

# Analysis of commercial PV modules after PID test

Takuya DOI\*1, Kohji MASUDA\*2, Hiroshi KATO\*2, Yasunori UCHIDA\*2, Katsuki SHIBATA\*2\*4, Shinji KAWAI\*3, Yutaka FUKUMOTO\*3, Fujio TAMAI\*3, Atsushi MASUDA\*1 and Michio KONDO\*1

\*1 National Institute of Advanced Industrial Science and Technology (AIST); \*2 Japan Electrical Safety & Environment Technology Laboratories (JET); \*3 Industrial Technology Center of SAGA; \*4 current affiliation is Chubu Electrical Safety Services Foundation.

## Introduction and Procedures

Motivation:  
To obtain the basic data about the PID test  
→ Understanding Mechanism of PID  
→ Find knowledge for PID prevention

PID Test [1]: Water film method, 25 °C, 168 hours,  $V_{sys}$   
Samples: PV module purchased from markets

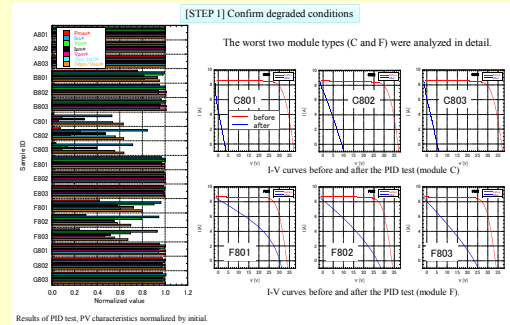
Test modules			
module type	cell type	module type	cell type
A	mc-Si	E	mc-Si
B	mc-Si	F	sc-Si
C	mc-Si	G	mc-Si

[1] Koch S et al., "Polarization effects and tests for crystalline silicon cells", 26th EUPVSEC (2011-9).

Analysis Procedure:

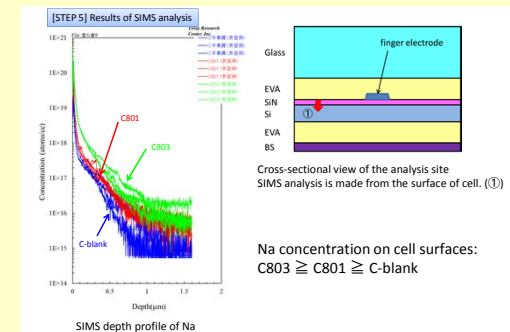
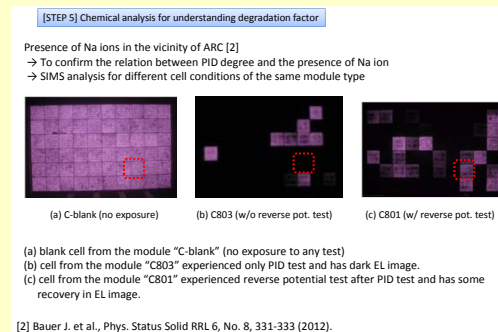
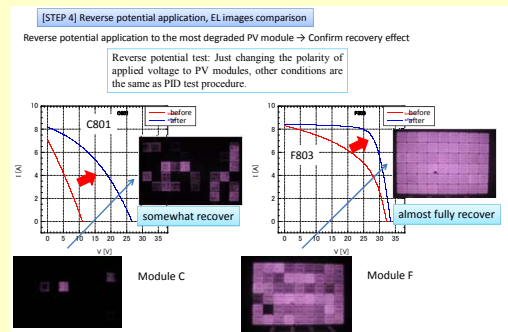
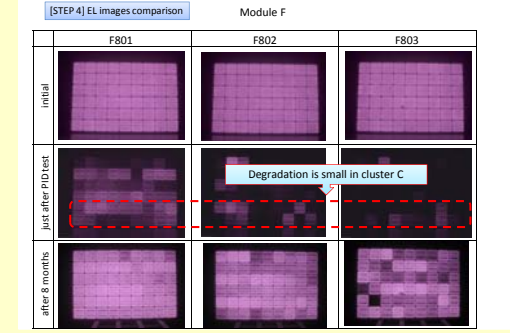
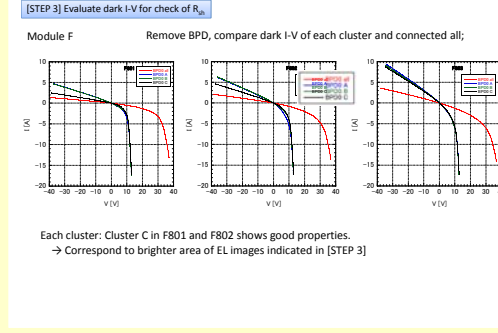
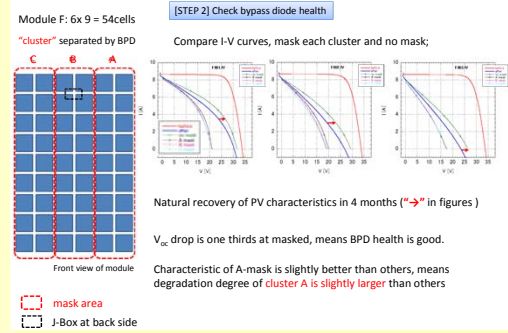
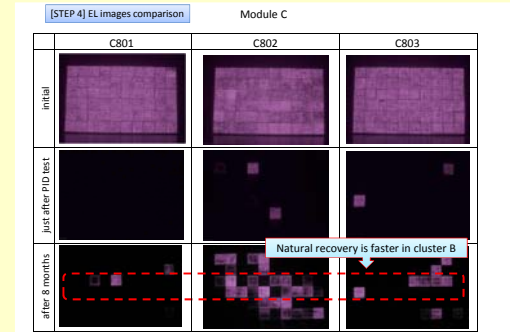
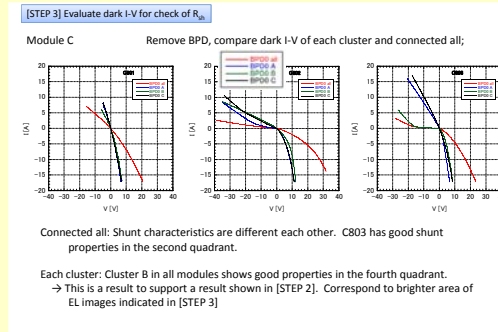
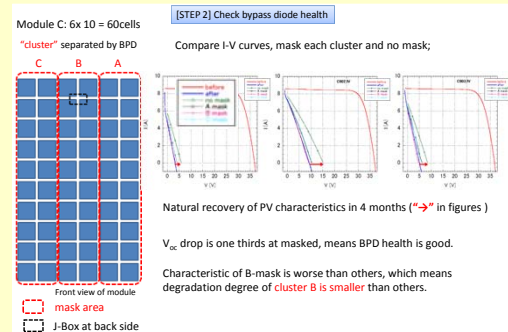
Largely degraded modules →  $R_{sh}$  is decreased significantly.  
→ Analysis was conducted in the following procedures:

- [STEP 1] Confirm degraded conditions
- [STEP 2] Check bypass diode health
- [STEP 3] Evaluate dark I-V for check of  $R_{sh}$
- [STEP 4] EL images comparison, Reverse potential application
- [STEP 5] Chemical analysis for understanding degradation factor



Results of PID test, PV characteristics normalized by initial.

## Results



## Conclusions

It was considered that:

- (1) PID degradation is a combination of reversible process and irreversible process because the recovery of PV characteristics by the applied reverse potential was depending on the module type.
- (2) Degraded cells indicated higher Na concentration than no exposure one from SIMS analysis; it was suggested that diffusion of Na is due to PID phenomenon. Furthermore, a possibility that Na collected by PID test was dispersed from the cell surface by reverse potential application was shown.

## Acknowledgments

This work was supported by the joint project of PVTEC, AIST, SAGA-ITC and JET under "Asia-Pacific Industrial Science & Technology and International Standardization Cooperation Program" conducted by METI. We appreciate to all the persons who supported this project.