Temperature Study on a-Si:H Solar Cell Degradation with Different Loading Conditions

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INTRODUCTION

The importance of predicting PV module lifetime reliable than previous trial is gaining significance with strongly growing PV industry.

There has been many researches mainly based on mathematical calculation for predicting PV module lifetime. However the results from these calculation have limitation to be practically applied to the commercial module evaluation and marketing.

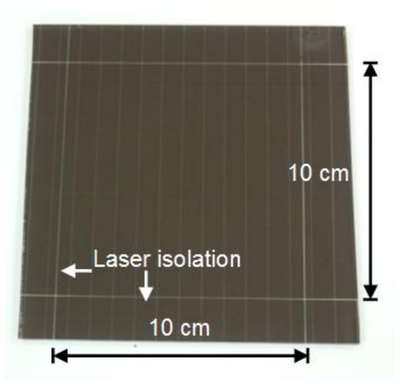
With many results and development in equipments for evaluating PV degradation characteristics, the practical test method which can predict PV module lifetime accurately are under research in many groups.

For relative reliable and accurate prediction of PV lifetime, detailed understanding in accelerating conditions and resultant degradation is essential.

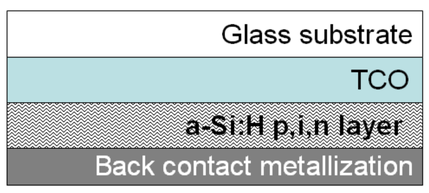
In this work, three different loading conditions and their effect on light degradation are compared for a-Si:H solar cell. Three loading conditions include open, short and maximum power point resistance. The maximum power point resistance has been calculated form the I-V characteristics before any light soaking.
The different degradation results from loading conditions has been analyzed by test cell temperature during the light soaking.

* The experiment in this work mainly focused on the degradation of a-Si cell itself. Other parts of complete module like back sheet, frame, soldering are not included in the analysis.

EXPERIMENTAL



(a)



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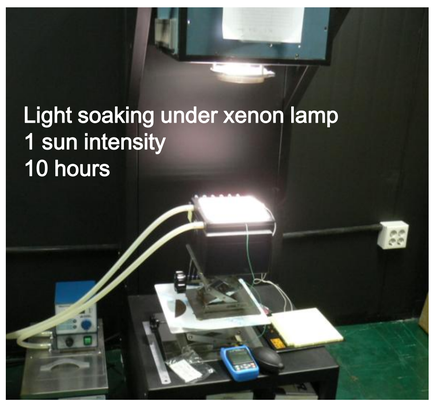

(c)

Figure 1. (a) Amorphous silicon solar cell for indoor aging test with dimensions and (b) cross sectional view for cell structure and (c) 1 sun light soaking tester

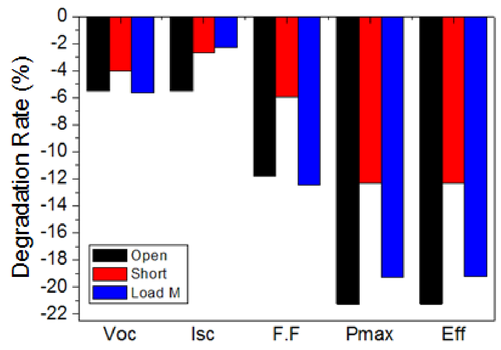

Figure 2. (a) Light degradation results depending on different loading. Light soaking intensity was full spectrum 1 sun (1kW/m^2) for 24 hours. Load M indicates resistive loading which has been calculated from the maximum power tracking point of I-V characteristics before light soaking.

Table. 1. The percentage change of electrical characteristics after 24 hours full spectrum light soaking. (%)

	Open	Short	Load M
Voc	-4.93	-3.92	-3.54
Isc	-3.72	-1.13	-3.29
F.F	-12.5	-3.94	-7.47
Pmax	-19.5	-8.89	-13.67
Eff.	-19.97	-8.78	-13.35

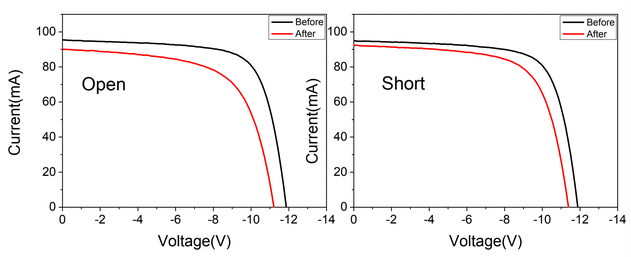

Figure 3. IV characteristics before and after 1 sun light soaking (24 hours) with different loading conditions.

