



International Workshop on the  
Sustainable Actions for “Year by Year Aging” under Reliability  
Investigations in Photovoltaic Modules, 2016

# SAYURI-PV 2016

## Agenda

**Date:** October 4th – 5th, 2016  
**Venue:** Auditorium in AIST Tsukuba Central Campus  
Central 1, 1-1-1 Higashi, Tsukuba, Ibaraki 305-8561, JAPAN  
<https://unit.aist.go.jp/rcpv/cie/>

### Organizing Committee

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Atsushi Masuda Keiichiro Sakurai  
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Akihiro Takano Kazufumi Tanaka Miki Terada  
Shuji Tokuda Yuzuru Ueda Norihiro Umeda  
Masaaki Yamamichi Isao Yoshida

### Host

Research Center for Photovoltaics (RCPV)  
in National Institute of Advanced Industrial Science and Technology (AIST)

This workshop is held under the auspices of The Japan Electrical Manufacturers' Association.

# International Workshop on the Sustainable Actions for “Year by Year Aging” under Reliability Investigations in Photovoltaic Modules, 2016 (SAYURI-PV 2016)

## [Day 1] October 4th

9:30- Registration

10:00- Opening (O-01)

Tadanori Tanahashi (AIST)

10:05- Welcome (O-02)

Koji Matsubara (AIST)

### Session I: Keynote

Chair: Masaaki Yamamichi (AIST)

10:15- PV challenge in JP (O-03)

Takamizu Sasaki (NEDO)

### Session II: Field Experiences for PV Reliability Research

Chair: Keiichiro Sakurai (AIST)

Hui Shen (Changzhou Trina Solar)

10:45- Correlation between visual defects and environmental conditions in 68 photovoltaic systems in Japan (O-04)

Kohji Masuda (JET)

11:15- PV reliability as addressed in IEA PVPS Task 13 (O-05)

Ulrike Jahn<sup>1</sup>, Magnus Herz<sup>1</sup>, Marc Köntges<sup>2</sup>, Karl. A. Berger<sup>3</sup> (<sup>1</sup>TÜV Rheinland, <sup>2</sup>ISFH, <sup>3</sup>AIT GmbH)

11:45- Investigation of the quality of recent photovoltaic modules under actual operating conditions (O-06)

Tetsuyuki Ishii<sup>1</sup>, Ritsuko Sato<sup>2</sup>, Sungwoo Choi<sup>2</sup>, Yasuo Chiba<sup>2</sup>, and Atsushi Masuda<sup>2</sup> (<sup>1</sup>CRIEPI, <sup>2</sup>AIST)

12:15- Lunch [Self Pay] & Poster Session (90 min)

### Session III: Novel Test Protocols-1

Chair: Atsushi Masuda (AIST)

(Acceleration Tests)

Tadashi Obayashi (JET)

13:45- Proposed new damp heat test standards for thin film PV modules (O-07)

Keiichiro Sakurai<sup>1</sup>, Akihiro Takano<sup>2</sup>, Hiroshi Tomita<sup>3</sup>, Kinichi Ogawa<sup>1</sup>, Darshan Schmitz<sup>3</sup>, Hajime Shibata<sup>1</sup>, Shuji Tokuda<sup>3</sup>, and Atsushi Masuda<sup>1</sup> (<sup>1</sup>AIST, <sup>2</sup>FWAVE Co., LTD., <sup>3</sup>Solar Frontier K.K.)

14:15- Permanent damage from partial shade in monolithic thin-film modules (O-08)

Timothy Silverman (NREL)

14:45- Acceleration of degradation by HAST and air-HAST in c-Si PV modules (O-09)

Tadanori Tanahashi<sup>2</sup>, Soh Suzuki<sup>1</sup>, Takuya Doi<sup>2</sup>, and Atsushi Masuda<sup>2</sup> (<sup>1</sup>ESPEC CORP., <sup>2</sup>AIST)

15:15- The influence of different climate on module's performance (O-10)

Hui Shen, Qiangzhong Zhu, Zhichao Ji, Jianmei Xu, Pierre J. Verlinden, Wei Zhou, Zhiqiang Feng (Changzhou Trina Solar Energy Co., Ltd.)

