



Development of Encapsulants for Perovskite Solar Cells

Everlight Chemical Industrial Corporation

2024/11/16

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

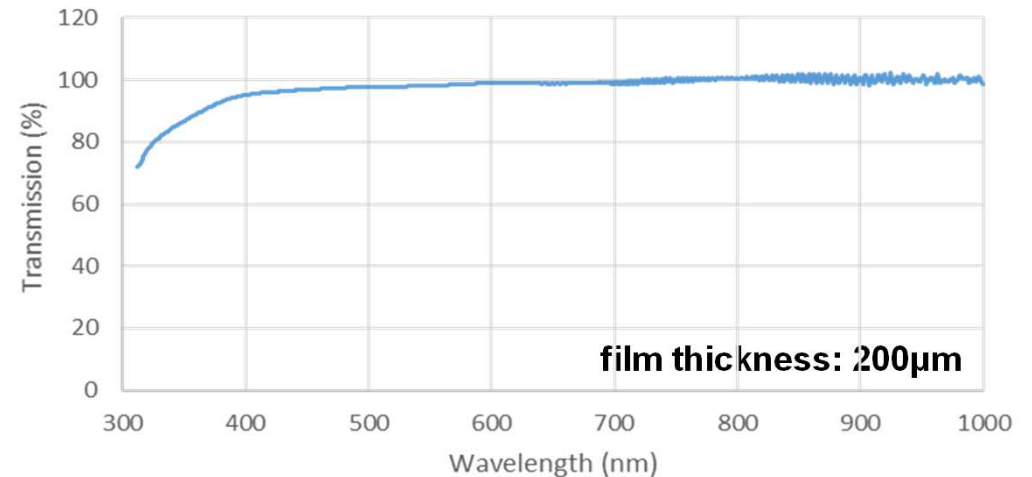


**High transmittance in
visible light region**

Eversolar[®] AB-302

Specification	AB-302
Appearance	Transparent liquid
Appearance after curing	Transparent
Viscosity (cps)@25°C	2,500±500
Tensile strength (glass/glass)	≥5 MPa
Curing condition (LED 365/405 nm)	9 J/cm ²
WVTR (40°C/90%RH@200μm)	≤4 g/m ² .day

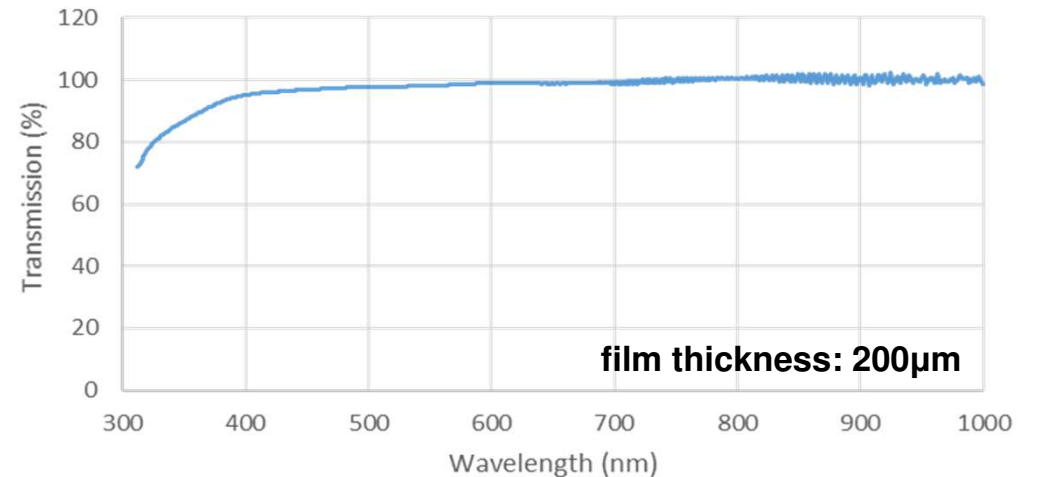
1. Dispensing 、 Slot-die coating
2. High transparency
3. Room temperature storage



