

TROY TECHNICAL

PEROVSKITE SOLAR CELLS

WEEKLY REPORT

October 3 - October 9, 2026 | Issue 2026-W40

**Bankable module performance, durability,
manufacturing yield and market entry**

18

ANALYZED ARTICLES

10

PRIORITY THEMES

Issued 2026-10-09 | English edition | fixed approved cover artwork



Perovskite Solar Cells: the boundary moved from isolated claims to qualification evidence

18 English articles were reviewed independently from the Japanese edition. Ten themes are retained for management decisions.

SIGNAL 01 | PRECURSORS

UNSW & UtmoLight: 23.5% efficiency for 676 cm² perovskite cells

Researchers at the University of New South Wales (UNSW), in collaboration with industry partner UtmoLight, have established a new world record for large-area perovskite solar cell submodules, achieving a certified stabilized power conversion efficiency of.

SIGNAL 02 | CELL STACK

LONGi: 35.5% perovskite-silicon tandem cell efficiency specs

Chinese solar giant LONGi has achieved a certified efficiency of 35.5% for its perovskite-silicon tandem cells and reported 31.4% efficiency for modules.

SIGNAL 03 | MODULE PROCESS

UNSW and UtmoLight: 23.5% efficiency for 30cm perovskite cells

Researchers at the University of New South Wales (UNSW) and UtmoLight have achieved a certified stabilized efficiency of 23.5% for a large-area perovskite solar submodule (30cm x 30cm, 676cm² aperture area).

SIGNAL 04 | QUALIFICATION

Perovskite Solar Cells: High-entropy contacts efficiency explained

A groundbreaking study published in Nature Photonics reveals that high-entropy molecular hole-selective contacts enable inverted perovskite solar cells to achieve record-breaking efficiency and sustained stability simultaneously.

DECISION

Focus this week's management attention on bankable module performance, durability, manufacturing yield and market entry. Move only when the linked evidence can be reproduced under your own operating conditions.

THREE MANAGEMENT MOVES

1. Buyers: compare certified performance with field-relevant lifetime, degradation and warranty evidence.
2. Suppliers: connect precursor and coating control to module yield, encapsulation, lead management and scale.
3. Executives: track stability, area, certification, yield, capex, lead control and warranty.

EVIDENCE DISCIPLINE

FACT states what the collected English source reports. BUSINESS READ and ACTION are editorial interpretations. UNKNOWN lists information that the source file does not establish. A linked article is not treated as independent confirmation of every claim.

Five numbers or evidence anchors that require conditions

23.5% A03	SOURCE-BOUND CONDITION Researchers at the University of New South Wales (UNSW), in collaboration with industry partner UtmoLight, have established a new world record for large-area perovskite solar cell submodules, achieving a certified.
35.5% A07	SOURCE-BOUND CONDITION Chinese solar giant LONGi has achieved a certified efficiency of 35.5% for its perovskite-silicon tandem cells and reported 31.4% efficiency for modules.
30cm A10	SOURCE-BOUND CONDITION Researchers at the University of New South Wales (UNSW) and UtmoLight have achieved a certified stabilized efficiency of 23.5% for a large-area perovskite solar submodule (30cm x 30cm, 676cm2 aperture area).
26.9% A01	SOURCE-BOUND CONDITION Chinese researchers have achieved a remarkable 26.9% power conversion efficiency in perovskite solar cells by integrating Prussian Blue (PB) nanoparticles, significantly boosting long-term stability.
676 cm A18	SOURCE-BOUND CONDITION Researchers at UNSW Sydney and Chinese manufacturer UtmoLight have set a new world record, achieving a certified stabilized power conversion efficiency of 23.5% for a 30 cm × 30 cm perovskite solar submodule with an.

HOW TO USE THESE NUMBERS

Each value is shown with the condition stated in the collected English article. Do not compare values across different test methods, device sizes, operating temperatures or commercial stages without normalizing those conditions.

Where the value chain moved

Each stage combines one leading theme and one supporting theme. The report treats handoffs as evidence transfers, not decorative arrows.

1

Precursors

P01/P06

Researchers at the University of New South Wales (UNSW), in collaboration with industry partner UtmoLight, have established a.

2

Cell stack

P02/P07

Chinese solar giant LONGi has achieved a certified efficiency of 35.5% for its perovskite-silicon tandem cells and reported.

3

**Module proce
ss**

P03/P08

Researchers at the University of New South Wales (UNSW) and UtmoLight have achieved a certified stabilized efficiency of.

4

Qualification

P04/P09

A groundbreaking study published in Nature Photonics reveals that high-entropy molecular hole-selective contacts enable.

5

**Deployment
& recycling**

P05/P10

Chinese researchers have achieved a remarkable 26.9% power conversion efficiency in perovskite solar cells by integrating.

EVIDENCE REQUIRED AT EACH HANDOFF

Precursors to Cell stack	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck stability, area, certification, yield, capex, lead control and warranty.
Cell stack to Module process	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck stability, area, certification, yield, capex, lead control and warranty.
Module process to Qualification	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck stability, area, certification, yield, capex, lead control and warranty.
Qualification to Deployment & recycling	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck stability, area, certification, yield, capex, lead control and warranty.

COMMON CONTROL POINT

No theme moves to a commercial commitment until a named owner has reproduced the relevant evidence and documented stability, area, certification, yield, capex, lead control and warranty.

Priority map: maturity and next decision locus



REPRODUCIBLE POSITIONING RULE

Horizontal position uses five discrete stages: Research, Prototype, Joint evaluation, Product adoption and Scale. The vertical bands classify the next decision locus: Tech / process, System / adoption, or Business / rules (including supply systems). Article-title cues take precedence; the overview is used only when the title is silent. These are categories, not impact ranks. Bubble diameter reflects the editorial score.

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P01

UNSW & UtmoLight: 23.5% efficiency for 676 cm2 perovskite cells

A03 | Precursors | Pilot

Date not stated

FACT

Researchers at the University of New South Wales (UNSW), in collaboration with industry partner UtmoLight, have established a new world record for large-area perovskite solar cell submodules, achieving a certified stabilized power conversion efficiency of 23.5% on a 676 cm2 aperture area. This breakthrough, achieved on a 30 x 30cm submodule, significantly narrows the efficiency gap between small laboratory cells and large-area modules.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P01.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 22/25 | MATURITY 2/5 | DECISION LOCUS: SYSTEM / ADOPTION

P02

LONGi: 35.5% perovskite-silicon tandem cell efficiency specs

A07 | Cell stack | Research

Date not stated

FACT

Chinese solar giant LONGi has achieved a certified efficiency of 35.5% for its perovskite-silicon tandem cells and reported 31.4% efficiency for modules. This breakthrough indicates the potential to generate approximately 25% more electricity than current solar panels, paving the way for large-scale commercialization. Qcells also announced its tandem technology received UL and IEC compliance certification, marking it as the first such tandem design.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P02.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 21/25 | MATURITY 1/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P03

UNSW and UtmoLight: 23.5% efficiency for 30cm perovskite cells

A10 | Module process | Pilot

Date not stated

FACT

Researchers at the University of New South Wales (UNSW) and UtmoLight have achieved a certified stabilized efficiency of 23.5% for a large-area perovskite solar submodule (30cm x 30cm, 676cm² aperture area). This new record surpasses the previous benchmark by 0.6 percentage points, demonstrating the scalability of perovskite technology beyond small laboratory cells.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P03.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 21/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

P04

Perovskite Solar Cells: High-entropy contacts efficiency explained

A05 | Qualification | Product adoption

Date not stated

FACT

A groundbreaking study published in Nature Photonics reveals that high-entropy molecular hole-selective contacts enable inverted perovskite solar cells to achieve record-breaking efficiency and sustained stability simultaneously. This research presents a new paradigm in solar cell design, demonstrating how molecular disorder can actively contribute to enhanced device performance.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P04.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: TECH / PROCESS

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P05

Perovskite Solar Cells: 26.9% efficiency specs via Prussian Blue

A01 | Deployment & recycling | Pilot

Date not stated

FACT

Chinese researchers have achieved a remarkable 26.9% power conversion efficiency in perovskite solar cells by integrating Prussian Blue (PB) nanoparticles, significantly boosting long-term stability. This novel approach enables the fabrication of large-area modules with a certified efficiency of 22.9%, demonstrating promising results in accelerated degradation and outdoor stability tests.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P05.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 2/5 | DECISION LOCUS: SYSTEM / ADOPTION

P06

UNSW & UtmoLight: 23.5% efficiency for 676 cm2 Perovskite PV

A18 | Precursors | Joint evaluation

Date not stated

FACT

Researchers at UNSW Sydney and Chinese manufacturer UtmoLight have set a new world record, achieving a certified stabilized power conversion efficiency of 23.5% for a 30 cm × 30 cm perovskite solar submodule with an aperture area of 676 cm2. This significant milestone dramatically narrows the efficiency gap between small lab cells and industrially relevant large-area modules, demonstrating the technology's strong potential for scalable manufacturing.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P06.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 3/5 | DECISION LOCUS: TECH / PROCESS

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P07

FAPbI3: AI-guided synthesis for 19%+ efficient solar cells

A11 | Cell stack | Product adoption

Date not stated

FACT
Researchers have developed an AI-assisted ligand-induced room-temperature injection (LTRI) method to mass-produce FAPbI3 perovskite nanocrystals at a rate of approximately 13g per hour, significantly reducing production costs. Laboratory-scale solar cells fabricated using these nanocrystals achieved over 19% power conversion efficiency.

