solar cell with and without mirror is almost the same value.

**Keywords:** Solar cell, Light intensity, Mirror, Light reflection

### 1. Introduction

In Thailand, rates of use electricity have rising steadily every year. However, the main source of energy has decreased that is opposite trend. Energy from the sun is renewable energy that is a clean energy and endless. It can be produced electricity by using solar cells. The uses of solar cells in Thailand are extensive because Thailand is located near the equator [1].

In Thailand, solar cells have been used for silicon type about 83.8 % [2]. The efficiency of solar cells is about 5-17 %. Therefore, many researchers have studied the increase of efficiency of solar cells such as the installing angle for solar cell in Thailand is  $10-15^\circ$  with the horizontal (turned on the south). Reducing the temperature of the solar cells and can increase performance about 1.2-5.39 % [3-4]. Solar cell with following the sun systems can increase performance about 13 % [5]. The efficiency will reduce in cases of increasing light intensity of solar cells that will be under normal sunlight and cover of standard manufacturer's limited [6].

In this work, the electrical parameters and efficiency of solar cells with increasing sun light intensity by using mirror are investigated.

### 2. Experiments

In the experiment, the solar cell with size of  $67.5 \text{ cm} \times 106.5 \text{ cm} \times 4 \text{ cm}$  is polycrystalline silicon (c-Si) of 100W at lifted angle of  $15^\circ$  with the horizontal plane and turned on the south. The experiment location is in Udonthani, Thailand under clear sky condition (*Latitude* of 17.60, *Longitude* of 102.77). A solar cell increases the light intensity by light

reflection from the mirror with size of  $60 \text{ cm} \times 80 \text{ cm} \times 0.3 \text{ cm}$  coated with mercury reflectance of 99% only in low intensity period.



**Figure 1** The experiment set up for solar cell with and without mirror

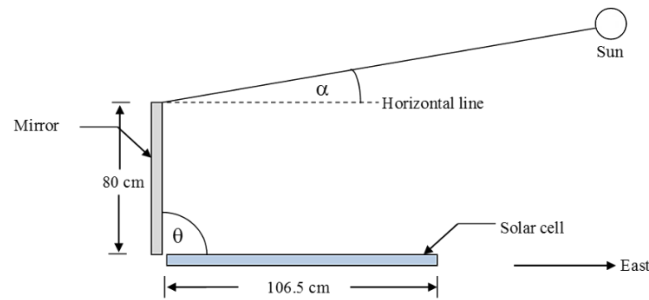
Figure 1 shows the experiment set up of solar cell without and with mirror to increase the sunlight intensity in low intensity period. The light intensity was measured by solar power meter and measured electricity generation of current and voltage by digital multi-meter in April 7<sup>th</sup>, 2016 from 06:00 AM to 06:00 PM.

Figure 2 and 3 show the position of sun that the sunlight reflects on mirror to solar cell. In addition, the angle of mirror before and after noon was set in Table 1 and 2, respectively.