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)	≥3 MPa
Curing condition (LED 365/405 nm)	9 J/cm ²
WVTR (40°C/90%RH@200μm)	≤7 g/m ² .day

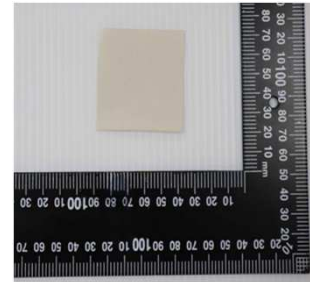
1. Dispensing · Screen printing
2. High transparency
3. Room temperature storage




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



Singh Hsia / Asst. Manager
 Signed for and on behalf of
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 Chemical Laboratory - Taipei



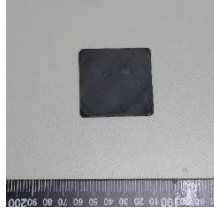
測試項目 (Test Item(s))	測試方法 (Method)	單位 (Unit)	結果 (Result)
			No.1
透濕度 / Water vapor transmission rate	參考 ASTM F1249-20 (溫度40 °C · 濕度90 %) / With reference to ASTM F1249-20 (Temperature: 40°C, Moisture: 90%)	g/(m ² -day)	0.037

Eversolar[®] AB-302c


Specification	AB-302	AB-302c
Appearance	Transparent liquid	Transparent liquid
Appearance after curing	Transparent	Transparent
Viscosity(cps)@25°C	2,500±500	5,000±1,000
Tensile strength (glass/glass)	≥5 MPa	≥3 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

PIB (Polyisobutylene)

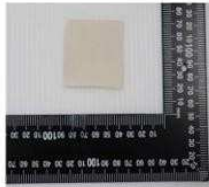


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測試項目 (Test Item(s))	測試方法 (Method)	單位 (Unit)	結果 (Result)
			No.1
透濕度 / Water vapor transmission rate	參考ASTM F1249-20. (溫度: 40°C, 濕度: 90%) / With reference to ASTM F1249-20. (Temperature: 40°C, Moisture: 90%)	g/(m ² -day)	<u>1.59</u>

Eversolar® AB-341



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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>

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.

Oxygen Transmission Rate (OTR) Testing


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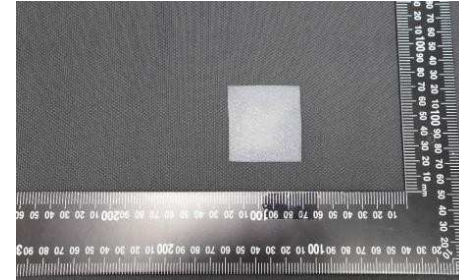


No.1



AB-341

No.2



TPO film

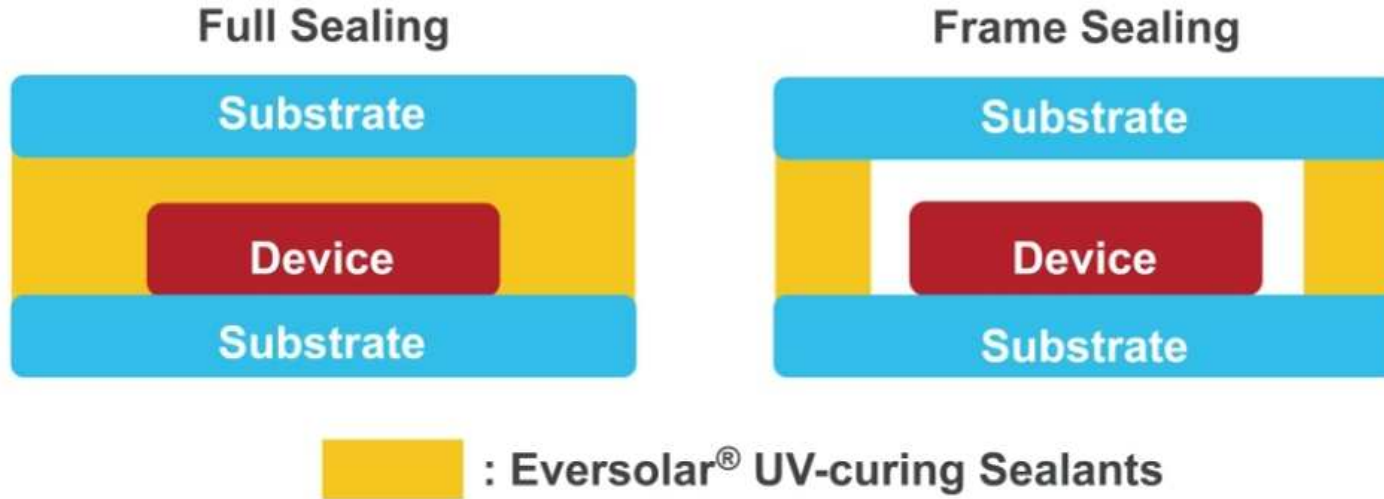
Test item ↴	Test method ↴	Unit ↴	Result ↴	
Oxygen Transmission Rate (OTR) ↴	ASTM D3985-17.(Temp.:25°C、Humidity:0%) ↴	c.c./(m ² .day) ↴	No.1 ↴	No.2 ↴
			182 ↴	1179 ↴