WHY IT MATTERS
The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ
For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION
Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P07.

UNKNOWN
Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: SYSTEM / ADOPTION

P08

Temporary Liquid Process Achieves 26% Efficiency and Enhanced Durability in Perovskite Solar Cells

A12 | Module process | Pilot

Date not stated

FACT
UC San Diego researchers have developed a novel crystallization method that boosts perovskite solar cell efficiency to 24-26% and significantly improves durability. By forming a temporary liquid phase during crystallization, the process yields larger, more uniform perovskite crystals with fewer defects, maintaining most of their initial efficiency after 8 weeks of continuous operation under simulated sunlight.

WHY IT MATTERS
The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ
For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION
Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P08.

UNKNOWN
Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 2/5 | DECISION LOCUS: SYSTEM / ADOPTION

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P09

Perovskite Solar: Underwater power specs at 10m depth

A16 | Qualification | Product adoption

Date not stated

FACT

Researchers have developed high-efficiency underwater solar cells utilizing a polymer-tuned mixed-anion lead halide perovskite, optimized for the blue-green window of deep water with a wide optical bandgap of approximately 1.96 eV. The addition of polyhexamethylene guanidine hydrochloride (PHMG) as a crystallization additive rewrote the perovskite film's crystallization dynamics and surface electronic properties.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P09.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: TECH / PROCESS

P10

UC San Diego: 26% perovskite efficiency via transient melting

A02 | Deployment & recycling | Pilot

Date not stated

FACT

Researchers at the University of California San Diego have developed a new fabrication method for perovskite solar cells and LEDs that involves generating a transient liquid during crystallization, yielding devices with 24% to 26% efficiency and exceptional durability. This technique enables the growth of larger, more uniform, and defect-sparse perovskite crystals.

WHY IT MATTERS

The decision relevance is bankable module performance, durability, manufacturing yield and market entry. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect precursor and coating control to module yield, encapsulation, lead management and scale.

ACTION

Within 30 days, compare certified performance with field-relevant lifetime, degradation and warranty evidence; record the evidence and owner against P10.

UNKNOWN

Still unproven or incompletely stated: stability, area, certification, yield, capex, lead control and warranty.

EDITORIAL SCORE 20/25 | MATURITY 2/5 | DECISION LOCUS: SYSTEM / ADOPTION

Playbook and 0-5 year roadmap

STAKEHOLDER	NOW 0-30 DAYS	NEXT 1-12 MONTHS	LATER 1-5 YEARS
Operating companies	compare certified performance with field-relevant lifetime, degradation and warranty evidence	Run production-like qualification with explicit acceptance and stop criteria.	Build a portfolio and architecture that can absorb technology and supplier changes.
Materials, equipment and technology suppliers	connect precursor and coating control to module yield, encapsulation, lead management and scale	Create shared reliability, process-window and failure-analysis data with customers.	Standardize interfaces, traceability, lifecycle support and recovery services.
Trading, investment and legal teams	Map stability, area, certification, yield, capex, lead control and warranty.	Contract for capacity, quality, change notice, liability, alternatives and exit.	Diversify regional, technical and customer concentration risk.

ROADMAP

NOW 0-30 DAYS Evidence ledger Owner: Strategy + quality Deliverable: claim, source, condition, owner	NOW 0-30 DAYS Risk screen Owner: Procurement + legal Deliverable: unknowns, alternatives, stop	NEXT 1-12 MONTHS Joint qualification Owner: R&D + supplier Deliverable: process window and failure data
NEXT 1-12 MONTHS Commercial gate Owner: Business + finance Deliverable: unit economics and capacity	LATER 1-5 YEARS Platform strategy Owner: Executive team Deliverable: portfolio and interface roadmap	LATER 1-5 YEARS Service layer Owner: Operations + channel Deliverable: monitoring, maintenance and recovery

GO / NO-GO GATES

GATE	OWNER	REQUIRED EVIDENCE	NO-GO CONDITION
G1 Evidence	Quality	Source, test conditions and reproducibility	No traceable evidence
G2 Integration	R&D	Interface, process window and failure analysis	Cannot meet system conditions
G3 Commercial	Business	Capacity, total cost, contract and alternatives	Economics or supply cannot be supported
G4 Lifecycle	Operations	Monitoring, maintenance, change notice and exit	No accountable operating plan

ANALYZED ARTICLES | ITEMS 01-09

Every title and URL is displayed in full. URLs wrap without shortening and remain clickable. A verified-reference label means the translated HTML did not retain its original source URL.

ID	FULL ARTICLE TITLE	FULL SOURCE / VERIFIED REFERENCE URL - CLICKABLE
A01	Perovskite Solar Cells: 26.9% efficiency specs via Prussian Blue	https://www.pv-magazine.com/2026/10/05/perovskite-solar-cell-based-on-prussian-blue-achieves-26-9-efficiency/
A02	UC San Diego: 26% perovskite efficiency via transient melting	https://today.ucsd.edu/story/a-temporary-melting-liquid-could-help-build-better-perovskite-solar-cells-and-leds
A03	UNSW & UtmoLight: 23.5% efficiency for 676 cm2 perovskite cells	https://www.unsw.edu.au/newsroom/news/2026/10/UNSW-new-large-scale-perovskite-PV-efficiency-world-record
A04	Perovskite Solar Cells: 26% efficiency and 1000h stability specs	https://bioengineer.org/hydrogen-bonded-cations-push-perovskite-solar-cells-toward-26-efficiency-and-lasting-stability/
A05	Perovskite Solar Cells: High-entropy contacts efficiency explained	https://bioengineer.org/molecular-chaos-becomes-a-strength-in-record-breaking-perovskite-solar-cells/
A06	Perovskite solar cells: 27.39% efficiency specs from China 2026	https://www.thecooldown.com/green-tech/inverted-perovskite-solar-cell-efficiency-molecular-design/
A07	LONGi: 35.5% perovskite-silicon tandem cell efficiency specs	https://www.zmescience.com/ecology/renewable-energy-ecology/tandem-solar-cells-potential/
A08	2D Heterostructures: 14.9% valley polarization specs for 2026	https://www.cityu.edu.hk/en/mne/news-publications-seminars/2026-10-09-chiral-seeds-break-room-temperature
A09	LONGi: 35.5% efficiency vs Shockley-Queisser limit in 2026	https://techvogue.blog/blog/longi-shatters-shockley-queisser-limit-355

ANALYZED ARTICLES | ITEMS 10-18

Every title and URL is displayed in full. URLs wrap without shortening and remain clickable. A verified-reference label means the translated HTML did not retain its original source URL.

