

Development of Encapsulants for Perovskite Solar Cells

Everlight Chemical Industrial Corporation,
R&D center
2026

The Global Benchmark in PSCs / OPV Encapsulation

Everlight Eversolar® SERIES

From laboratory research to commercial production — trusted by world-class institutions across Europe and beyond.

- Pioneer in PV encapsulation since the **DSSC era**
- Preferred benchmark at **Oxford, Cambridge, HZB, Fraunhofer, EMPA & more**
- Active partner in **VALHALLA, NEXUS, PEARL, SOPHIA** & more EU projects

31x

Lower WVTR
vs. PIB / POE / TPO

1,930+
hours

T₁₀₀ Damp Heat
ISOS-D3 (85°C / 85%RH)

~12

Publications / Year
incl. citations in Nature

300+

Thermal Cycles
Minimal degradation

Outline

01

**Introduction of
Eversolar® AB-series
Encapsulants**

02

**Eversolar® AB-series
Performances &
Durability Tests**

03

**Application Solutions
& Summary**

Eversolar® AB-Series — Description and Features

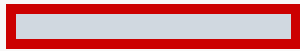
Description

Eversolar® AB-series is a UV-curable encapsulant providing excellent protection and waterproofing properties for sensitive components.

Applications



Full-Area Sealing



Frame Sealing



Edge Sealant



Secondary Sealant



Lead-Out Hole Sealing



Solder Protection

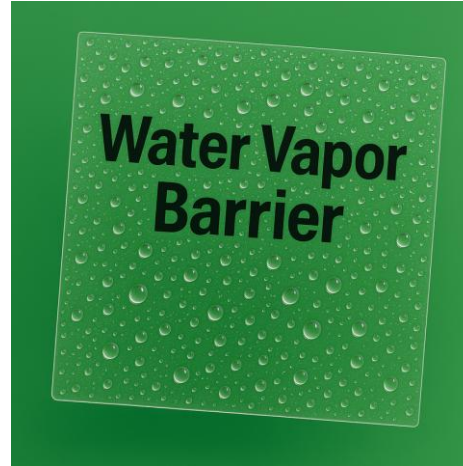
Key Features

- 01** Solvent-free, no VOC impact
- 02** Excellent chemical inertness for sensitive material
- 03** Excellent resistance to yellowing
- 04** Elastomer flexibility after curing
- 05** Low water vapor transmission rate (WVTR)
- 06** High adhesion for various substrates
- 07** Room temperature storage, UV-curable (LED 365/405nm)

Features of Eversolar[®] Encapsulants



**Flexible substrates
adhesion**



**Water-vapor blocking
for devices**

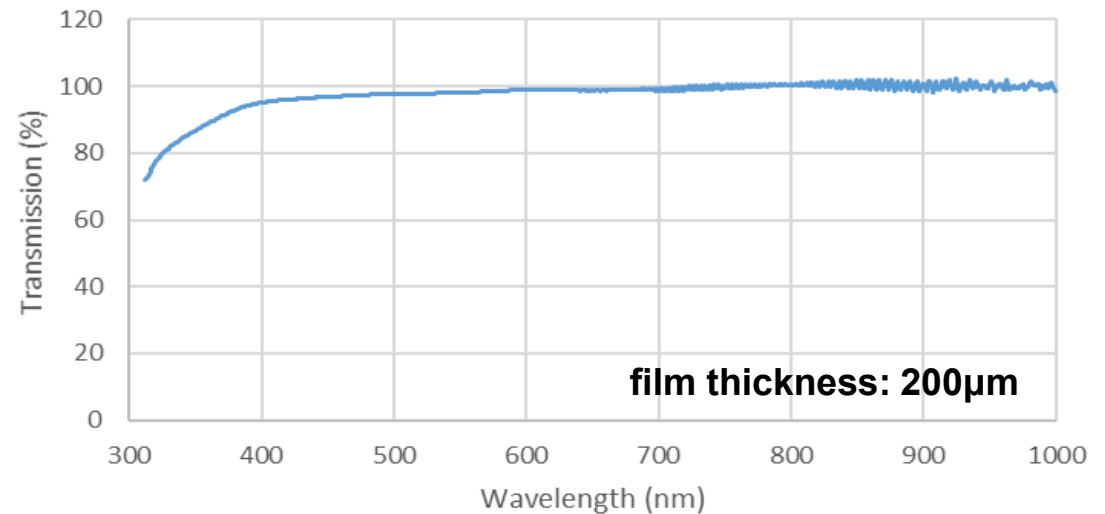


**High transmittance in
visible light region**

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)	6~9 J/cm ²
WVTR (40°C/90%RH)	≤0.8 g·mm/m ² ·day