AB-341

TPO film

➤ The OTR of AB-341 is better than commercial PIB (Polyisobutylene).

Encapsulation Types of Eversolar®



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

Anti-yellowing Test

Test method

UVA-340nm / 60°C / 0.86W/cm²

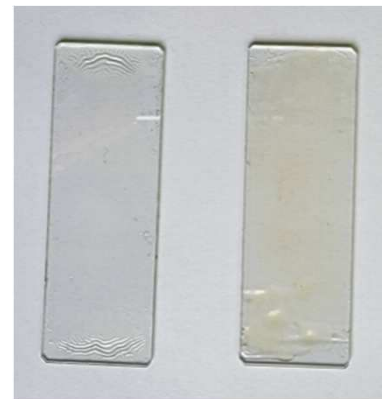
Test time: 500 hours

※ Standard specification : IEC 61345

Results

Item	ΔYI
AB-series	<5.0
Benchmark	+17.42

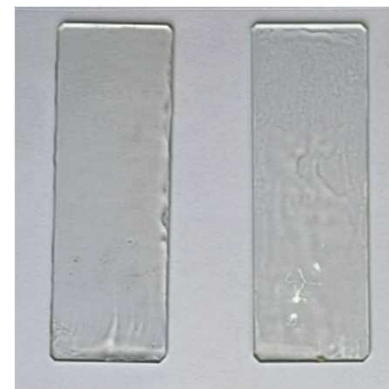
Benchmark



0 hr

500 hr

AB-series

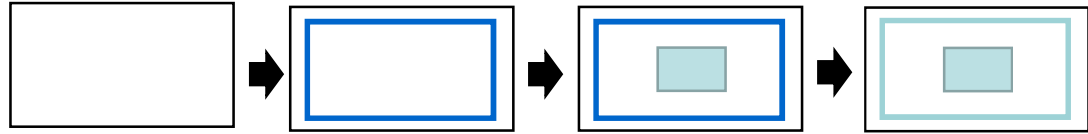


0 hr

500 hr

Moisture Resistance Test

Test method



1. Blank FTO glass

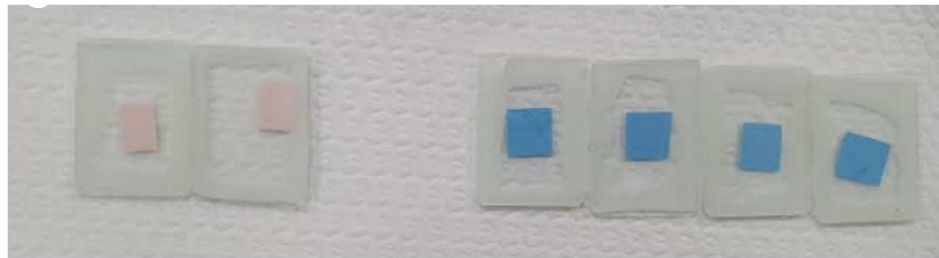
2. AB-341 frame coating

3. Place moisture test paper

4. Seal another FTO glass

Result

85°C/85%RH@1,000hr



Competitor

AB-341



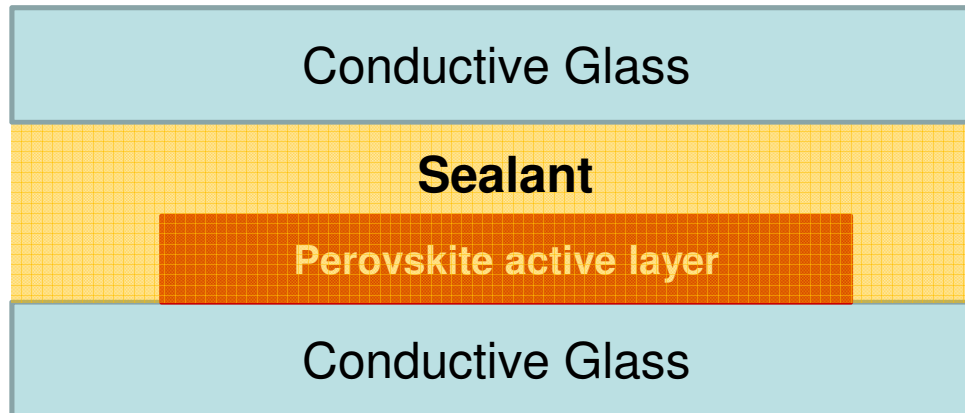
Constant temperature and humidity environment