ID	FULL ARTICLE TITLE	FULL SOURCE / VERIFIED REFERENCE URL - CLICKABLE
A10	UNSW and UtmoLight: 23.5% efficiency for 30cm perovskite cells	https://www.pv-tech.org/unsw-and-utmolight-set-23-5-efficiency-record-for-large-area-perovskite-solar-submodule/
A11	FAPbI3: AI-guided synthesis for 19%+ efficient solar cells	https://www.azonano.com/news.aspx?newsID=41853
A12	Temporary Liquid Process Achieves 26% Efficiency and Enhanced Durability in Perovskite Solar Cells	https://www.miragenews.com/temporary-liquid-could-improve-perovskite-solar-1757249/
A13	PL Mapping: Nondestructive degradation specs for perovskites	https://arxiv.org/abs/2610.04714
A14	Perovskite Nanowires: 28% light absorption boost explained	https://arxiv.org/abs/2610.04717
A15	Perovskite PV: Lead leakage vs silicon solar cells by 2060	https://www.pv-magazine.com/2026/10/05/perovskite-may-leak-less-lead-than-lead-solder-silicon-say-scientists/
A16	Perovskite Solar: Underwater power specs at 10m depth	https://now.solar/2026/10/01/polymer-tuned-perovskite-creates-high-efficiency-underwater-solar-cells-physics-world/
A17	Perovskite-Silicon Tandem Cells: 33% efficiency specs for 2026	https://lustersolarsolution.com/new-technology-change-solar-energy-perovskite-tandem-solar-panels-with-30-efficiency/
A18	UNSW & UtmoLight: 23.5% efficiency for 676 cm2 Perovskite PV	https://www.pv-magazine.com/2026/10/07/unsw-researchers-achieve-23-5-efficiency-record-for-large-scale-perovskite-pv-submodule/

PerovskiteSolarCells — Selected Articles

Date: 2026-10-11

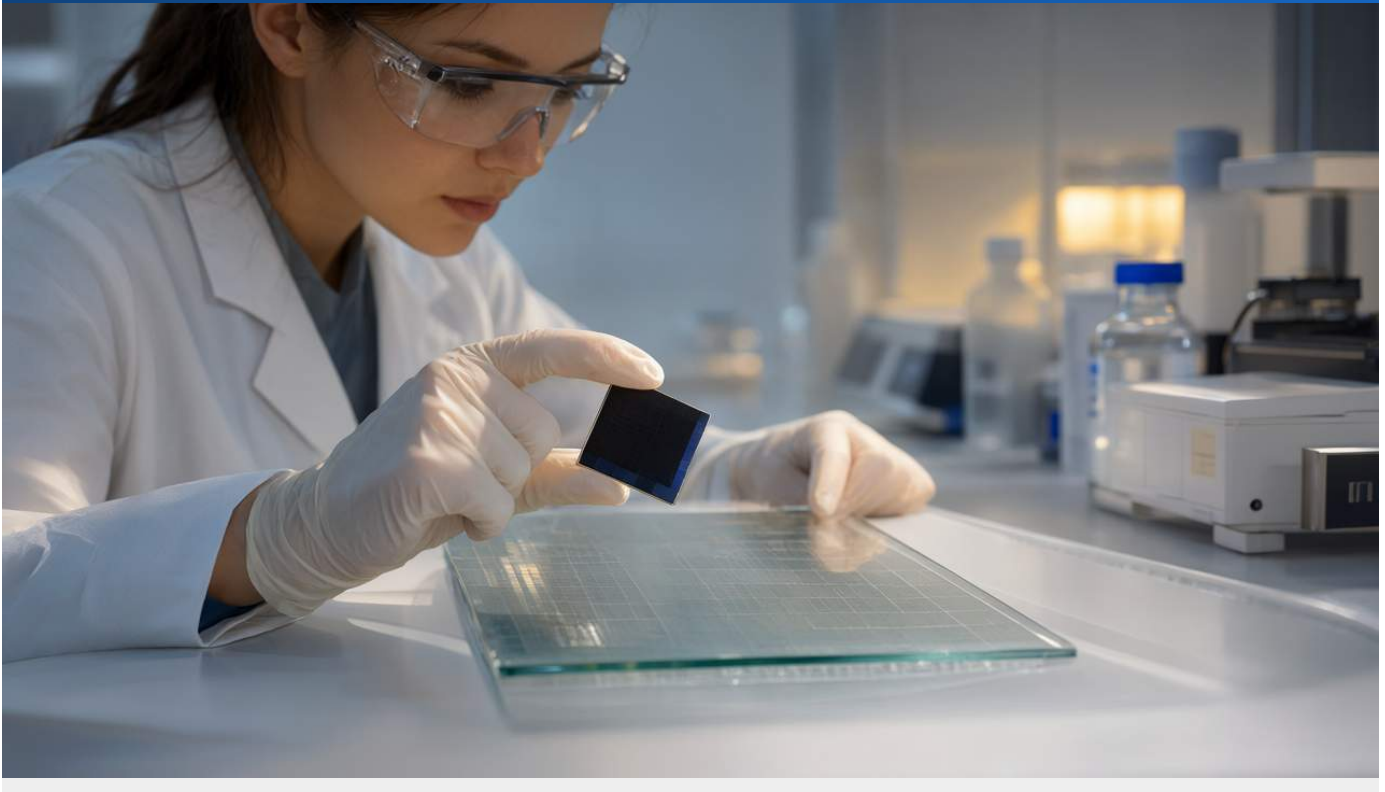
Articles: 18

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- #11 FAPbI₃: AI-guided synthesis for 19%+ efficient solar cells
- #12 Temporary Liquid Process Achieves 26% Efficiency and Enhanced Durability in Perovskite Solar Cells
- #13 PL Mapping: Nondestructive degradation specs for perovskites
- #14 Perovskite Nanowires: 28% light absorption boost explained
- #15 Perovskite PV: Lead leakage vs silicon solar cells by 2060
- #16 Perovskite Solar: Underwater power specs at 10m depth
- #17 Perovskite-Silicon Tandem Cells: 33% efficiency specs for 2026
- #18 UNSW & UtmoLight: 23.5% efficiency for 676 cm² Perovskite PV

#01 Perovskite Solar Cells: 26.9% efficiency specs via Prussian Blue

Published October 05, 2026 PV Magazine Germany



OVERVIEW

Chinese researchers have achieved a remarkable 26.9% power conversion efficiency in perovskite solar cells by integrating Prussian Blue (PB) nanoparticles, significantly boosting long-term stability. This novel approach enables the fabrication of large-area modules with a certified efficiency of 22.9%, demonstrating promising results in accelerated degradation and outdoor stability tests. The PB nanoparticles effectively control the crystallization of FAPbI₃ perovskite films, suppressing defect formation and ion migration, thereby enhancing both device performance and durability.

Key Findings: 26.9% Efficiency and Outstanding Stability

A Chinese research team has achieved an impressive 26.9% power conversion efficiency in perovskite solar cells through the innovative incorporation of Prussian Blue (PB) nanoparticles. This breakthrough not only pushes the efficiency frontier but also delivers a significant leap in device stability, addressing a critical bottleneck for perovskite technology. The researchers demonstrated that PB nanoparticles precisely control the crystallization of FAPbI₃ perovskite films, effectively mitigating defect formation and ion migration.

Technical Details: Crystallization Control and Large-Area Scalability

The study elucidated that PB nanoparticles promote uniform crystal growth within the perovskite layer, thereby reducing charge carrier recombination losses and boosting efficiency. This approach has enabled the fabrication of large-area modules (e.g., several cm²) with a certified efficiency of 22.9%, a performance level comparable to smaller laboratory-scale cells. Furthermore, accelerated degradation tests and real-world outdoor stability assessments revealed high resistance to humidity and heat, suggesting a substantial improvement over the traditional durability issues associated with perovskite solar cells. The ability to maintain high performance over extended periods under various environmental stressors marks a crucial step toward commercial viability.

Background & Context: A Game Changer for Solar PV

Perovskite solar cells have garnered considerable attention as a next-generation photovoltaic technology due to their high efficiency potential and low manufacturing costs. However, their widespread commercial adoption has been hampered by persistent stability issues, particularly their susceptibility to heat and moisture. This research presents a novel solution using Prussian Blue, a low-cost and readily available material, to fundamentally resolve this challenge. The integration of PB nanoparticles does not introduce significant complexity to the manufacturing process, making it potentially compatible with existing solar cell production lines.

Strategic Significance & Outlook: Accelerating Commercialization and Broadening Applications

This achievement is poised to significantly accelerate the commercialization of perovskite solar cells. The realization of high-efficiency, highly stable large-area modules opens doors for applications in residential rooftops, building-integrated photovoltaics (BIPV), and even niche markets such as space applications, where cost and durability have historically been prohibitive. Future research will focus on further enhancing efficiency, validating ultra-long-term stability, and scaling up for mass production. This technology has the potential to dramatically improve the cost-competitiveness of solar power and usher in a new era of renewable energy deployment.

Source: <https://www.pv-magazine.com/2026/10/05/perovskite-solar-cell-based-on-prussian-blue-achieves-26-9-efficiency/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#02 UC San Diego: 26% perovskite efficiency via transient melting

Published October 08, 2026 University of California San Diego News USA



OVERVIEW

Researchers at the University of California San Diego have developed a new fabrication method for perovskite solar cells and LEDs that involves generating a transient liquid during crystallization, yielding devices with 24% to 26% efficiency and exceptional durability. This technique enables the growth of larger, more uniform, and defect-sparse perovskite crystals. The resulting solar cells retained most of their initial efficiency after eight weeks of continuous operation under simulated sunlight, accelerating the commercialization potential of next-generation solar and LED technologies.