Discussions

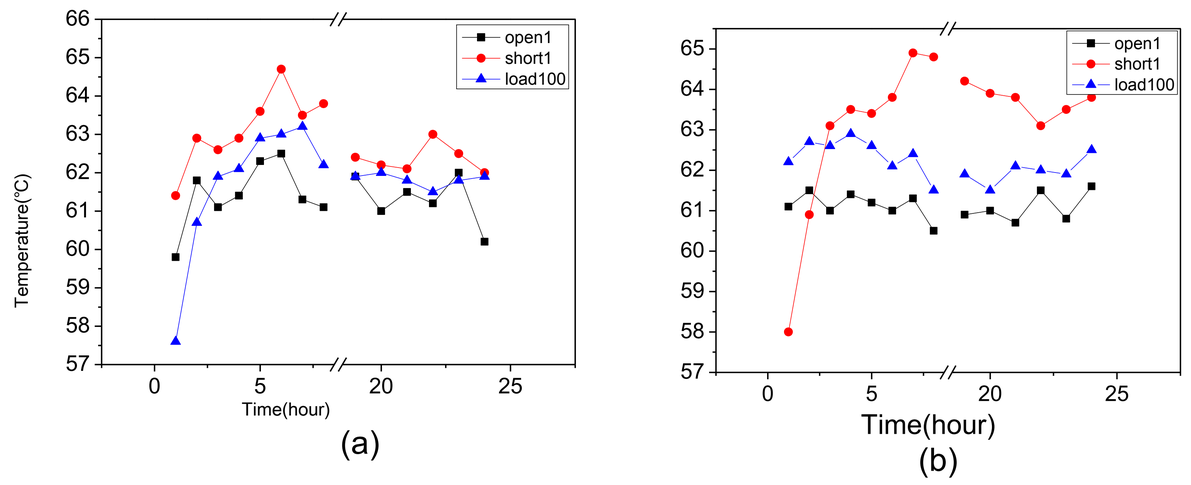

Figure 4. Two test sets of a-Si cell temperature during 24 hours 1 sun intensity light soaking. Both test shows opened load condition has higher cell temperature than other two load conditions during the whole light soaking test.

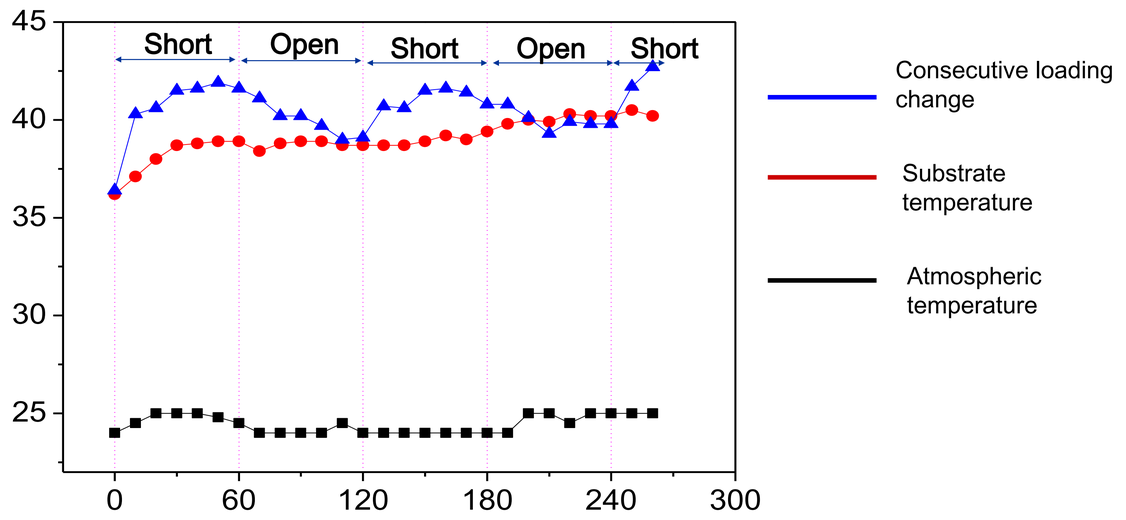

Figure 5. Consecutive loading variation between opened and shorted load conditions during the light soaking. This result indicates the temperature variation in Fig. 4 has been resulted from the loading condition itself.

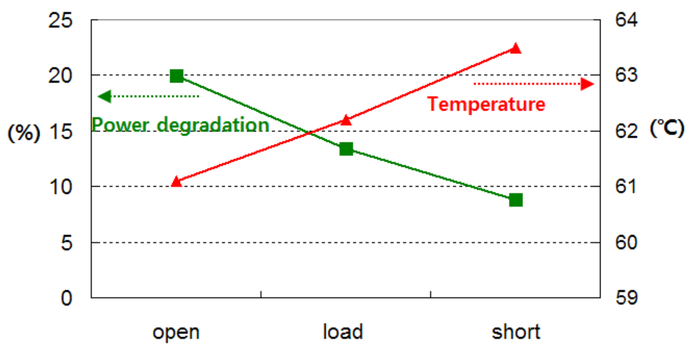

Figure 6. Comparison between a-Si cell temperature and power degradation after 24 hours light soaking with different loading conditions. This result shows different load conditions cause unexpected cell temperature difference with related power degradation rate.

Though the difference is small (few ℃s), different load condition shows clear relation to cell temperature during the light soaking and resultant output power degradation is almost twice different.
(Shorted test cell ⇒ - 8.78%, opened cell ⇒ nearly - 20%)

The electrical effects due to various load condition should be evaluated further for wider understanding of different load conditions in light soaking degradation

SUMMARY

- Different load types resulted in different cell temperature during the light soaking which was not intended. This temperature difference would mainly be caused by the different amount of current flow through the a-Si cell.

- The output power degradation rate depending on different load conditions shows clear relation with test cell temperature resulted from load conditions. As generally known from Stabler-Wronski effect, higher temperature (short) suppressed output power degradation while lower temperature (open) showed most degradation with light soaking.

- For relatively accurate prediction of a-Si module lifetime, above degradation rate difference caused by different loading condition should be carefully considered.

ACKNOWLEDGEMENT
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