

Development of Encapsulants for Perovskite Solar Cells

Everlight Chemical Industrial Corporation, R&D center
2025/1/20

Outline

- **Introduction of Eversolar[®] AB-series Encapsulants**
- **Eversolar[®] AB-series Performances & Durability Tests**
- **Summary**

Eversolar® AB-Series Description and Features

Description

Eversolar® AB-series is a type of UV-curable encapsulant, providing excellent protection and waterproofing properties for components

Features

- 1.Solvent-free, no VOC impact.
- 2.Excellent chemical inertness for sensitive material encapsulation.
- 3.Excellent resistance to yellowing effect.
- 4.Elastomer & flexibility after curing.
- 5.Low water vapor transmission rate (WVTR).
- 6.High adhesion for various substrates.
- 7.Suitable for full-area sealing & frame sealing.

Features of Eversolar[®] Encapsulants

Elastomer



Flexible substrates
adhesion

Moisture barrier



Water-vapor blocking
for devices

Transparency

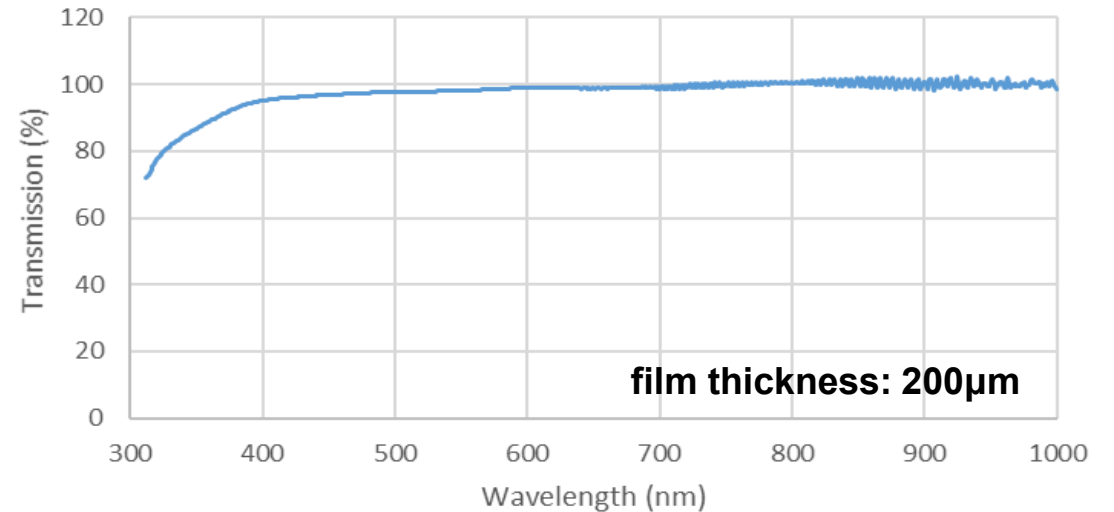


High transmittance in
visible light region

Eversolar[®] AB-302

Specification	AB-302
Appearance	Transparent liquid
Appearance after curing	Transparent
Viscosity (cps)@25°C	2,500±600
Tensile strength (glass/glass)	≥8 MPa
Curing condition (LED 365/405 nm)	9 J/cm ²
WVTR (40°C/90%RH@200μm)	≤4 g/m ² .day