15:45- Coffee Break (30 min)

### Session IV: Novel Test Protocols-2

Chair: Hidenari Nakahama (Nisshinbo Mechatronics)

(PID)

Christos Monokroussos (TÜV Rheinland, Shanghai)

16:15- A characterization by using laser-based technique for failure Si PV modules (O-11)

Y. Ishikawa<sup>1</sup>, M. A. Islam<sup>1</sup>, K. Noguchi<sup>1</sup>, H. Iida<sup>2</sup>, Y. Takagi<sup>2</sup>, and H. Nakahama<sup>2</sup> (<sup>1</sup>NAIST, <sup>2</sup>Nisshinbo Mechatronics)

16:45- Potential-induced degradation of n-type crystalline silicon photovoltaic modules (O-12)

Keisuke Ohdaira<sup>1</sup>, Seira Yamaguchi<sup>1</sup>, Chizuko Yamamoto<sup>2</sup>, Kohjiro Hara<sup>2</sup>, and Atsushi Masuda<sup>2</sup> (<sup>1</sup>JAIST, <sup>2</sup>AIST)

17:15- PID in thin-film PV modules and PID standards development (O-13)

Peter Hacke (NREL)

17:45 End of 1st Day

18:00- Banquet

# International Workshop on the Sustainable Actions for “Year by Year Aging” under Reliability Investigations in Photovoltaic Modules, 2016 (SAYURI-PV 2016)

## [Day 2] October 5th

9:00- Registration

### Session V: Cells, Materials, and Components Chair: Timothy Silverman (NREL) Michio Shibata (DuPont K. K.)

9:30- Degradation mechanisms of c-Si PV cells exposed to acetic acid vapor (O-14)

Tadanori Tanahashi, Norihiko Sakamoto, Hajime Shibata, Yukiko Hara, and Atsushi Masuda (AIST)

10:00- PV modules' reliability deployed in Japanese PV power plant from viewpoint of encapsulant (O-15)

Tsuyoshi Shioda (Mitsui Chemicals)

10:30- IEC standardization of BD thermal runaway test (O-16)

Yasunori Uchida (JET)

11:00- Coffee Break (30 min)

### Session VI: Novel Test Protocols-3 Chair: Peter Hacke (NREL) Kohji Masuda (JET) (Sequential Tests and Others)

11:30- Sequential and combined acceleration tests for physical and mechanical stresses in crystalline Si photovoltaic modules (O-17)

Atsushi Masuda<sup>1</sup>, Chizuko Yamamoto<sup>1</sup>, Naomi Uchiyama<sup>1</sup>, Kiyoshi Ueno<sup>2</sup>, Toshiharu Yamazaki<sup>2</sup>, Kazunari Mitsuhashi<sup>3</sup>, Akihiro Tsutsumida<sup>3</sup>, Jyunichi Watanabe<sup>3</sup>, Jyunko Shirataki<sup>3</sup>, and Keiko Matsuda<sup>3</sup>

(<sup>1</sup>AIST, <sup>2</sup>Choshu Industry Co., Ltd., <sup>3</sup>Toray Research Center, Inc.)

12:00- Effects of hygrothermal environment on PID acceleration for crystalline Si photovoltaic modules (O-18)

Yasushi Tachibana<sup>1</sup>, Takeshi Toyoda<sup>1</sup>, Toshiharu Minamikawa<sup>1</sup>, Yukiko Hara<sup>2</sup>, and Atsushi Masuda<sup>2</sup> (<sup>1</sup>IRII, <sup>2</sup>AIST)

12:15- Na migration process in crystalline Si photovoltaic modules by potential induced degradation test (O-19)

Fumitaka Ohashi<sup>1</sup>, Hiroki Yoshida<sup>1</sup>, Yukiko Hara<sup>2</sup>, Atsushi Masuda<sup>2</sup>, Shuichi Nonomura<sup>1</sup> (<sup>1</sup>Gifu Univ., <sup>2</sup>AIST)