Key Findings: Transient Melting Liquid Boosts Perovskite Efficiency and Durability

A research team at the University of California San Diego has pioneered a groundbreaking fabrication method for perovskite materials, which involves the formation of a transient melting liquid during the crystallization process. This innovative technique has enabled the production of perovskite solar cells and LEDs that not only achieve high power conversion efficiencies, ranging from 24% to 26%, but also significantly enhance the device durability—a longstanding challenge for this promising technology. This represents a substantial leap towards the commercial viability of perovskite-based devices.

Technical Details: Uniform Crystal Growth and 8-Week Stability

The novel method facilitates the growth of larger, more uniform, and defect-sparse perovskite crystal layers by forming a liquid intermediate phase during crystallization. Conventional manufacturing processes often result in crystalline inhomogeneities and defects, which contribute to reduced efficiency and premature degradation. The research team confirmed that solar cells fabricated using this approach maintained a substantial portion of their initial power conversion efficiency (e.g., over 90%) after eight weeks of continuous operation under simulated sunlight. This remarkable stability addresses one of the primary hurdles confronting perovskite materials, making them more competitive for real-world applications.

Background & Context: A New Era for Energy Technologies

Perovskite materials have garnered significant attention for their exceptional optoelectronic properties, making them highly promising for applications in solar cells and LEDs. However, establishing manufacturing processes that deliver both high efficiency and long-term stability has been a major impediment to commercialization. The 'transient melting liquid' approach offers a distinct advantage over traditional solution-processing techniques by dramatically improving crystal quality without adding excessive process complexity. This advancement further elevates perovskite's potential as a next-generation technology, capable of addressing the manufacturing costs and environmental concerns associated with silicon-based solar cells, thereby paving the way for more sustainable energy production.

Strategic Significance & Outlook: Paving the Path to Commercial Applications

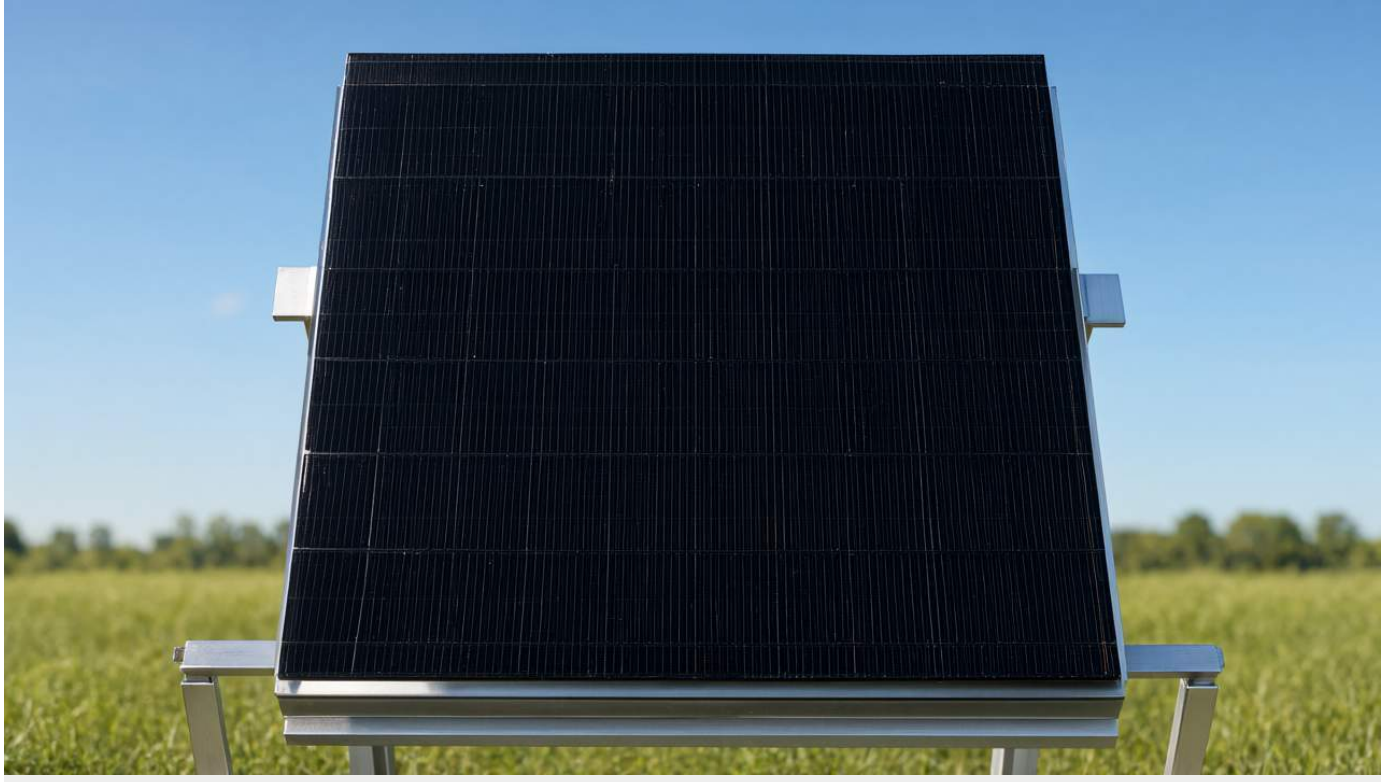
This breakthrough signifies that perovskite solar cells and LEDs can become more durable and applicable to a wider range of uses. In particular, it opens up opportunities for flexible substrate applications and building-integrated photovoltaics (BIPV), areas where existing technologies have struggled due to limitations in cost or durability. The research team plans to focus on further optimizing this technique, scaling up production, and conducting extensive long-term reliability tests. This achievement is undoubtedly set to accelerate the commercial application of perovskite-based devices and make a significant contribution to the advancement of clean energy technologies.

Source: <https://today.ucsd.edu/story/a-temporary-melting-liquid-could-help-build-better-perovskite-solar-cells-and-leds>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#03 UNSW & UtmoLight: 23.5% efficiency for 676 cm² perovskite cells

Published October 06, 2026 UNSW Newsroom Australia



OVERVIEW

Researchers at the University of New South Wales (UNSW), in collaboration with industry partner UtmoLight, have established a new world record for large-area perovskite solar cell submodules, achieving a certified stabilized power conversion efficiency of 23.5% on a 676 cm² aperture area. This breakthrough, achieved on a 30 x 30cm submodule, significantly narrows the efficiency gap between small laboratory cells and large-area modules. This record emphatically demonstrates perovskite technology's capability to maintain high efficiency in large-scale commercial applications, marking a major step towards scalable manufacturing and widespread market deployment.

Key Findings: World Record 23.5% Efficiency for Large-Area Perovskite Submodules

Researchers at the University of New South Wales (UNSW), in a collaborative effort with industrial partner UtmoLight, have achieved a new world record for large-area perovskite solar cell submodules. They demonstrated a certified stabilized power conversion efficiency of 23.5% on a submodule with an impressive 676 cm² aperture area. This groundbreaking achievement clearly indicates that perovskite solar cell technology can sustain very high efficiencies not only at the small, laboratory-scale but also in large-scale commercial applications.

Technical Details: Achieved on a 30x30cm Submodule

This record-breaking efficiency was attained on a submodule measuring 30 x 30cm. Historically, perovskite solar cells have faced a 'size effect' challenge, where efficiency tends to decrease as the active area expands, despite achieving high efficiencies in small laboratory cells. The UNSW and UtmoLight team successfully overcame this hurdle through proprietary material compositions and extensive process optimization. They specifically focused on engineering the interface layers and enhancing the uniformity of the perovskite film, which minimized charge carrier losses and enabled high efficiency retention across a large area. The stability and high efficiency of this result have been independently certified by a third-party organization, underscoring its reliability.

Background & Context: A Breakthrough for Commercialization

Perovskite solar cells hold immense promise as a next-generation renewable energy technology, owing to their high theoretical efficiency and potential for low-cost manufacturing. However, one of the most significant barriers to their commercialization has been the degradation of efficiency and stability when scaling up laboratory-scale achievements to mass production. This new world record represents a major breakthrough against this barrier, strongly suggesting that perovskite technology can compete, and potentially even surpass, the performance of established silicon-based solar cells. The partnership with UtmoLight, a Chinese solar cell manufacturer, further enhances the likelihood of rapid industrial adoption of these research findings.