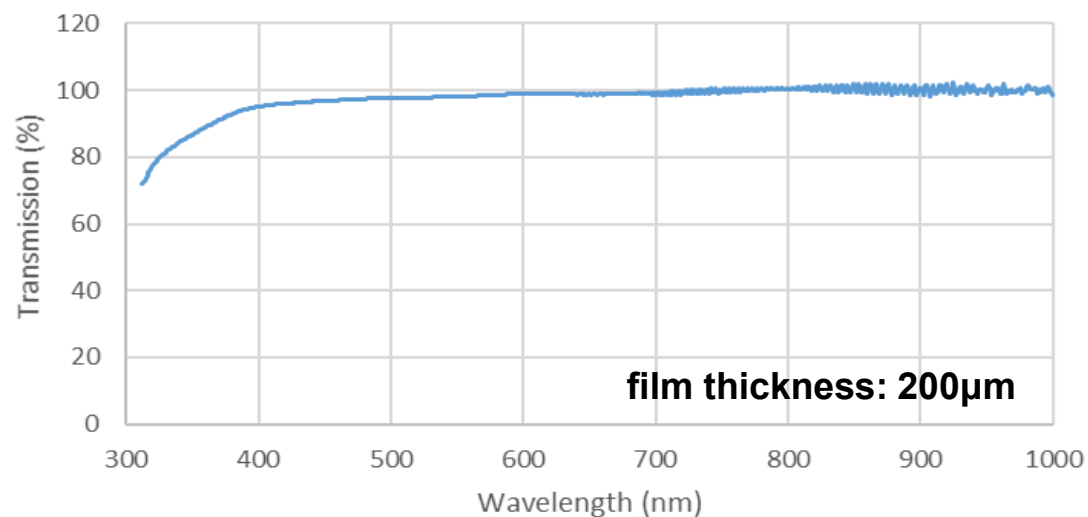
1. Dispensing / Slot-die coating
2. High transparency
3. Glass substrate encapsulation
4. Room temperature storage



Eversolar® AB-302c

Specification	AB-302c
Appearance	Transparent liquid
Appearance after curing	Transparent
Viscosity (cps)@25°C	5,000±1,000
Tensile strength (glass/glass)	≥3 MPa
T-peeling force (PET/PET)	≥5 N/inch
Curing condition (LED 365/405 nm)	6~9 J/cm ²
WVTR (40°C/90%RH)	≤0.8 g·mm/m ² ·day

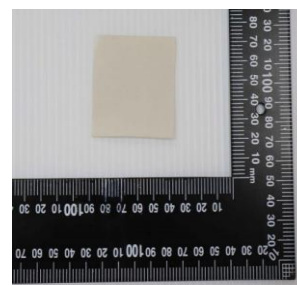
1. Dispensing / Slot-die coating
2. High transparency
3. Flexible substrate encapsulation
4. Room temperature storage



Eversolar® AB-341

Specification	AB-341
Appearance	Gray paste
Appearance after curing	Gray opaque
Viscosity (cps)@25°C	70,000±10,000
Tensile strength (glass/glass)	≥3 MPa
Curing condition (LED 365/405 nm)	6~9 J/cm ²
WVTR (40°C/90%RH)	~ 10 ⁻² g·mm/m ² .day

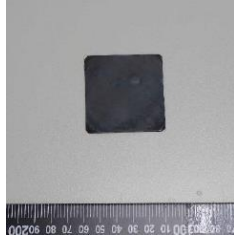
1. Dispensing / Screen-printing
2. Opaque (non-transparency)
3. Low WVTR
4. Room temperature storage



Singh Hsiao / Asst. Manager
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) @200µm	0.037

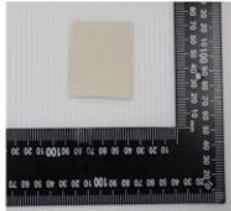
WVTR Testing Comparison – AB-341 vs. PIB



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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