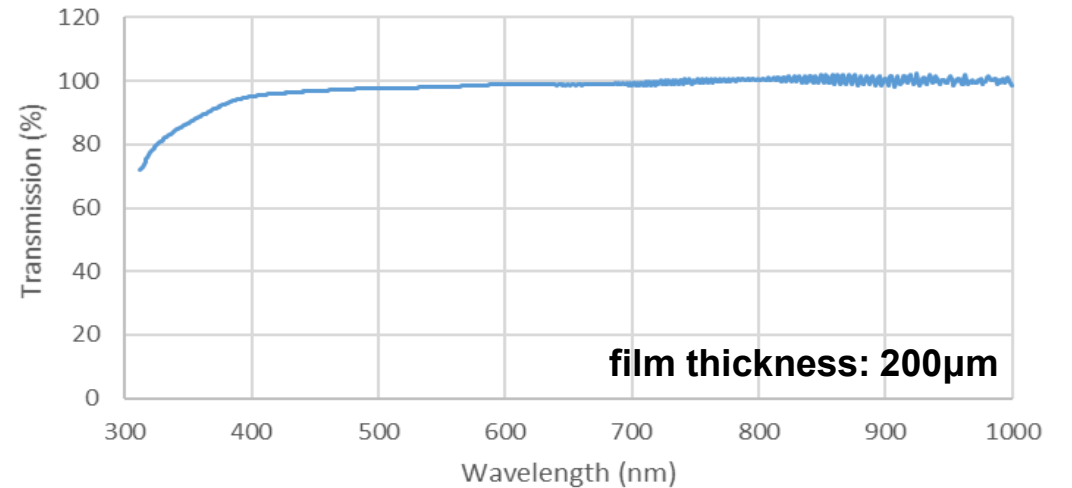
1. Dispensing 、 Slot-die coating
2. High transparency
3. Room temperature storage



Eversolar[®] AB-313

Specification	AB-313
Appearance	Transparent paste
Appearance after curing	Transparent
Viscosity (cps)@25°C	38,000±8,000
Tensile strength (glass/glass)	≥5 MPa
Curing condition (LED 365/405 nm)	9 J/cm ²
WVTR (40°C/90%RH@200μm)	≤7 g/m ² .day

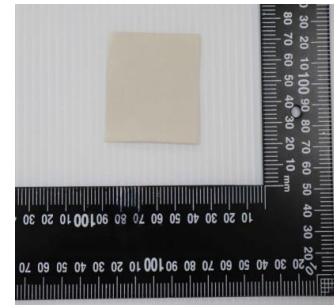
1. Dispensing 、 Screen printing
2. High transparency
3. Room temperature storage




Eversolar[®] AB-341

Specification	AB-341
Appearance	Gray paste
Appearance after curing	Gray opaque
Viscosity (cps)@25°C	45,000±10,000
Tensile strength (glass/glass)	≥3 MPa
Curing condition (LED 365/405 nm)	9 J/cm ²
WVTR (40°C/90%RH@200µm)	~ 10 ⁻² g/m ² .day

1. Dispensing 、 Screen printing
2. Opaque (non-transparency)
3. Room temperature storage
4. Low WVTR



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 Signed for and on behalf of
 SGS TAIWAN LTD.
 Chemical Laboratory - Taipei

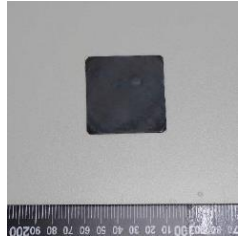


測試項目 (Test Item(s))	測試方法 (Method)	單位 (Unit)	結果 (Result)
			No.1
透濕度 / Water vapor transmission rate	參考 ASTM F1249-20 (溫度40°C · 濕度90%) / With reference to ASTM F1249-20 (Temperature: 40°C, Moisture: 90%)	g/(m ² -day)	0.037

Eversolar[®] AB-302c

Specification	AB-302	AB-302c
Appearance	Transparent liquid	Transparent liquid
Appearance after curing	Transparent	Transparent
Viscosity(cps)@25°C	2,500±600	5,000±1,000
Tensile strength (glass/glass)	≥8 MPa	≥5 MPa
T-peeling force (PET/PET)	-----	≥5 N/25mm
WVTR (40°C/90%RH@200μm)	≤4 g/m ² .day	≤4 g/m ² .day

WVTR Testing Comparison – ASTM F1239-20

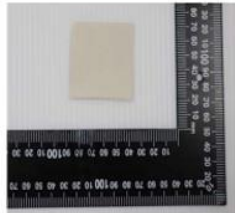


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測試項目 (Test Item(s))	測試方法 (Method)	單位 (Unit)	結果 (Result)
			No.1
透濕度 / Water vapor transmission rate	參考ASTM F1249-20. (溫度: 40°C, 濕度: 90%) / With reference to ASTM F1249-20. (Temperature: 40°C, Moisture: 90%)	g/(m ² -day)	<u>1.59</u>