12:30- Characterization of PID acceleration for crystalline Si solar cell modules using a laser terahertz emission microscope (LTEM) (O-20)

Hidetoshi Nakanishi<sup>1</sup>, Fujikazu Kitamura<sup>1</sup>, Kiyotaka Matsuo<sup>1</sup>, Minoru Mizubata<sup>1</sup>, Iwao Kawayama<sup>2</sup>, Masayoshi Tonouchi<sup>2</sup>, Katsuhiko Shirasawa<sup>3</sup>, Toshimitsu Mochizuki<sup>3</sup>, Hidetaka Takato<sup>3</sup>

(<sup>1</sup>SCREEN Holdings, <sup>2</sup>Osaka Univ. <sup>3</sup>AIST)

12:45- Lunch [Self Pay] & Poster Session (105 min)

### Session VII: Practical Issues in PV Reliability Chair: George Kelly (IEC TC82) Isao Yoshida (JEMA)

14:30- Long term performance analysis of various PV modules in Hokuto mega-solar (O-21)

Yuzuru Ueda (Tokyo Univ. of Science)

15:00- Reliability of power rating and labeling (O-22)

Christos Monokroussos, Kengo Morita and Werner Herrmann (TÜV Rheinland Group)

15:30- Challenges to overcome before spreading BIPV system (O-23)

Akihiko Nakajima (KANEKA)

### Session VIII: Standardization Chair: Masaaki Yamamichi (AIST)

16:00- Coordination of international standards with implementation of the IEC RE conformity assessment system (O-24)

George Kelly (IEC TC82 Secretariat)

16:30- General Discussion & Closing Remarks (O-25)

Tadanori Tanahashi (AIST)

17:00 Wrap up

# International Workshop on the Sustainable Actions for “Year by Year Aging” under Reliability Investigations in Photovoltaic Modules, 2016 (SAYURI-PV 2016)

## Poster Session : [Day 1] October 4th

- P-01 **Influence of volcanic ash fall on generated energy from photovoltaic modules**  
Tadashi Hirayama<sup>1</sup>, Takumi Tashima<sup>1</sup>, Shuma Kawabata<sup>1</sup>, Akihito Hirai<sup>2</sup>, Yukio Yoshimura<sup>3</sup>, and Atsushi Masuda<sup>4</sup>  
(<sup>1</sup>Kagoshima Univ., <sup>2</sup>Central Automotive Products, <sup>3</sup>Kagoshima Prefectural Institute of Industrial Technology, <sup>4</sup>AIIST)
- P-02 **The measurement technology of PV module temperature in PV system field**  
Hiromi Tobita, Hirofumi Shinohara, Hisayuki Miura, and Takeshi Furutani (JET)
- P-03 **Study of carrier lifetime measurement methods for PID tested module**  
Kazuki Noguchi<sup>1</sup>, Mohammad Aminul Islam<sup>1</sup>, Takuya Oshima<sup>1</sup>, Yasuaki Ishikawa<sup>1</sup>, Hidenari Nakahama<sup>2</sup>, and Yukiharu Uraoka<sup>1</sup>  
(<sup>1</sup>NAIST, <sup>2</sup>Nisshinbo Mechatronics)
- P-04 **The influence of the temperature on EL intensity of the PID tested Si PV modules**  
Takuya Oshima, Mohammad Aminul Islam, Kazuki Noguchi, Yasuaki Ishikawa, and Yukiharu Uraoka (NAIST)
- P-05 **Potential-induced degradation and recovery process for thin-film Si photovoltaic modules**  
Yukiko Hara and Atsushi Masuda (AIIST)
- P-06 **Progression behavior of the potential-induced degradation of n-type c-Si-wafer-based photovoltaic modules with a front-side p<sup>+</sup> emitter**  
Seira Yamaguchi<sup>1</sup>, Atsushi Masuda<sup>2</sup>, and Keisuke Ohdaira<sup>1</sup> (<sup>1</sup>JAIST, <sup>2</sup>AIIST)
- P-07 **Analysis of cross-section between cell and interconnector in field-aged photovoltaic modules**  
Tomoyuki Hirooka<sup>1</sup>, Kohji Masuda<sup>2</sup>, Yasunori Uchida<sup>2</sup>, and Tadashi Obayashi<sup>2</sup> (<sup>1</sup>Kusumoto Chemicals, <sup>2</sup>JET)
- P-08 **Combined test of UV irradiation and highly accelerated hygrothermal treatment for photovoltaic modules using light source with high intensity**  
H. Morita<sup>1</sup>, M. Terada<sup>1</sup>, Y. Oka<sup>1</sup>, K. Mori<sup>1</sup>, and A. Masuda<sup>2</sup> (<sup>1</sup>Toray Industries, <sup>2</sup>AIIST)
- P-09 **Developing an acetic acid detection sensor for photovoltaic modules using a pH-sensitive fluorescent dye**  
H. Nagasaki<sup>1</sup>, T. Itayama<sup>1</sup>, K. Iwami<sup>1</sup>, C. Yamamoto<sup>2</sup>, Y. Hara<sup>2</sup>, A. Masuda<sup>2</sup>, and N. Umeda<sup>1</sup> (<sup>1</sup>TUAT, <sup>2</sup>AIIST)