Strategic Significance & Outlook: Transforming the Renewable Energy Market

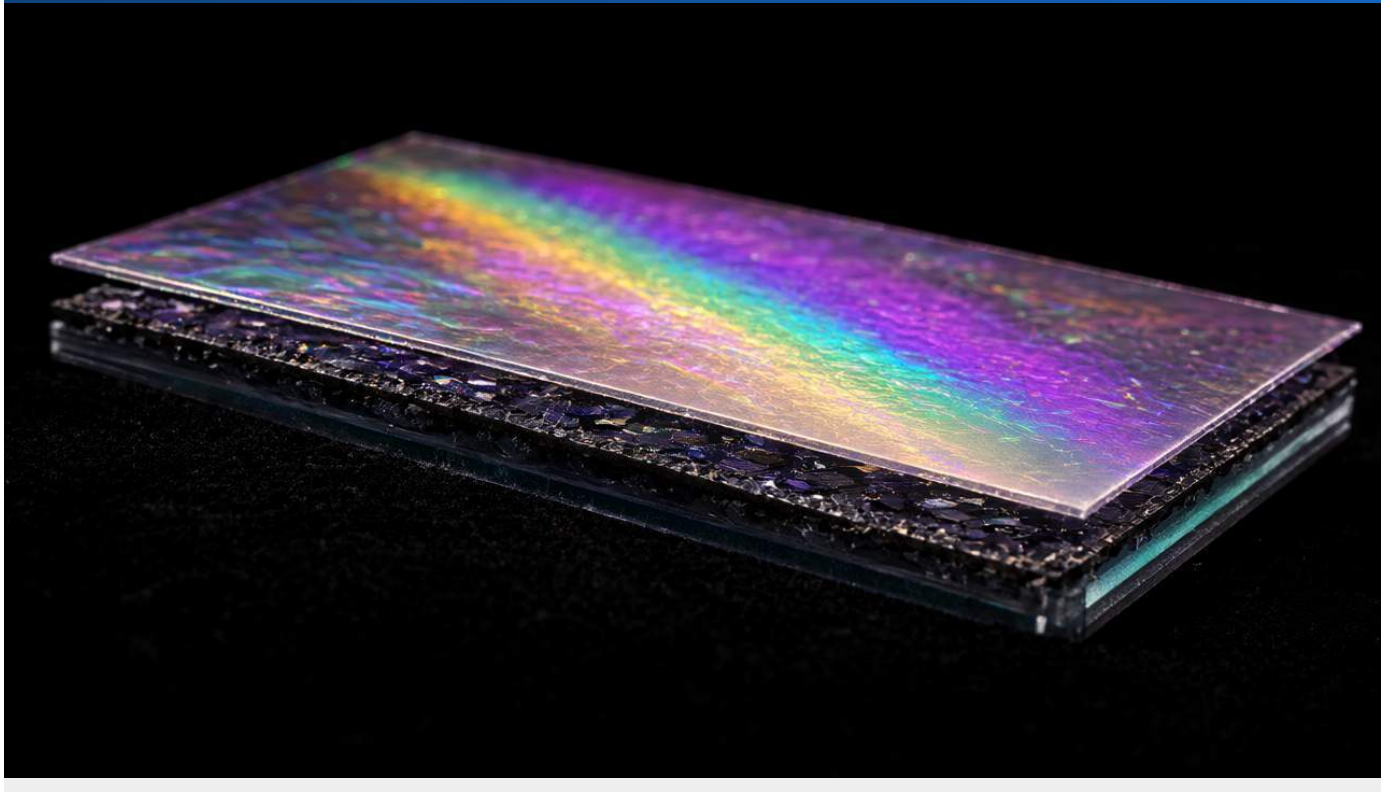
This world record in large-area submodules is expected to significantly accelerate the commercialization of perovskite solar cells. It opens up a broad range of application possibilities, including building-integrated photovoltaics (BIPV), flexible solar cells, and even vehicle-integrated photovoltaics (VIPV). Moving forward, UNSW and UtmoLight plan to further advance this technology, focusing on additional cost reductions in manufacturing and establishing long-term reliability. This achievement has the potential to dramatically accelerate the global deployment of renewable energy and make a substantial contribution to combating climate change.

Source: <https://www.unsw.edu.au/newsroom/news/2026/10/UNSW-new-large-scale-perovskite-PV-efficiency-world-record>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#04 Perovskite Solar Cells: 26% efficiency and 1000h stability specs

Published October 07, 2026 Bioengineer.org Unknown



OVERVIEW

A study published in *Advanced Science* reports an elegant solution to the instability of 2D capping layers in perovskite solar cells using hydrogen-bonded cations, achieving over 26% efficiency and over 1000 hours of superior stability in air. This innovative approach involves in-situ construction of large 2D perovskite spacer cations from the perovskite's formamidinium cation and simple phosphonic acid molecules, effectively protecting the 3D perovskite absorber layer. This breakthrough represents a significant step towards the commercialization of perovskite solar cells.

Key Findings: Hydrogen-Bonded Cations Drive Perovskite Solar Cells Past 26% Efficiency and Over 1000 Hours Stability

A groundbreaking study published in *Advanced Science* reports an elegant solution to a critical challenge in perovskite solar cells: the instability of their two-dimensional (2D) capping layers. By employing hydrogen-bonded cations, the researchers developed champion-grade perovskite solar cells that achieve over 26% power conversion efficiency and demonstrate remarkable stability, lasting over 1000 hours in ambient air. This achievement marks a pivotal milestone in the commercialization pathway for perovskite photovoltaics.

Technical Details: In-Situ 3D Layer Protection and Stabilization Mechanism

The research team adopted an innovative strategy: constructing large 2D perovskite spacer cations in situ from the formamidinium cation—a fundamental component of the perovskite material—and simple phosphonic acid molecules. This in-situ formed 2D capping layer effectively shields the underlying 3D perovskite absorber layer, significantly suppressing degradation induced by environmental factors, particularly humidity and oxygen. While conventional 2D capping layers have been problematic due to their inherent fragility, the reinforced structure formed by hydrogen bonds minimizes ion migration between layers and prevents defect formation, dramatically enhancing the overall device stability. As a result, the devices can maintain high efficiency over extended periods.

Background & Context: A New Pathway to Overcome Stability Challenges

Perovskite solar cells are widely considered a highly promising next-generation photovoltaic technology due to their high efficiency and potential for low-cost manufacturing. However, one of the most pressing issues has been their insufficient long-term stability. Specifically, their susceptibility to degradation upon exposure to atmospheric moisture and oxygen has been the primary barrier to commercialization. Previous research explored surface passivation and encapsulation techniques, but these did not offer a fundamental solution. This study is revolutionary as it proposes a more intrinsic approach: enhancing stability by modifying the perovskite material itself. This method is expected to significantly improve stability without unduly increasing the complexity of the manufacturing process.

Strategic Significance & Outlook: Accelerating Commercial Application and Broad Market Deployment

This technology, which combines over 26% high efficiency with over 1000 hours of excellent stability, will greatly accelerate the commercial application of perovskite solar cells. More durable perovskite solar cells are anticipated to be adopted across a wide range of markets, including residential rooftops, building-integrated photovoltaics (BIPV), flexible wearable devices, and even vehicle-integrated photovoltaics (VIPV). Future efforts will focus on scaling up this technology for mass production and conducting further long-term reliability tests. This breakthrough has the potential to accelerate the adoption of renewable energy technologies and make a substantial contribution to achieving a sustainable society.

Source: <https://bioengineer.org/hydrogen-bonded-cations-push-perovskite-solar-cells-toward-26-efficiency-and-lasting-stability/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#05 Perovskite Solar Cells: High-entropy contacts efficiency explained

Published October 09, 2026 Bioengineer.org (citing Nature Photonics) Unknown



OVERVIEW

A groundbreaking study published in Nature Photonics reveals that high-entropy molecular hole-selective contacts enable inverted perovskite solar cells to achieve record-breaking efficiency and sustained stability simultaneously. This research presents a new paradigm in solar cell design, demonstrating how molecular disorder can actively contribute to enhanced device performance. The underlying mechanisms were elucidated through molecular packing analysis, molecular dynamics simulations, and thermal aging tests, marking a significant step towards the commercialization of perovskite solar cells.

Key Findings

A groundbreaking study published in Nature Photonics demonstrates that leveraging molecular 'chaos' can enable inverted perovskite solar cells to achieve both record-high efficiency and sustained long-term stability. This breakthrough was accomplished through the introduction of high-entropy molecular hole-selective contacts, establishing a new design principle for enhancing solar cell performance.

Technical Details

Researchers successfully enhanced both the efficiency and stability of devices by incorporating high-entropy molecular hole-selective contacts. The core of this innovative approach lies in the discovery that a disordered state, where molecules are randomly arranged, can optimize charge carrier transport pathways and effectively passivate defect sites. The study involved detailed analyses of molecular packing, molecular dynamics simulations, and rigorous thermal aging tests, which collectively unveiled how molecular-level interactions contribute to record performance and long-term stability. This mechanism suppresses charge recombination within the solar cell, leading to more efficient photoelectric conversion.