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

Oxygen Transmission Rate (OTR) Testing

Singh Hsiao
Singh Hsiao / Asst. Manager
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei

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

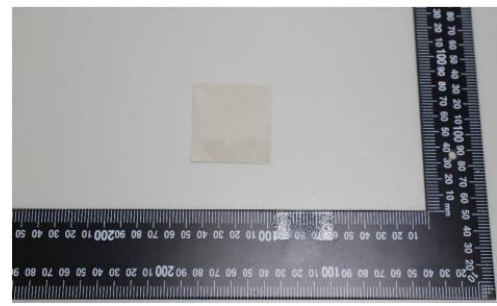
測試結果

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

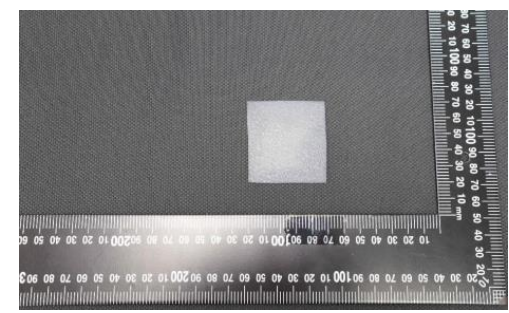
AB-341 TPO film

No.1



AB-341

No.2



TPO film

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

Summary of Eversolar® AB Series Characteristics

Specification	AB-302	AB-302c	AB-302i	AB-302e	AB-341	AB-402
Appearance	Transparent liquid	Transparent liquid	Transparent liquid	White paste	Gray paste	Clear liquid
Appearance after curing	Transparent	Transparent	Transparent	Transparent*	Gray opaque	Transparent
Viscosity (cps) @25°C	2,500 ± 500	5,000 ± 1,000	8,000 ± 1,600	10,000 ± 2,000	70,000 ± 10,000	2,200 ± 500
Tensile strength (glass/glass)	≥ 5 MPa	≥ 3 MPa	≥ 5 MPa	≥ 3 MPa	≥ 3 MPa	≥ 5 MPa
T-peeling force (PET/PET)	-	≥ 5 N/inch	≥ 5 N/inch	-	≥ 1.5 N/inch	-
UV curing condition (LED 365/405 nm)	6~9 J/cm ²	6~9 J/cm ²	6~9 J/cm ²	6~9 J/cm ²	6~9 J/cm ²	6~9 J/cm ²
WVTR (40°C/90%RH)	≤ 0.8 g·mm/m ² ·day	≤ 0.8 g·mm/m ² ·day	≤ 0.4 g·mm/m ² ·day	≤ 0.2 g·mm/m ² ·day	~ 10 ⁻² g·mm/m ² ·day	~ 3 g·mm/m ² ·day
OTR (23°C/0%RH)	~ 240 cc/(m ² ·day)	~ 240 cc/(m ² ·day)	~ 240 cc/(m ² ·day)	~ 240 cc/(m ² ·day)	~ 180 cc/(m ² ·day)	< 0.5 cc/(m ² ·day)

* At thickness of 50 μm, transparency is 90%–92%. Thinner layers exhibit even higher transparency.

* Typical internal test values, not guaranteed specifications. Results may vary depending on film thickness and test method.