Edge Seal
 PIB (Polyisobutylene)



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測試項目 (Test Item(s))	測試方法 (Method)	單位 (Unit)	結果 (Result)
			No.1
透濕度 / Water vapor transmission rate	參考 ASTM F1249-20 (溫度40 °C · 濕度90 %) / With reference to ASTM F1249-20 (Temperature: 40°C, Moisture: 90%)	g/(m ² -day)	<u>0.037</u>

Edge Seal
 Eversolar® AB-341

1. The WVTR of AB-341 is better than commercial PIB (Polyisobutylene).
2. AB-341 can be applied for both edge sealing and carpet sealing due to its excellent compatibility with PSCs.

Oxygen Transmission Rate (OTR) Testing

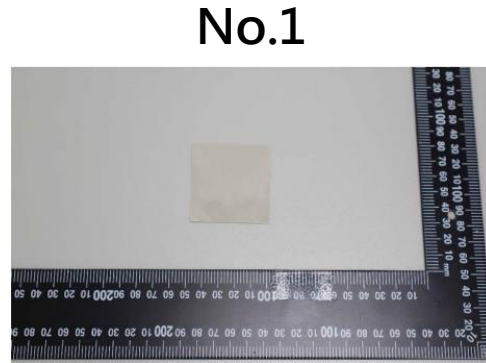
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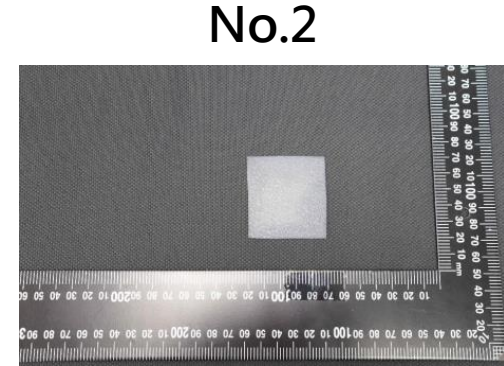
No.1 : 棕色片狀(AB341)
 No.2 : 白色片狀(TPO)

測試結果

測試項目	測試方法	單位	結果	
			No.1	No.2
透氧度 (OTR)	參考 ASTM D3985-17. (溫度: 25°C · 濕度: 0%)	c.c./(m ² -day)	182	1179
	Temp. Humidity		AB-341	TPO film