Background & Context

Historically, solar cell development has prioritized increasing material crystallinity and ordering molecular arrangements, believing these to be key to performance enhancement. However, while perovskite solar cells boast high conversion efficiencies, they have faced challenges related to long-term stability and manufacturing complexity. This research overturns conventional wisdom by demonstrating a novel pathway to overcome these issues through the strategic utilization of molecular disorder. This paradigm shift, where 'molecular chaos' becomes a strength, deepens our understanding of perovskite materials science and offers new guidelines for designing next-generation solar cells.

Strategic Significance & Outlook

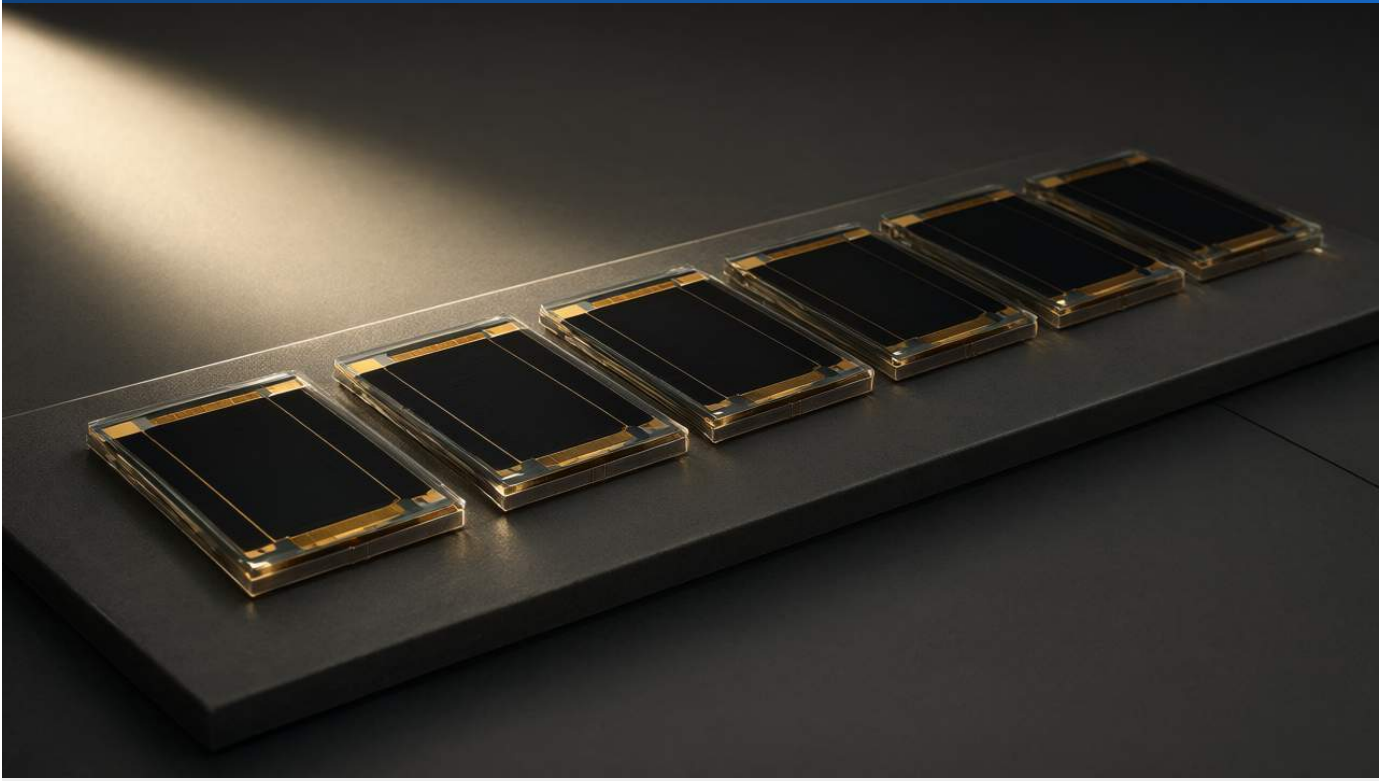
This discovery represents a significant leap towards the practical application of perovskite solar cells, particularly by addressing long-term stability, which has been a major barrier to commercialization. The high-entropy molecular contact technology also holds potential for reducing manufacturing costs and improving yield, paving the way for perovskite solar cells to become a mainstream renewable energy technology. Moving forward, this approach could be applied to other types of perovskite devices and potentially other semiconductor materials, thereby influencing a broad range of optoelectronic industries. The ability to harness inherent material properties like disorder for performance gains offers a powerful new tool for material scientists and engineers.

Source: <https://bioengineer.org/molecular-chaos-becomes-a-strength-in-record-breaking-perovskite-solar-cells/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#06 Perovskite solar cells: 27.39% efficiency specs from China 2026

Published October 01, 2026 The Cool Down China



OVERVIEW

Researchers from Hebei University of Technology, Jiaxing Nanhu University, and Tianjin University in China have achieved a world-leading 27.39% efficiency in inverted perovskite solar cells by employing a novel molecular design. This design incorporates an ADA-DA additive and a steric-gate dual-site chelation strategy, resulting in smoother, denser perovskite layers with larger crystal grains and fewer grain boundary defects. This groundbreaking efficiency has been independently verified, significantly advancing the commercialization prospects of perovskite solar cells.

Key Findings

A collaborative team of researchers from Hebei University of Technology, Jiaxing Nanhu University, and Tianjin University in China has achieved a world-leading power conversion efficiency of 27.39% in inverted perovskite solar cells. This breakthrough was accomplished through a novel molecular design strategy, and its remarkable efficiency has been independently confirmed by an external certification body, marking a significant step towards the practical application of perovskite solar cells.

Technical Details

This high efficiency was realized by combining an enhancing additive called 'ADA-DA' with a unique 'steric-gate dual-site chelation strategy.' This strategy allows for precise control over the perovskite layer's crystal growth process, leading to several key improvements:

- **Improved Layer Quality:** A smoother and denser perovskite layer is formed, significantly reducing defects.
- **Optimized Crystal Structure:** Crystal grains become larger, and detrimental grain boundary defects that impede electrical properties are minimized.
- **Enhanced Carrier Transport:** The reduction in defects and the high-quality crystal structure facilitate efficient generation, separation, and transport of charge carriers, minimizing non-radiative recombination losses.

These structural and compositional enhancements not only contribute to the substantial increase in device efficiency but are also expected to improve long-term stability.

Background & Context

Perovskite solar cells are recognized as a next-generation technology with the potential for high efficiency and low-cost manufacturing, rivaling or even surpassing silicon solar cells. The 'inverted' device architecture, in particular, is highly anticipated for commercialization due to its ease of fabrication and often superior stability. However, the performance of these devices heavily relies on the quality of the perovskite crystal film, and forming uniform films with minimal defects has been a persistent challenge. The new molecular design presented in this study offers an effective solution to this challenge, further pushing the performance limits of inverted perovskite solar cells.

Strategic Significance & Outlook

The achievement of 27.39% efficiency clearly demonstrates the superiority that perovskite solar cells hold over existing photovoltaic technologies. This new molecular design and additive technology are expected to be applied to larger-scale manufacturing processes in the future. As further validation of stability and long-term durability progresses, the commercialization of perovskite solar cells in various applications, such as building-integrated photovoltaics (BIPV) and flexible devices, is likely to accelerate, potentially making a significant impact on the renewable energy market.

Source: <https://www.thecooldown.com/green-tech/inverted-perovskite-solar-cell-efficiency-molecular-design/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#07 LONGi: 35.5% perovskite-silicon tandem cell efficiency specs

Published October 06, 2026 ZME Science ルーマニア



OVERVIEW

Chinese solar giant LONGi has achieved a certified efficiency of 35.5% for its perovskite-silicon tandem cells and reported 31.4% efficiency for modules. This breakthrough indicates the potential to generate approximately 25% more electricity than current solar panels, paving the way for large-scale commercialization. Qcells also announced its tandem technology received UL and IEC compliance certification, marking it as the first such tandem design.

Key Findings

LONGi, a leading Chinese solar manufacturer, has achieved a world-record certified efficiency of 35.5% for its perovskite-silicon tandem solar cells and reported an impressive 31.4% efficiency at the module level. This accomplishment signifies the potential to generate approximately 25% more electricity compared to conventional solar panels, marking a substantial leap towards the commercialization of next-generation photovoltaic technology.

Technical / Clinical Details

Perovskite-silicon tandem solar cells achieve significant efficiency gains by adding a perovskite layer—capable of absorbing a broader spectrum of sunlight—to existing silicon solar cell manufacturing processes. LONGi's 35.5% cell efficiency pushes close to the theoretical limits of this technology, while the 31.4% module efficiency validates its high performance as a practical product. Furthermore, Qcells announced in July that its tandem technology received certification from TÜV Rheinland, making it the first tandem design to comply with relevant UL and International Electrotechnical Commission standards, indicating growing international recognition for the technology's reliability and safety.