Encapsulation Types of Eversolar®



 : Primary Sealant  : Secondary Sealant

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

Anti-yellowing Test

Test method

UVA-340nm / 60°C / 0.86W/cm²

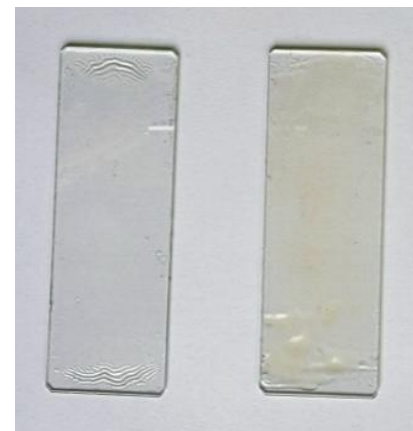
Test time: 500 hours

※ Standard specification : IEC 61345

Results

Item	ΔYI
AB-302	+0.5
AB-341	+4.1
Benchmark	+17.4

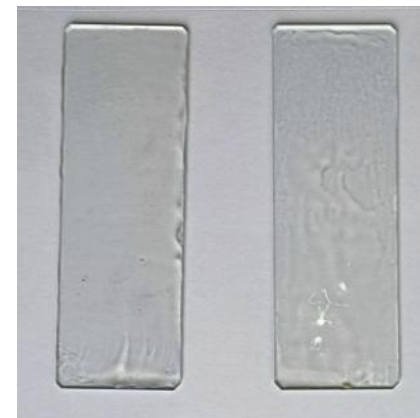
Benchmark



0 hr

500 hr

AB-series



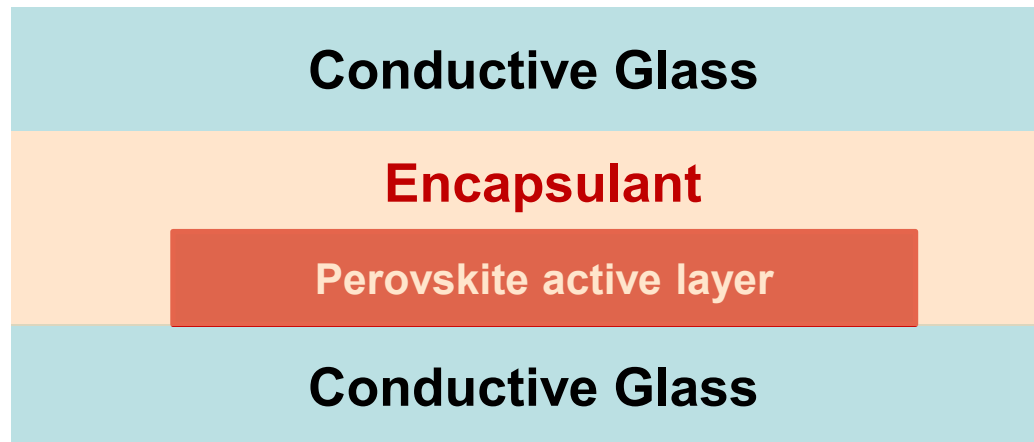
0 hr

500 hr

PSC Compatibility Test (1/2)

Purpose: Study the compatibility between sealant and PSC active layer

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



PSC Compatibility Test (2/2)

Result Atmospheric environment storage test

AB-302	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

- **The AB-series exhibits excellent compatibility with the perovskite solar cell.**

Literature reference for compatibility of Eversolar®

Paper / year	Journal	Eversolar®	How the encapsulant was used
Crystal-facet-directed all-vacuum-deposited perovskite solar cells (2026)	Nature Materials	AB-341	Applied across the substrate ; cover glass placed and UV-cured
Hole-transport-layer-dependent degradation mechanisms... (2026)	EES Solar	AB-302 AB-313 AB-341	Applied to cover the cell / module area in a comparative study
Dismantling degradation pathways of narrow-bandgap Pb-Sn perovskites (2025)	Nature Communications	AB-341	The active area was fully covered by AB-341
Rationally designed universal passivator... (2025)	Nature Communications	AB-341	Applied over the active area ; glass placed, compressed and UV-cured
A green solvent enables precursor phase engineering... (2024/25)	Nature Communications	AB-341	Spread across the full device area for ISOS-L testing

Literature evidence supports the compatibility of the Eversolar® encapsulant family with direct full-area contact on perovskite active layers.

Engaging in Academic Research and Development

nature

Article | Published: 23 December 2024

Steering perovskite precursor solutions for multijunction photovoltaics

[Shuaifeng Hu](#) , [Junke Wang](#), [Pei Zhao](#), [Jorge Pascual](#), [Jianan Wang](#), [Florine Rombach](#), [Akash Dasgupta](#), [Wentao Liu](#), [Minh Anh Truong](#), [He Zhu](#), [Manuel Kober-Czerny](#), [James N. Drysdale](#), [Joel A. Smith](#), [Zhongcheng Yuan](#), [Guus J. W. Aalbers](#), [Nick R. M. Schipper](#), [Jin Yao](#), [Kyohei Nakano](#), [Cruz](#), [André Dallmann](#), [M. Greyson Christoforo](#), [James M. Ball](#), [David P. McMeekin](#), [K. Zaininger](#), ... [Henry J. Snaith](#) 