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				

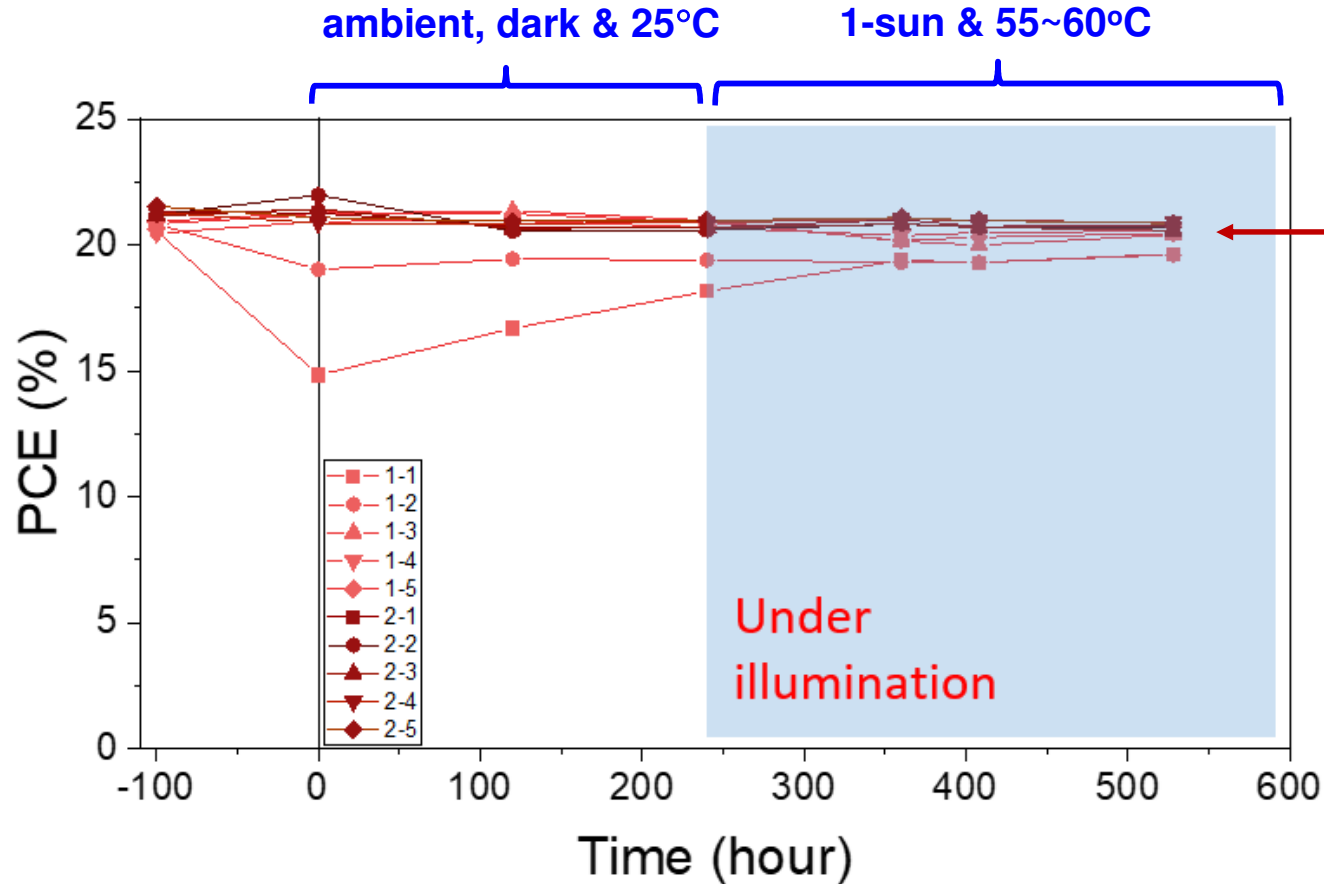
No efficiency degradation

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				

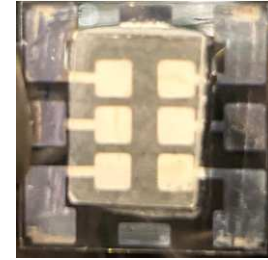
No efficiency degradation

Both of the PSC cell are stable.

Light Soaking-Heat Test for AB-341 Encapsulation