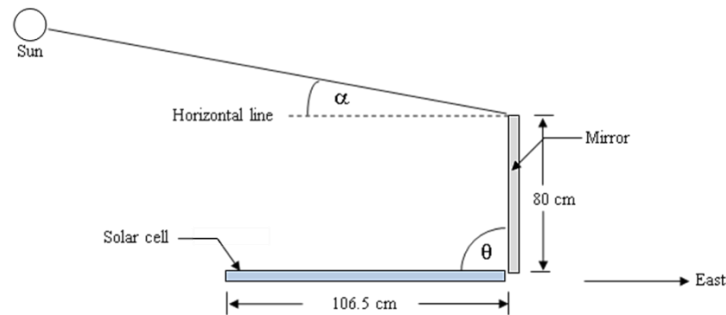
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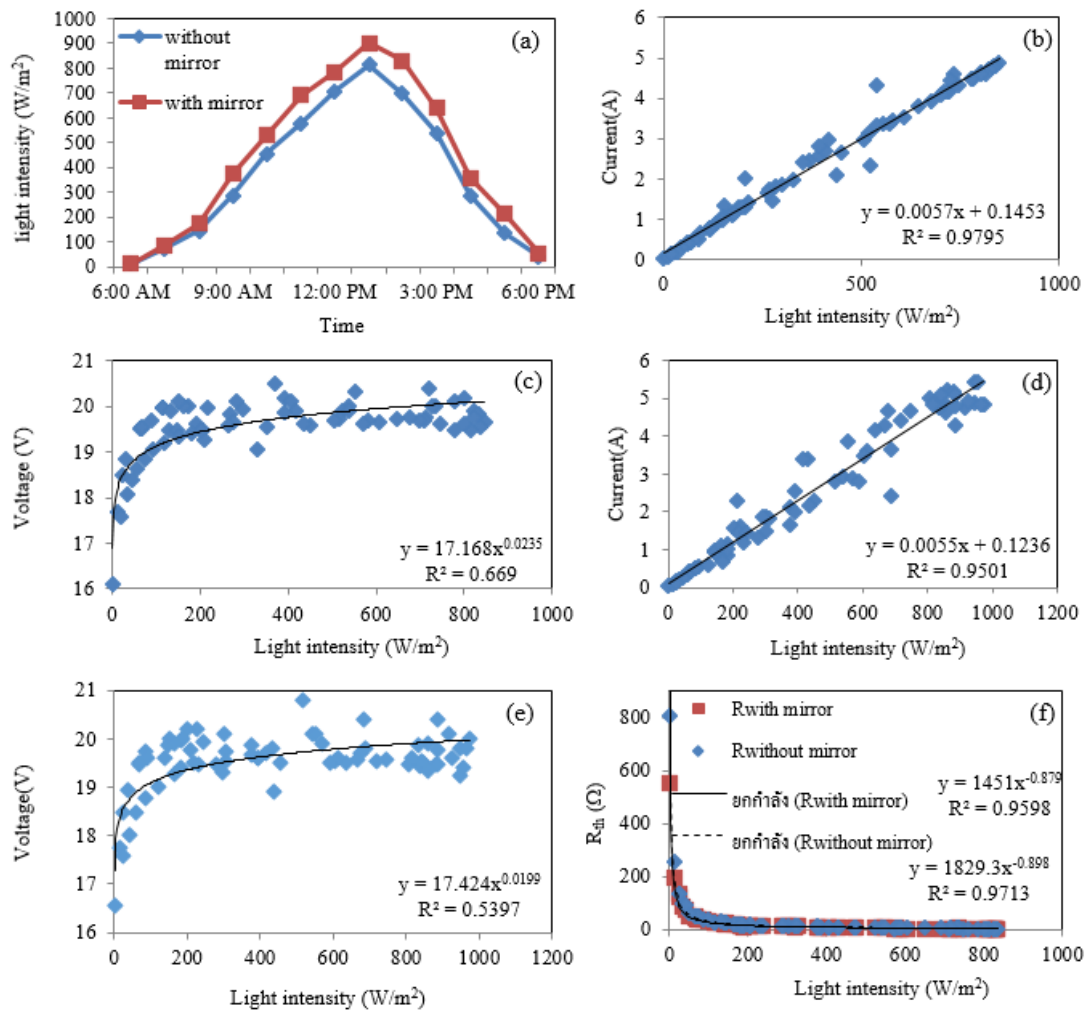
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**Figure 2** The position of sun and mirror angle before noon



**Figure 3** The position of sun and mirror angle after noon



**Figure 4** Dependence of (a) the sunlight intensity on time, (b) current and (c) voltage of solar cell with mirror; (d) current and (e) voltage of solar cell without mirror; and (f) Thevenin's resistance of solar cell with and without mirror on light intensity.

**Table 1** Condition of adjustment the mirror angle before noon

Step	Period time	Sun angle, $\alpha$ (deg.)	Mirror angel, $\theta$ (deg.)
1 <sup>st</sup>	6:00 AM – 8.30 AM	0° - 35.2°	90°
2 <sup>nd</sup>	8:40 AM – 12:10 PM	37.6° – 79.6°	110°

**Table 2** Condition of adjustment the mirror angle after noon

Step	Period time	Sun angle, $\alpha$ (deg.)	Mirror angel, $\theta$ (deg.)
3 <sup>rd</sup>	12:20 PM – 3.50 PM	79.4° – 63.7°	110°
4 <sup>th</sup>	4:00 PM – 6:00 PM	61.4° - 4.7°	90°

### 3. Results and discussions

Figure 4(a) shows the sunlight intensity from 6:00 AM to 6:00 PM. The maximum of sunlight intensity of solar cell with and without mirror is 970 and 800 W/m<sup>2</sup>, respectively. The average of sunlight intensity of solar cell with mirror is higher than that for solar cell without mirror about 22.6%. Consequently, the current and power of solar cell with mirror is higher than that for solar cell without mirror as shown in Fig. 4(b) and (d). The current of solar cell with mirror increases with increasing light intensity as linear function. The maximum of current of solar cell with and without mirror is 5.46 and 4.87 A, respectively. In Fig. 4(c) and (e), the voltage is about 20 V when light intensity approaches to 200 W/m<sup>2</sup> then will be stable for both of solar cell with and without mirror. In Fig. 4(f), the Thevenin's resistance, the resistance series with voltage source in equivalent electric circuit, depends on light intensity for solar cell with and without mirror. Accordingly, resistance value of solar cell with and without mirror decreases with increasing light intensity and their minimum values are about 3.52 and 4.04  $\Omega$ , respectively.

### 4. Conclusions

The effect of sunlight intensity on the photovoltaic of c-Si solar cell with and without mirror is investigated in this paper. The experiment carried on increasing the natural light intensity by light reflection from the mirror at sunlight intensity less than 1 kW/m<sup>2</sup>. The current and power of solar cell with mirror are higher than that for solar cell without mirror. Therefore, the relationship between current of solar cell and sunlight intensity is linear function. In addition, the voltage will not depend on light intensity but it depends on temperature. The Thevenin's resistance value decreases with increasing sunlight intensity. These results in this work lead to increase the efficiency of solar cell when the light intensity is low or less than kW/m<sup>2</sup>.

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### 6. References

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