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nature communications

Article | [Open access](#) | Published: 22 November 2024

A green solvent enables precursor phase engineering of stable formamidinium lead triiodide perovskite solar cells

[Benjamin M. Gallant](#), [Philippe Holzhey](#), [Joel A. Smith](#), [Saqlain Choudhary](#), [Karim A. Elmetekawy](#), [Pietro Caprioglio](#), [Igal Levine](#), [Alexandra A. Sheader](#), [Esther Y. Rachel C. Kilbride](#), [Karl-Augustin Zaininger](#), [James M. E M. Herz](#), [Dominik J. Kubicki](#) & [Henry J. Snaith](#) 

nature portfolio

Article

Disentangling Degradation Pathways of Narrow Bandgap Lead-Tin Perovskite Material and Photovoltaic Devices

Florine Rombach, Akash Dasgupta, Manuel Kober-Czerny, James Ball, and 4 more

ACS Energy Letters > Vol 9/Issue 9 > Article

Open Access

LETTER | August 27, 2024

Vacuum-Deposited Bifacial Perovskite Solar Cells

[han Rodkey](#), and [Henk J. Bolink*](#)

nature portfolio

Article

Rationally designed universal passivator for high-performance single-junction and tandem perovskite solar cells

Jiangzhao Chen, Yinsu Feng, Jike Ding, Quanxing Ma, Hong Zhang, and 11 more

NANO · MICRO
small

Research Article | [Full Access](#)

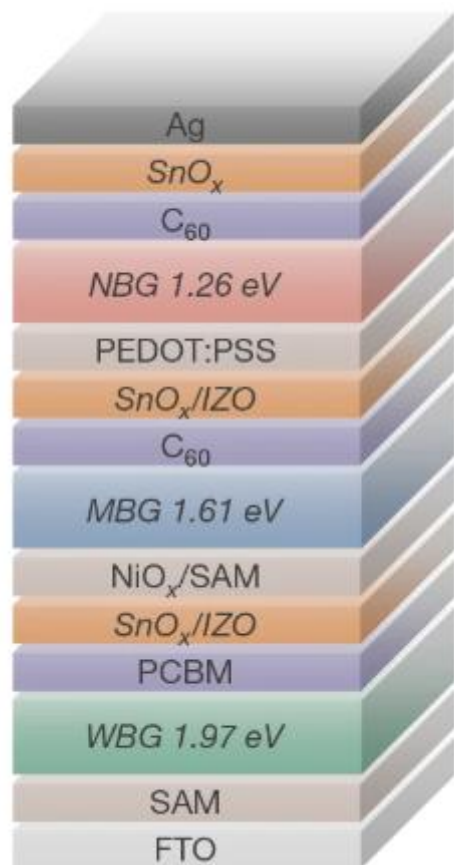
Managing Pb-Related Imperfections via Rationally Designed Aniline Derivative with Bilateral Cyano and Acetyl Groups as Lewis Base for High-Efficiency Perovskite Solar Cells Exceeding 24%

[Zijie He](#), [Zuolin Zhang](#), [Jike Ding](#), [Wenhuan Gao](#), [Mengjia Li](#), [Cong Chen](#) 

First published: 12 June 2024 | <https://doi.org/10.1002/smll.202404334> | Citations: 2