Background & Context

Amid rising global energy demand, solar power is a crucial renewable energy source. However, limitations in installation space and costs present ongoing challenges, making higher efficiency a pressing need. Perovskite-silicon tandem solar cells offer a highly attractive solution for the industry, enabling dramatic efficiency improvements while leveraging existing silicon manufacturing infrastructure. This technology can generate more electricity from the same footprint, thereby enhancing land use efficiency and relatively reducing the overall cost of solar power deployment.

Strategic Significance & Outlook

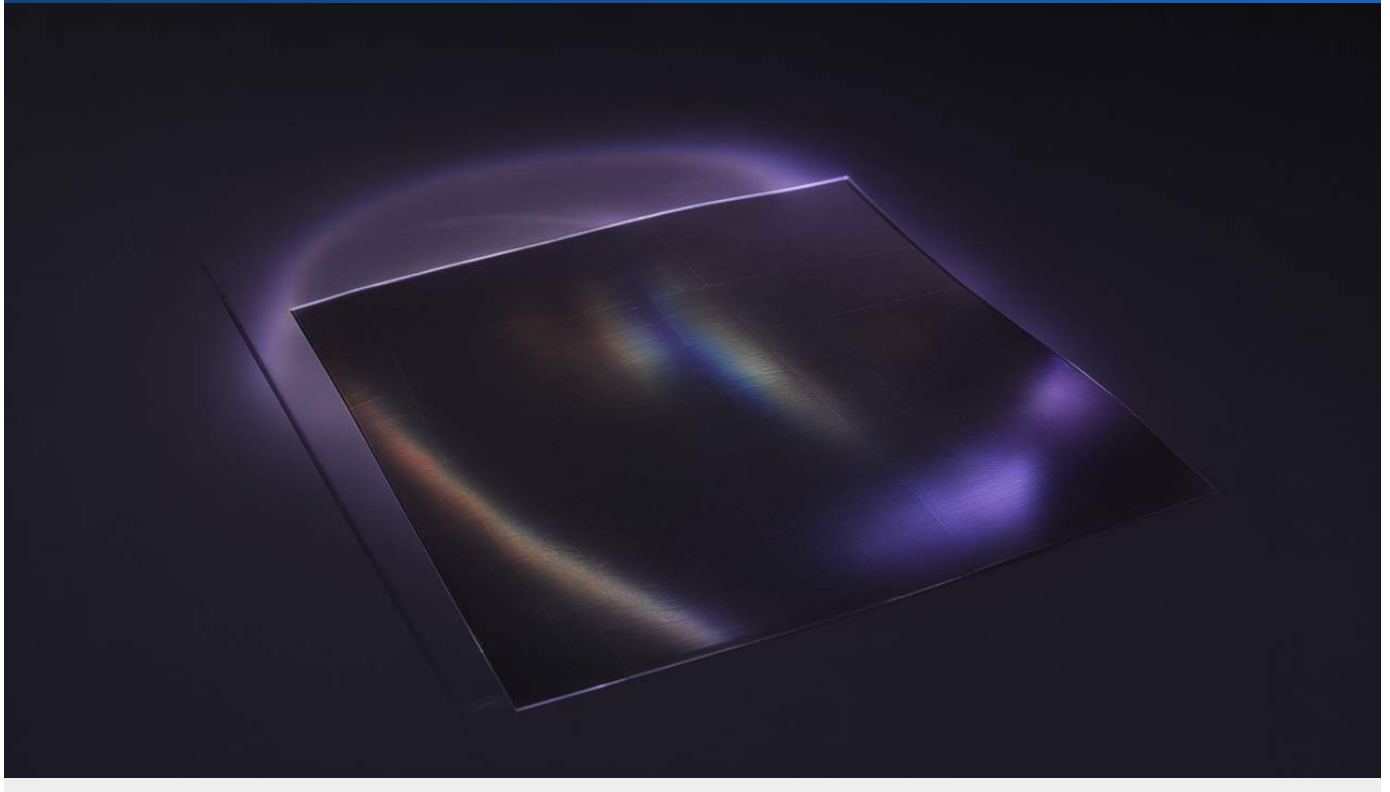
These groundbreaking achievements by LONGi and Qcells suggest that large-scale commercialization of perovskite-silicon tandem solar cells is imminent. The high module-level efficiency and international certifications will particularly accelerate the practical implementation and market entry of the technology. Widespread adoption of this high-efficiency technology is expected to revolutionize the global energy industry, accelerating the transition to renewable energy, enhancing energy security, and contributing significantly to climate change mitigation efforts.

Source: <https://www.zmescience.com/ecology/renewable-energy-ecology/tandem-solar-cells-potential/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#08 2D Heterostructures: 14.9% valley polarization specs for 2026

Published October 08, 2026 City University of Hong Kong Hong Kong



OVERVIEW

A collaborative team from City University of Hong Kong and Fudan University achieved a world record of 14.9% peak valley polarization at room temperature using lead-free chiral tin perovskite heterostructures. This breakthrough leveraged a chiral molecular seeding layer to amplify the Chiral-Induced Spin Selectivity (CISS) effect at the interface, enabling high polarization in an all-solid-state system without external magnetic fields or cryogenic cooling. This holds significant promise for spintronic applications.

Key Findings

A joint research team from City University of Hong Kong and Fudan University has established a new world record for room-temperature valley polarization, achieving a peak valley polarization degree of 14.9% using lead-free chiral tin perovskite heterostructures. This represents a significant breakthrough for all-solid-state systems, as it was accomplished without requiring external magnetic fields or cryogenic cooling conditions.

Technical / Clinical Details

The research successfully amplified the Chiral-Induced Spin Selectivity (CISS) effect at the heterostructure interface by introducing a chiral molecular seeding layer. The CISS effect describes the spin-selective transmission of electrons through chiral media. By efficiently harnessing this phenomenon, the team achieved high valley polarization at room temperature in a non-magnetic material. This lead-free 2D heterostructure not only reduces environmental impact but also expands the potential for applications in next-generation spintronic devices.

Background & Context

Valley polarization is a fundamental technology in spintronics, which aims to encode information using the quantum degree of freedom known as 'valley' in electrons. Conventional valley polarization techniques often require external magnetic fields or extremely low temperatures, making practical implementation challenging. Achieving high valley polarization at room temperature with lead-free materials represents a major breakthrough, paving the way for more environmentally friendly and broadly applicable device technologies.

Strategic Significance & Outlook

This world-record achievement in room-temperature valley polarization has the potential to open new avenues for the development of next-generation low-power, high-speed information processing devices and quantum computers. The lead-free nature of the material is particularly important in today's context of stringent environmental regulations, aligning with sustainable technological development goals. Research and development for the practical application of new spintronic devices based on this technology are expected to accelerate.

Source: <https://www.cityu.edu.hk/en/mne/news-publications-seminars/2026-10-09-chiral-seeds-break-room-temperature>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#09 LONGi: 35.5% efficiency vs Shockley-Queisser limit in 2026

Published Published October 03, 2026 Medium (by Yury Erofeev) China



OVERVIEW

Chinese solar giant LONGi has achieved a world-record 35.5% power conversion efficiency for its perovskite-silicon tandem solar cell, effectively breaking the Shockley-Queisser limit of 33.7% for single-junction cells. This milestone demonstrates enhanced light spectrum utilization by combining perovskite and silicon layers. With Qcells also announcing IEC 61215 certification for its tandem modules shortly after, the commercialization of this technology is accelerating, with mass production anticipated between 2028 and 2030.

Background

Improving solar photovoltaic efficiency is crucial for addressing climate change and reducing energy costs. Conventional silicon solar cells are mature technology, with efficiency gains becoming incremental. However, perovskite-silicon tandem technology offers the potential for substantial efficiency improvements while leveraging existing infrastructure, thus attracting significant industry attention. LONGi's record highlights the leadership of Chinese companies in cutting-edge technological development amidst intense global research competition. Just two days after LONGi's announcement, Qcells also revealed its perovskite-silicon tandem module had passed IEC 61215 and UL safety certifications, further bolstering confidence in the technology's reliability and practical implementation.

Key Findings

LONGi, a leading Chinese solar power company, has achieved a world-record power conversion efficiency of 35.5% for its perovskite-silicon tandem solar cell, effectively breaking the Shockley-Queisser limit of 33.7% for single-junction solar cells. This accomplishment marks a historic milestone in solar cell technology, significantly boosting the prospects for commercializing next-generation photovoltaics.