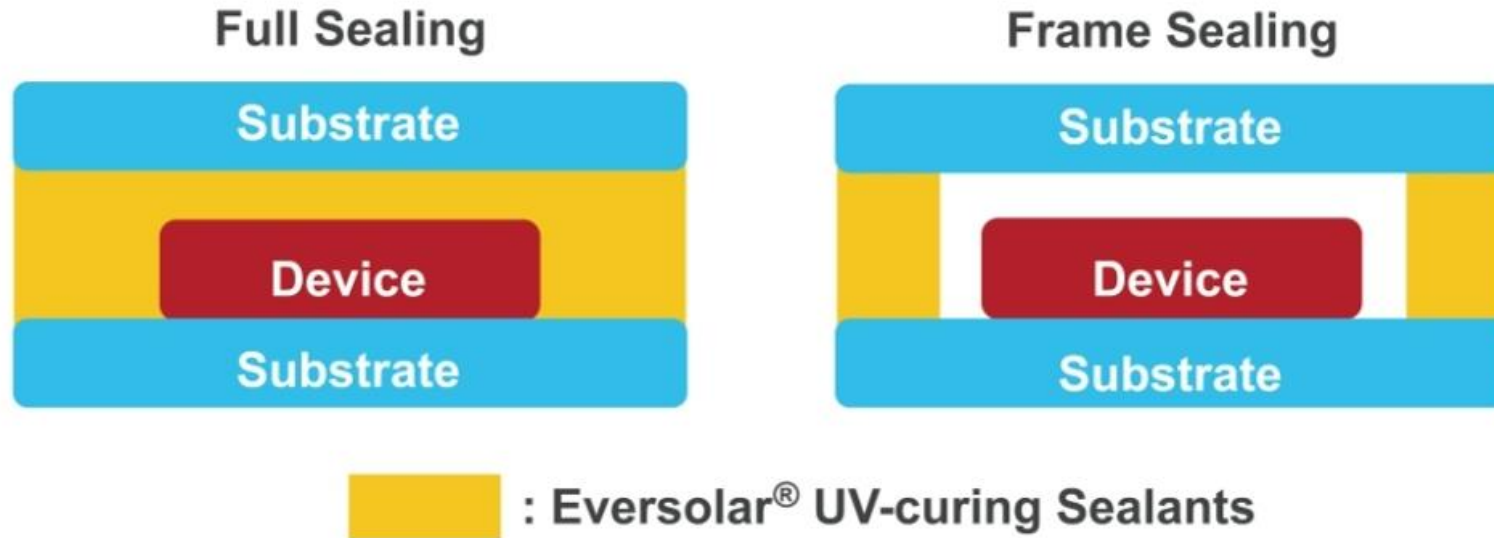
AB-341



TPO film

- Competitive TPO film is Thermoplastic polyolefin used for solar cell encapsulation