All perovskite tandem – Eversolar®

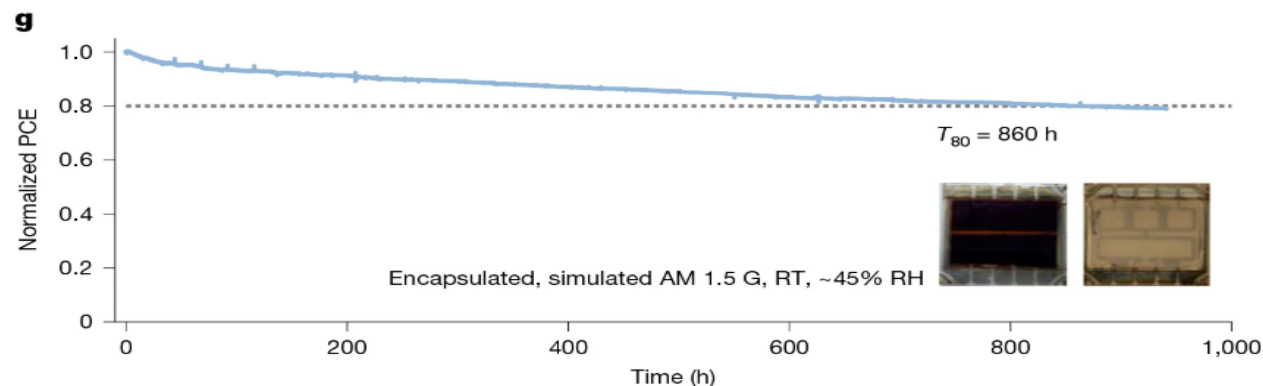
nature



Steering perovskite precursor solutions for multijunction photovoltaics

[Shuaifeng Hu](#) , [Junke Wang](#), [Pei Zhao](#), [Jorge Pascual](#), [Jianan Wang](#), [Florine Rombach](#), [Akash Dasgupta](#), [Wentao Liu](#), [Minh Anh Truong](#), [He Zhu](#), [Manuel Kober-Czerny](#), [James N. Drysdale](#), [Joel A. Smith](#), [Zhongcheng Yuan](#), [Guus J. W. Aalbers](#), [Nick R. M. Schipper](#), [Jin Yao](#), [Kyohei Nakano](#), [Silver-Hamill Turren-Cruz](#), [André Dallmann](#), [M. Greyson Christoforo](#), [James M. Ball](#), [David P. McMeekin](#), [Karl-Augustin Zainer](#), ... [Henry J. Snaith](#)  [+ Show authors](#)

All types of cell were encapsulated with a cover glass and ultraviolet (UV)-activated adhesive (Eversolar AB-341, Everlight Chemical Industrial Co.), which was cured under a UV LED lamp

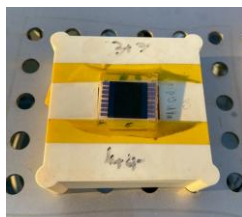
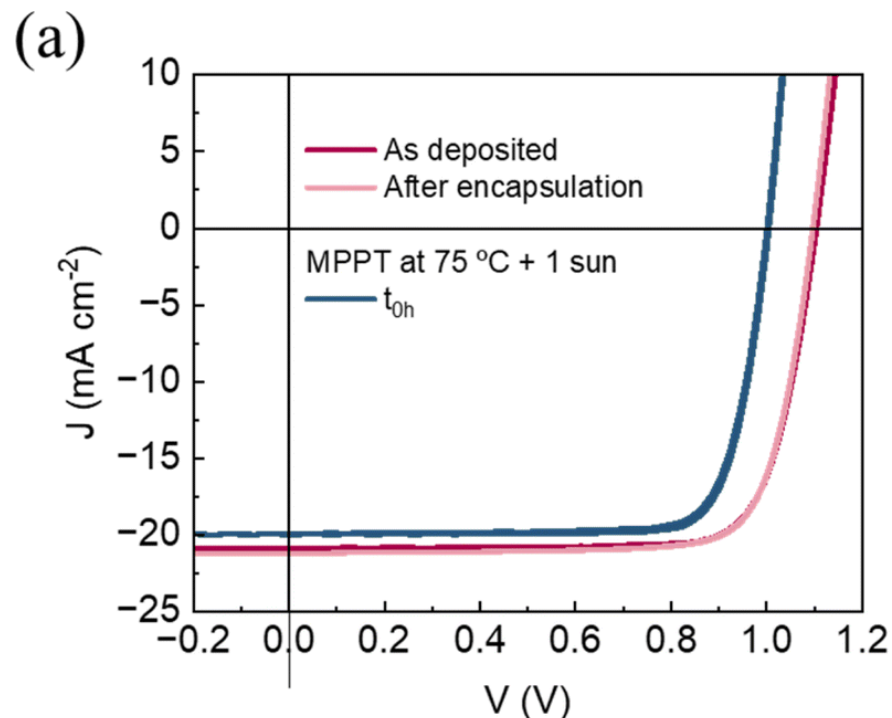