## Poster Session : [Day 2] October 5th

- P-10 **Unexplained causes of the most frequent degradation mode of crystalline silicon photovoltaic modules**  
Sadao Sakamoto and Atsushi Masuda (AIIST)
- P-11 **Fast measurement system for operating strings in Yoshinogari mega solar power plant**  
Shigeomi Hara and Makoto Kasu (Saga Univ.)
- P-12 **Analysis of long term operational data in residential photovoltaic systems**  
Hajime Wakabayashi and Kohji Masuda (JET)
- P-13 **Study of potential induced degradation and recovery of c-Si module**  
Mohammad Aminul Islam<sup>1</sup>, Kazuki Noguchi<sup>1</sup>, Takuya Oshima<sup>1</sup>, Hirokata Iida<sup>2</sup>, Yasushi Takagi<sup>2</sup>, Yasuaki Ishikawa<sup>1</sup>, and Hidenari Nakahama<sup>2</sup>  
(<sup>1</sup>NAIST, <sup>2</sup>Nisshinbo Mechatronics)
- P-14 **Activation of surface recombination at a SiN<sub>x</sub>/n-type c-Si interface after potential-induced degradation**  
Naoyuki Nishikawa, Seira Yamaguchi, and Keisuke Ohdaira (JAIST)
- P-15 **Potential-induced degradation for silicon heterojunction photovoltaic modules**  
Chizuko Yamamoto<sup>1</sup>, Seira Yamaguchi<sup>2</sup>, Keisuke Ohdaira<sup>2</sup>, and Atsushi Masuda<sup>1</sup> (<sup>1</sup>AIIST, <sup>2</sup>JAIST)
- P-16 **Mechanism of potential-induced degradation for p-type crystalline silicon photovoltaic modules**  
Sachiko Jonai, Hideaki Hagihara, Hiroaki Sato, and Atsushi Masuda (AIIST)
- P-17 **Testing procedures including damp heat and thermal cycle processes for highly reliable photovoltaic modules**  
Kohji Masuda, Yasunori Uchida, and Tadashi Obayashi (JET)
- P-18 **Detecting acetic acid in photovoltaic modules through changes in the relative reflectance of tin films**  
T. Itayama<sup>1</sup>, H. Nagasaki<sup>1</sup>, K. Iwami<sup>1</sup>, C. Yamamoto<sup>2</sup>, Y. Hara<sup>2</sup>, A. Masuda<sup>2</sup>, and N. Umeda<sup>1</sup> (<sup>1</sup>TUAT, <sup>2</sup>AIIST)
- P-19 **The study of IV characteristic, EL image, internal wiring and cell cross section of PV modules, which were exposed to outside for over 20 years**  
Tadashi Obayashi (JET)
- P-20 **Introduction of JET O&M certification**  
Tadashi Obayashi (JET)