'TORAY'
Innovation by Chemistry

Observing Mini PV Module Degradation Through Successive Damp Heat Testing and Thermal Cycle Testing Procedure

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1. Introduction

PV Module (Backsheet) ⇐ stress { UV / Temperature / Humidity }

Backsheets have degraded by environmental stresses such as UV, temperature, thermal cycling, and humidity, etc. However, the degradation effects due to these factors during PV module's lifetime are not clear. We have studied reliability of the modules that have a backsheet using a high durability (anti-hydrolysis) PET film, and a common backsheet "TPT".(PVF/PET/PVF)

2. Experiment

Table.1 Backsheets of testing modules

	Module "A" Backsheet "A"	Module "B" Backsheet "B"	Module "C" Backsheet "C"
EVA side→ Cross-sectional View of BS Outer side→	PVF 38μm / PET 250μm / PVF 38μm	Olefin 150μm / Anti hydrolysis PET 125μm / Protective coating	Olefin 150μm / White Anti hydrolysis PET 125μm

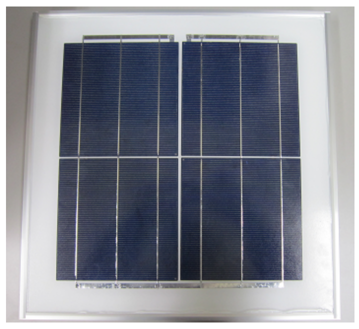

Fig.1 Mini PV module
400mm x 400mm, 6" p-Si 4 cells

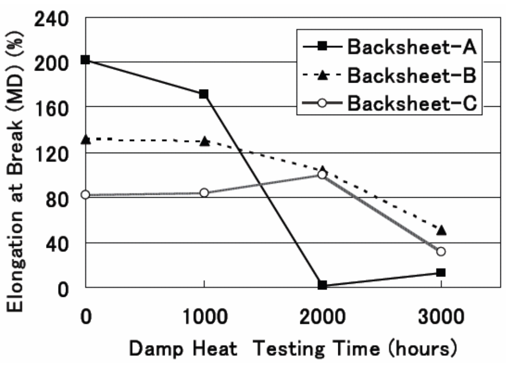

Fig.2 DHT degradation of backsheets' elongation

The elongation at break of backsheet "A" decreased significantly after Dump Heat Test of 2000 hours. This result shows that the 250-micron standard PET film in backsheet "A" has degraded and became brittle.

On the other hand, backsheet "B" and "C" have maintained over 100% elongation in value. This results show that those backsheets have enough flexibility, and suggest that the high durability PET ("Lumirror" X10S or MX11) has not degraded significantly.

initial → DHT 1000hrs → DHT 1000hrs → TCT 200cs → DHT 1000hrs

(after each step →) Visual inspection (backside) / Output Measurement (Pmax)

Fig.3 Test Method for modules
DHT : 85℃85%RH, TCT : -40~85℃

3.Result and Conclusion

3.1 Visual inspection

After DHT2000hrs+TCT200c, visual inspection from the backside of module "A" showed cracking in the common grade PET film of the core layer. This result can be attributed that standard PET film has degraded and became brittle after DHT 2000 hours ,and it has broken under the stress of TCT.

Contrary Module "B" and "C" did not changed in visual.

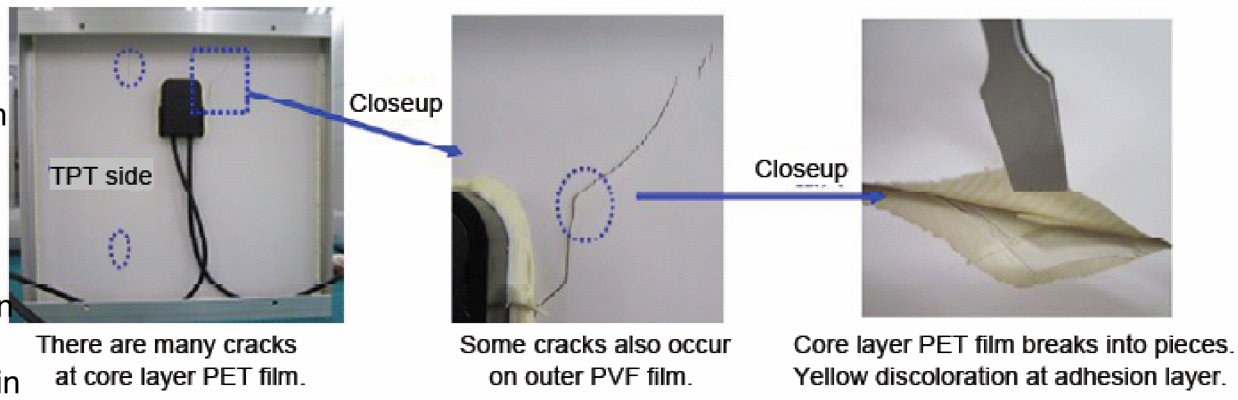

Fig. 4 Visual Inspection from the backside of **module "A"** after DHT 2000hrs and TCT 200cycles

3.2 Output characteristics

After DHT 2000 hrs, Pmax of all modules did not degrade. But after TCT200c, module "A" has more degraded than that of module "B"&"C". The degrading ΔPmax value is 5.3%.

After additional DHT of 1000hrs, Pmax of module "A" has further degraded to 90% of initial Pmax value. On the other hand, Pmax of module "B"& "C" after additional DHT 1000h (total DHT 3000hr) have maintained more than 95% of initial Pmax Value. The difference between module"A" and "B"(or "C")is more expanding than that before additional DHT1000hrs.The modules with a backsheet using high durability PET film have higher Pmax retention of initial Pmax value than a backsheet used PVF/common grade PET/PVF.

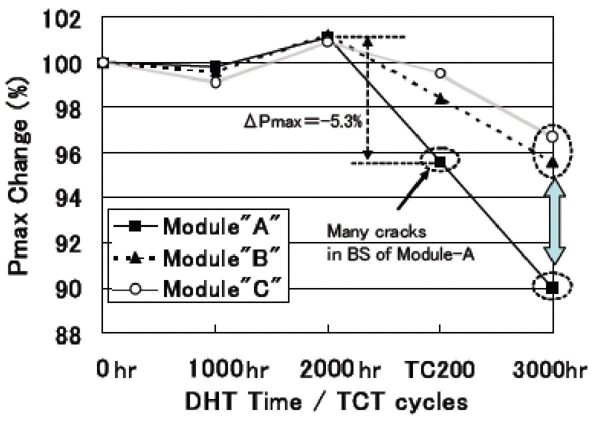

Fig. 5 Pmax Changes after DHT／TCT

3.3 Conclusion

For longer module's lifetime, high durability PET film is better solution for backsheet design. Furthermore, cracking of backsheet is a potentially serious to electric safety. High durability PET film is the one of the key factor to improve PV module life.

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