ISOS-L2 for AB-341 Encapsulation

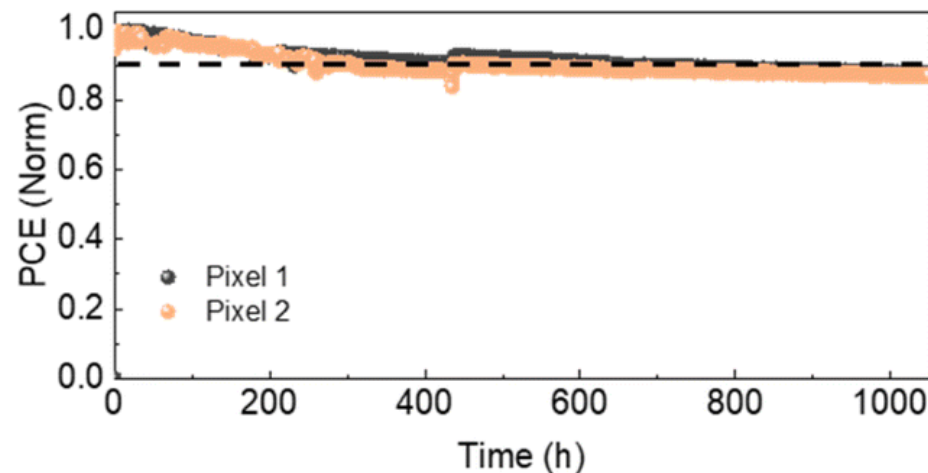


From the journal:
EES Solar

Large-area close-space sublimation enables the fabrication of efficient and stable perovskite solar cells



**Champion Outdoor PSCs
in VALHALLA EU project**



Device encapsulation for the MPP tracking measurements

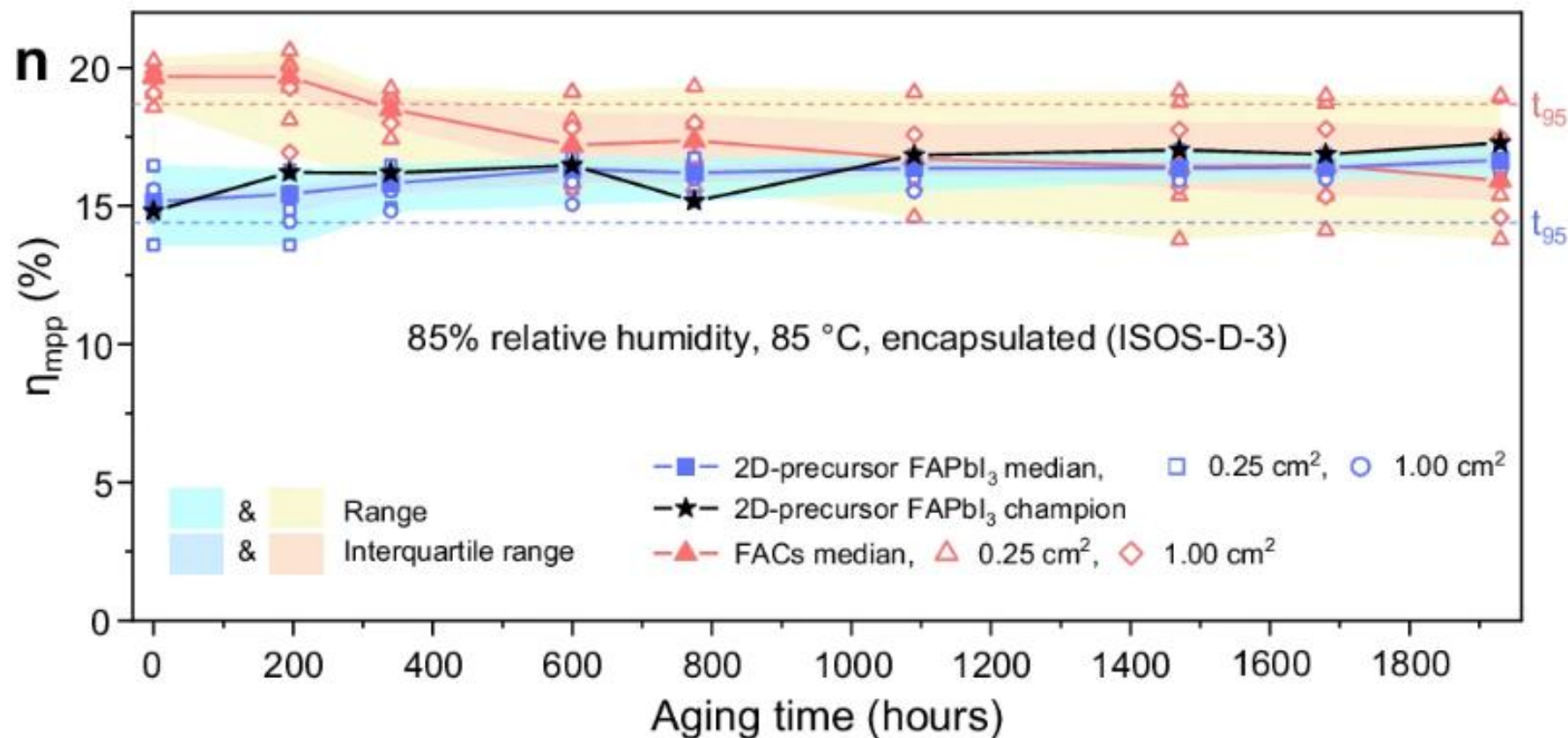
To connect the device to the MPP tracking system, 4 copper wires (CUL100/0.35) were soldered to the device using an ultrasonic soldering (9210 MkII AIR) with lead-free soldering wires (Cerasolzer GS-155) at 200 °C. The device was then encapsulated by applying a thick layer (~1 mm) of **Eversolar® AB-341 UV curable resin** from **Everlight Chemicals** on the device, and then covered with a glass substrate, as shown in Fig. S10.