Encapsulation Types of Eversolar®



Coating process : Doctor-blading 、 Screen-printing 、 Dispensing

Anti-yellowing Test

Test method

UVA-340nm / 60°C / 0.86W/cm²

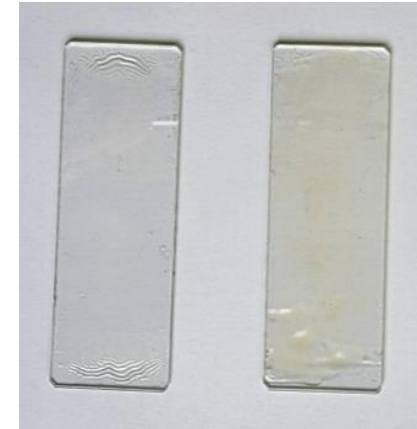
Test time: 500 hours

※ Standard specification : IEC 61345

Results

Item	ΔYI
AB-313	+0.56
AB-341	+4.12
Benchmark	+17.42

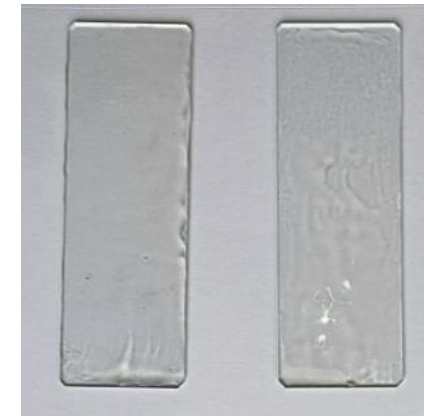
Benchmark



0 hr

500 hr

AB-series

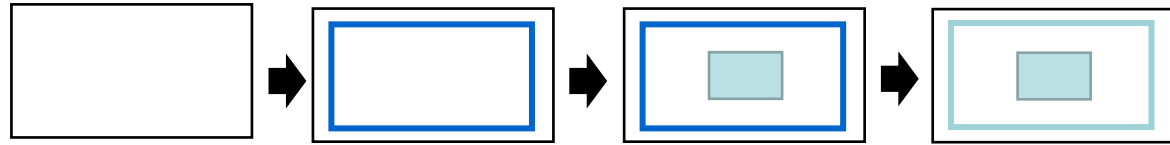


0 hr

500 hr

Moisture Resistance Test

Test method



1. Blank FTO glass

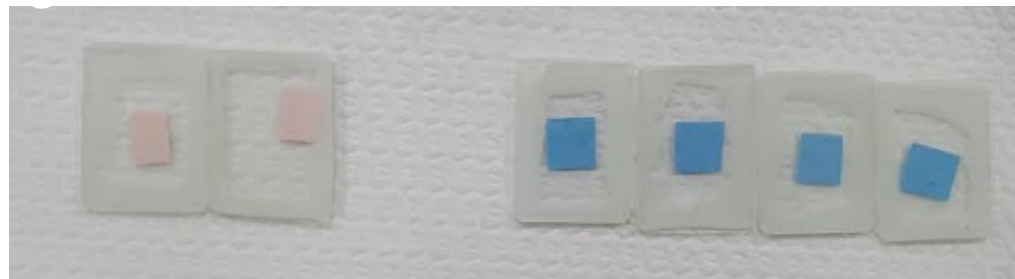
2. AB-341 frame coating

3. Place moisture test paper

4. Seal another FTO glass

Result

85°C/85%RH@1,000hr



Competitor

AB-341



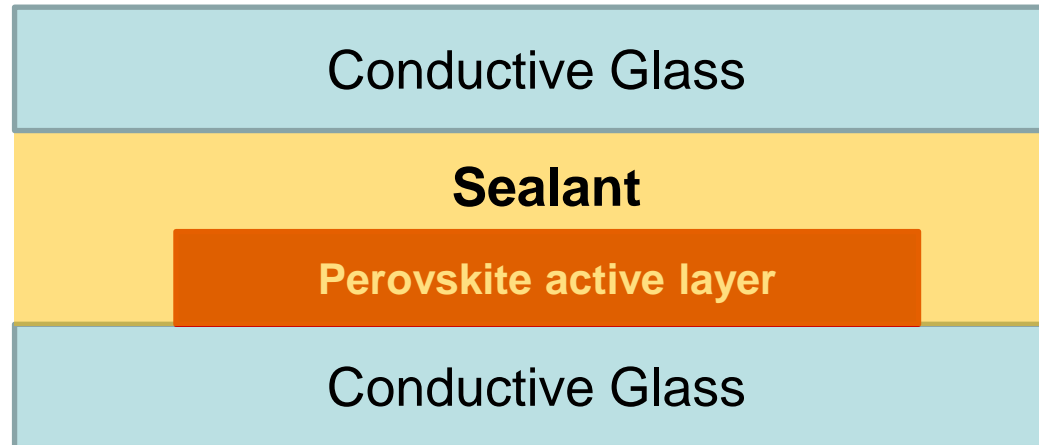
Constant temperature and humidity environment

Moisture test paper absorb water: pink color
Moisture test paper keep dry: blue color

PSC Compatibility Test (1/2)

Purpose: Study the compatibility between sealant and PSC active layer

Test method Coating sealant on the PSC active layer and then encapsulate the cell



PSC Compatibility Test (2/2)

Result

Atmospheric environment storage test

AB-313	Jsc (mA/cm²)	Voc (V)	FF (%)	PCE (%)	Loss (%)
Initial	21.7	0.90	67	13.1	
After 1 month	22.2	0.97	68	14.6	-----
	Fully coated on the perovskite active layer				

