

SEMI PV79-0818

TEST METHOD FOR EXPOSURE DURABILITY OF PHOTOVOLTAIC (PV) CELLS TO ACETIC ACID VAPOR

This Standard was technically approved by the Photovoltaic – Materials Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 22, 2018. Available at www.semiviews.org and www.semi.org in August 2018; originally published August 2017.

1 Purpose

- 1.1 The current collection failure induced by the corrosion in finger electrodes on photovoltaic (PV) cells has been elucidated as a major degradation cause of crystalline silicon (c-Si) PV modules installed in hot-humid climate.
- 1.2 However, in the current damp heat stress test for PV modules, thousands of hours requires in the confirmation of this corroding phenomenon.
- 1.3 Therefore, the test method is proposed to reduce the test period, which is to directly expose PV cells to acetic acid vapor at high-temperature and -humidity conditions.

Evolution of AC Equivalent Circuit to Confirm the Formation of Gap underneath Finger Electrodes

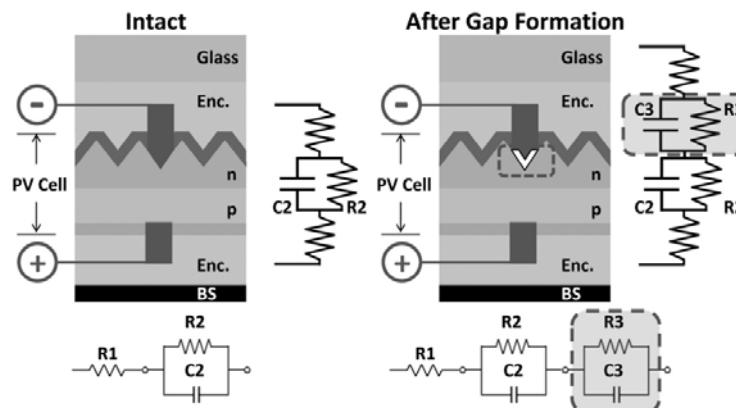


Figure 1
Evolution of AC Equivalent Circuit to Confirm the Formation of Gap Underneath Finger Electrodes

2 Scope

- 2.1 This Test Method is a comparative test method between a reference PV cell and PV cells to be tested.
- 2.2 This Test Method assesses relative durability of c-Si PV cells to acetic acid vapor at hygrothermal conditions.
- 2.3 This Test Method detects the alterations in current-voltage characteristics of PV cells and in AC impedance characteristics (see Figure 1).

NOTE 1: It is recommended to refer the following publication, to elucidate the principle and availability of this Test Method. Tanahashi, T., Sakamoto, N., Shibata, H., and Masuda, A. "Electrical detection of gap formation underneath finger electrodes on c-Si PV cells exposed to acetic acid vapor under hygrothermal conditions." *Proc. in 2016 43rd IEEE Photovoltaic Specialists Conference* (2016): pp. 1075–1079.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This Test Method shall be applied to c-Si PV cells except for hetero-junction c-Si PV cells.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI M59 — Terminology for Silicon Technology

4.2 IEC Standard¹

IEC 61215-2:2016 — Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 2: Test Procedures

4.3 Other Documents

IEA PVPS T-13-1 — Review of Failures of PV Modules²

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

NOTE 2: Terms and acronyms relating to silicon and other semiconductor technology are defined in SEMI M59. Terms and acronyms relating to PV cell and module are defined in IEA PVPS T-13-1. Other abbreviations and acronyms used in this Document.

5.1 Abbreviations and Acronyms

5.1.1 PV — photovoltaic

5.1.2 c-Si — crystalline silicon

5.1.3 FF — fill factor

5.1.4 rms — root mean square value

5.2 Symbols

5.2.1 $P_{\max}$ — maximum generating electric-power

5.2.2 V_{OC} — open circuit voltage

5.2.3 I_{SC} — short circuit current

6 Apparatus

6.1 Glass Chamber (see Figure 2a and Figure 2c)

6.1.1 Glass chamber with thick glass-wall should be used in this method, to avoid the fluctuation of temperature in testing space. And, the size of glass chamber shall be sufficient to include testing PV cells. Then, the glass chamber (over 200 mm width, 200 mm height) for thin layer chromatography should be recommended. For the air-circulation to uniformly keep humidity and concentration of acetic acid in testing space, air-circulator (e.g., small axial flow fan) should be put into the glass chamber.

6.2 Inner Frame of Glass Chamber (see Figure 2b)

6.2.1 Inner frame of inactive material(s) to acetic acid vapor should be used for the exposure of PV cells to acetic acid vapor without direct contact of PV cells to the glass wall and poured acetic acid aqueous solution.

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² International Energy Agency, NET Ltd., Waldweg, 8, CH 1717 – St. Ursen, Switzerland; Telephone: +41.26.494.00.30, Fax: +41.26.494.00.34, <http://www.iea-pvps.org>