ISOS-D3 for AB-341 Encapsulation

nature communications

A green solvent enables precursor phase engineering of stable formamidinium lead triiodide perovskite solar cells

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



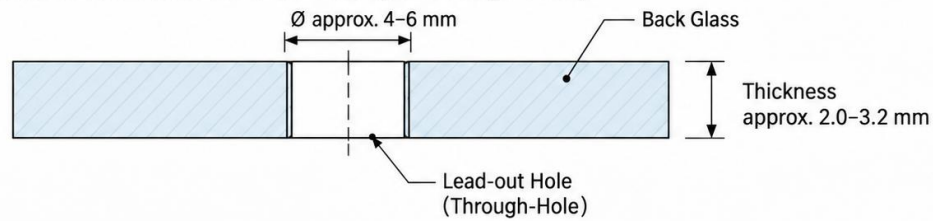
Application Solutions: Potting, Lead-Out Hole Sealing

Eversolar® AB-350 — Dual-Cure (UV + Thermal) Sealant

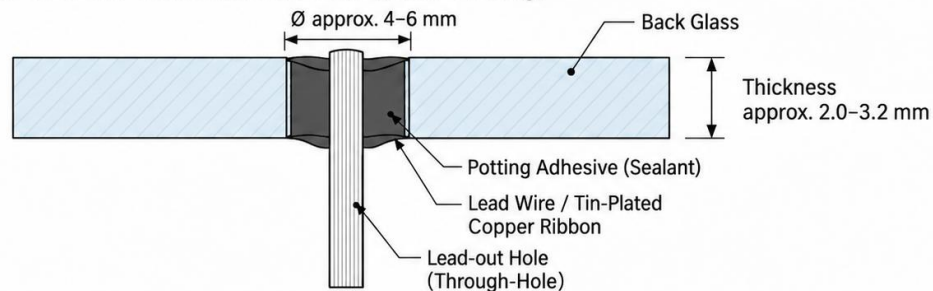
(1) Top View



(2) Enlarged Local Cross-Sectional Side View (at Through-Hole)



(3) Enlarged Local Cross-Sectional Side View (After Potting)



Potting

Fills and seals cavities around junction structures; deep-cure reaches regions that UV light alone cannot.

Lead-Out Hole Sealing

Seals through-holes in the back glass while fixing the tin-plated copper ribbon in place.

Gap Filling

Low-shrinkage sealing of irregular gaps, with strong adhesion to both glass and metal substrates.

Dual-Cure System

UV for fast positioning, thermal cure for full depth in regions shadowed by the lead wire.

Summary



Proven Product Range

Everlight offers a full encapsulant range for perovskite solar cells — transparent (AB-302 series and 402) and opaque (AB-341 series) grades, plus AB-350 for potting, lead-out hole sealing and gap filling.



Industry-Validated Durability

Eversolar® has met ISOS-D3, ISOS-L2, and ISOS-O2/O3 standards. We welcome collaboration opportunities with all partners in the perovskite community.

Thank You!