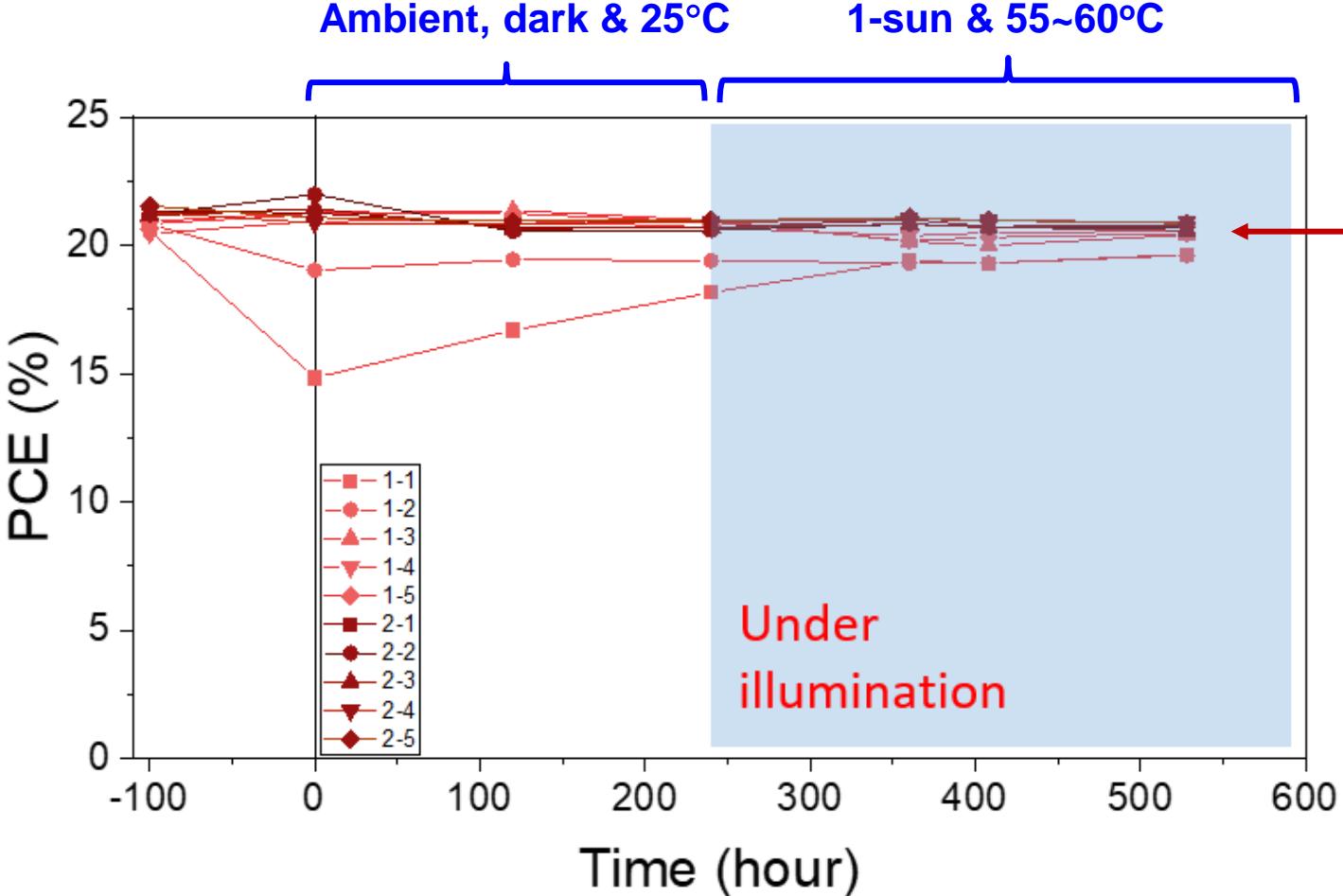
No efficiency degradation

AB-341	Jsc (mA/cm²)	Voc (V)	FF (%)	PCE (%)	Loss (%)
Initial	21.3	0.79	76	12.8	
After 1 month	21.1	0.85	76	13.7	-----
	Fully coated on the perovskite active layer				

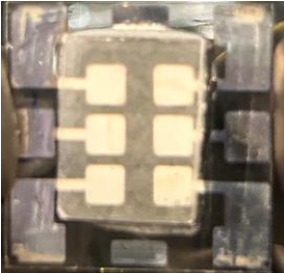
No efficiency degradation

Both of the PSC cell are stable.