Electrode Corrosion-Free

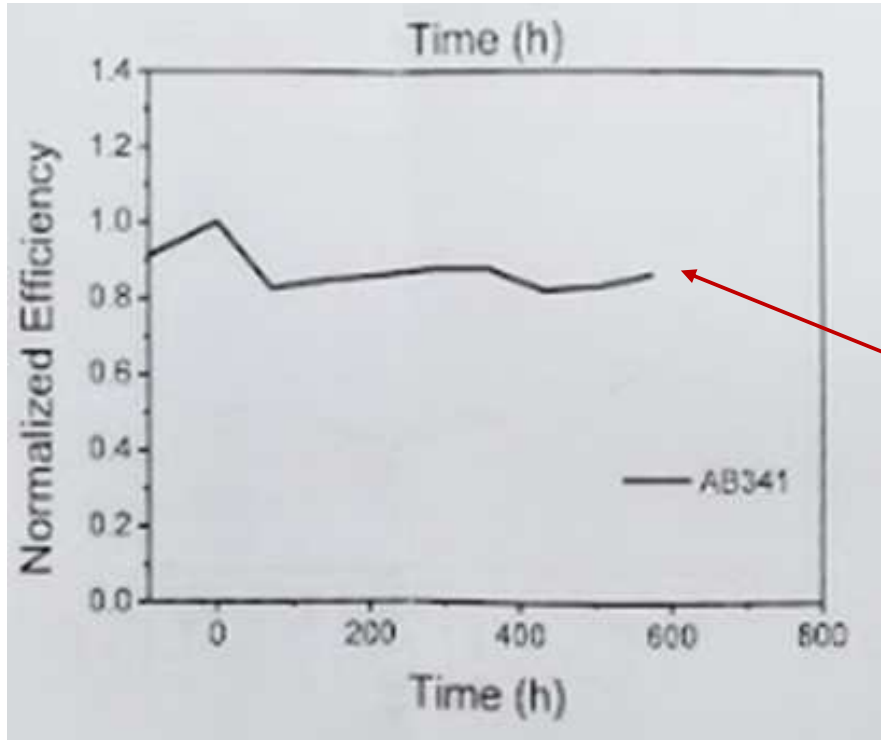


Good Perovskite appearance



Damp-Heat Test for AB-341 Encapsulation

Test condition : 85°C/85%RH



PCE (%)	AB341
0hr	16.10
576hr	13.94 ($>T_{80}$)
$\Delta\%$	14.5

Summary

- Everlight Chemical 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!