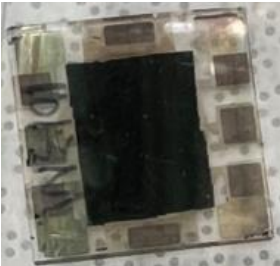
Light Soaking-Heat Test for AB-341 Encapsulation



Electrode Corrosion-Free

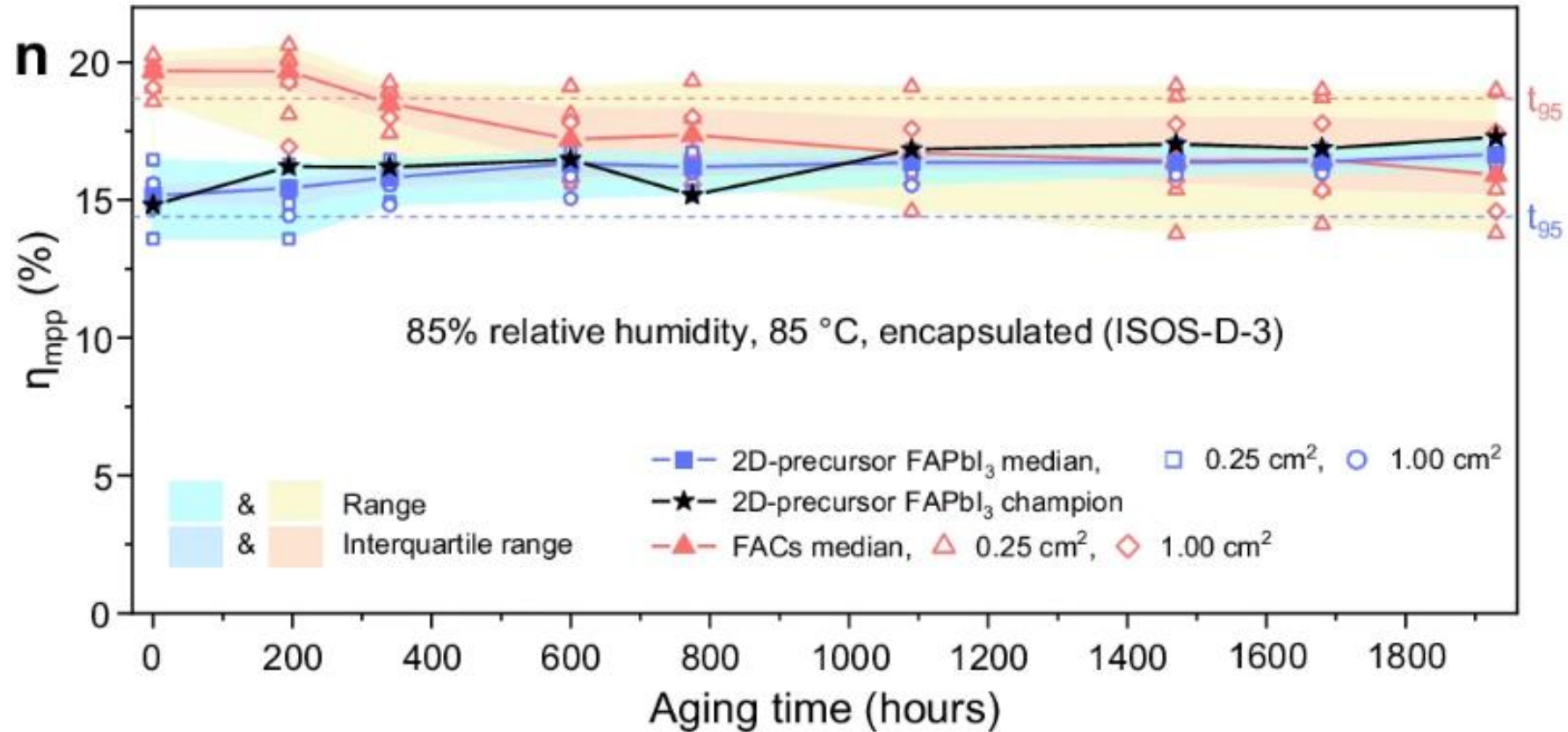


Good Perovskite appearance



Damp-Heat Test for AB-341 Encapsulation

Test condition : 85°C/85%RH (ISOS-D-3)



Summary

- Everlight offers high-quality encapsulants suitable for Perovskite solar cells, including transparent and opaque options for various applications.
- AB-341 encapsulant has successfully passed a 1000-hour durability test at 85°C and 85%.

Thank You!