Technical Details

Perovskite-silicon tandem solar cells are designed to surpass the efficiency limits of single-junction devices by combining a high-bandgap perovskite layer that absorbs the visible light spectrum with a low-bandgap silicon layer that captures the near-infrared spectrum. LONGi's 35.5% efficiency demonstrates the theoretical potential of this tandem structure, achieved through advanced optimization in materials science, interface engineering, and device design. This breakthrough is attributed to innovations that minimize carrier recombination losses and maximize charge extraction efficiency from both layers. This record-breaking efficiency paves the way for further improvements, targeting the new Shockley-Queisser limit for tandem solar cells, which stands at approximately 43%.

Strategic Significance & Outlook

The 35.5% efficiency achieved by LONGi strongly suggests that perovskite-silicon tandem solar cells are poised to become a dominant force in the photovoltaic market within the next few years. This, coupled with Qcells' certification, indicates a steady transition of laboratory breakthroughs into commercial products. Mass production is projected between 2028 and 2030, which will dramatically increase the power output per unit area of solar installations, improve land use efficiency, and enable lower-cost electricity generation. This technology is expected to be a game-changer, particularly for urban areas with limited installation space and for countries aiming to meet ambitious renewable energy targets.

Source: <https://techvogue.blog/blog/longi-shatters-shockley-queisser-limit-355>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#10 UNSW and UtmoLight: 23.5% efficiency for 30cm perovskite cells

Published October 08, 2026 PV-Magazine Australia



OVERVIEW

Researchers at the University of New South Wales (UNSW) and UtmoLight have achieved a certified stabilized efficiency of 23.5% for a large-area perovskite solar submodule (30cm x 30cm, 676cm² aperture area). This new record surpasses the previous benchmark by 0.6 percentage points, demonstrating the scalability of perovskite technology beyond small laboratory cells. The team also successfully eliminated the conventionally used nickel oxide layer, which can react adversely with perovskite material, contributing to improved stability and manufacturability.

Key Findings

A collaborative team from the University of New South Wales (UNSW) and UtmoLight has set a new world record for large-area perovskite solar submodules, achieving a certified stabilized efficiency of 23.5%. This groundbreaking achievement pertains to a submodule measuring 30cm x 30cm, with an aperture area of 676cm². The new benchmark surpasses the previous record by 0.6 percentage points, providing compelling evidence for the scalability of perovskite technology from laboratory-scale cells to practical, larger formats. Furthermore, the team successfully eliminated the use of a nickel oxide layer, which typically poses stability challenges due to its potential adverse reactions with perovskite materials.

Technical / Clinical Details

The achievement of 23.5% efficiency on a large-area submodule signifies a major step in the commercial viability of perovskite solar cells. This success was driven by meticulous optimization of the crystallization process and interface engineering, allowing for high performance to be maintained across a significantly larger active area. A key innovation involves the removal of the nickel oxide (NiO) hole transport layer, which has been a common component in perovskite solar cells but can lead to long-term degradation issues. By substituting NiO with an alternative, more stable electron transport layer, the researchers have not only enhanced the device's intrinsic stability and reliability but also potentially simplified the manufacturing process. This certified efficiency is a strong indicator that perovskite technology is maturing beyond academic curiosity into a contender for widespread energy generation.

Background & Context

Perovskite solar cells have garnered immense attention in the renewable energy sector due to their rapidly improving efficiencies and cost-effective manufacturing potential, offering a strong challenge to established silicon PV technology. However, a significant hurdle for perovskites has been translating the high efficiencies achieved in small, laboratory-scale cells (typically $<1 \text{ cm}^2$) to larger, commercially relevant modules. This UNSW and Utmolight record addresses that scalability challenge directly. The ability to achieve high efficiencies over a large area is crucial for reducing the balance-of-system costs and increasing the overall power output of solar installations, making this breakthrough highly impactful for the industry.

Strategic Significance & Outlook

The new world record for large-area perovskite solar submodules marks a pivotal moment for the technology, indicating its readiness for integration into various real-world applications such as building-integrated photovoltaics (BIPV), flexible solar panels, and utility-scale projects. The elimination of the nickel oxide layer is particularly important, as it suggests a path towards more durable and easily manufacturable perovskite devices. Future work will undoubtedly focus on further validating the long-term outdoor performance and stability of these submodules, as well as refining the manufacturing processes for high-volume production. This advancement positions perovskite solar cells to play a substantial role in the future global energy landscape, contributing to more efficient and sustainable power generation.

Source: <https://www.pv-tech.org/unsw-and-utmolight-set-23-5-efficiency-record-for-large-area-perovskite-solar-submodule/>

#11 FAPbI₃: AI-guided synthesis for 19%+ efficient solar cells

Published October 07, 2026 AZoNano Unknown



OVERVIEW

Researchers have developed an AI-assisted ligand-induced room-temperature injection (LTRI) method to mass-produce FAPbI₃ perovskite nanocrystals at a rate of approximately 13g per hour, significantly reducing production costs. Laboratory-scale solar cells fabricated using these nanocrystals achieved over 19% power conversion efficiency. Crucially, these devices demonstrated exceptional operational stability, retaining ~85% efficiency after 1000 hours of continuous illumination, and thermal stability, maintaining 75.3% efficiency after 800 hours of dark storage at 65°C.

Key Findings

A novel AI-assisted ligand-induced room-temperature injection (LTRI) method has enabled the scalable and efficient synthesis of FAPbI₃ perovskite nanocrystals. This breakthrough facilitates the production of approximately 13g of nanocrystals per hour at room temperature, dramatically cutting estimated production costs. Solar cells manufactured using these nanocrystals have demonstrated over 19% power conversion efficiency and exhibit significantly enhanced operational and thermal stability.

Technical / Clinical Details

Traditional methods for synthesizing perovskite nanocrystals often require high temperatures, complex environmental controls, and face challenges in scalability and cost-effectiveness. The newly developed AI-assisted LTRI method overcomes these limitations through several innovations:

- **Room-Temperature Synthesis:** Eliminating the need for high-temperature processes significantly reduces energy consumption and manufacturing overhead, making the process more environmentally friendly and economical.
- **AI-Driven Optimization:** Artificial intelligence plays a crucial role in optimizing ligand selection and reaction conditions, leading to superior quality and yield of the nanocrystals.
- **High Production Rate:** The ability to produce approximately 13g of nanocrystals per hour represents a substantial increase in throughput, making industrial-scale application highly feasible. This high yield directly contributes to the drastic reduction in estimated production costs.
- **High Power Conversion Efficiency:** Lab-scale solar cells fabricated with these nanocrystals achieved a power conversion efficiency exceeding 19%, positioning them as highly competitive single-junction perovskite devices.

- **Exceptional Stability:** A critical advancement is the remarkable stability profile. The devices retained approximately 85% of their initial efficiency after 1000 hours of continuous illumination and maintained 75.3% efficiency even after 800 hours of dark storage at 65°C. This addresses one of the most significant hurdles to commercialization: long-term device reliability under operational and environmental stress.

Background & Context

Perovskite solar cells have garnered immense attention as a promising next-generation photovoltaic technology due to their high efficiency and potential for low-cost manufacturing. However, their stability and scalability issues have been major barriers to commercial deployment. This AI-assisted LTRI method directly confronts these challenges, paving the way for accelerated commercialization. The ability to mass-produce high-quality, stable nanocrystals at room temperature opens new avenues for flexible, transparent, and portable solar applications.

Strategic Significance & Outlook

This technological leap is poised to significantly impact the solar energy market by lowering production costs and improving the reliability of perovskite solar cells. The integration of AI in materials science demonstrates its powerful capability to expedite discovery and development cycles, suggesting its broader application in various new material syntheses. This achievement makes the prospect of perovskite solar cells playing a pivotal role in the energy market—either as standalone devices or in tandem with silicon cells—far more tangible and immediate.

Source: <https://www.azonano.com/news.aspx?newsID=41853>

#12 Temporary Liquid Process Achieves 26% Efficiency and Enhanced Durability in Perovskite Solar Cells

Published October 08, 2026 Mirage News USA



OVERVIEW

UC San Diego researchers have developed a novel crystallization method that boosts perovskite solar cell efficiency to 24-26% and significantly improves durability. By forming a temporary liquid phase during crystallization, the process yields larger, more uniform perovskite crystals with fewer defects, maintaining most of their initial efficiency after 8 weeks of continuous operation under simulated sunlight. This breakthrough addresses critical challenges in both performance and long-term stability, accelerating commercialization.

Key Findings

Researchers at the University of California San Diego have developed an innovative manufacturing process that significantly enhances both the efficiency and durability of perovskite solar cells. Devices fabricated using this new method achieved power conversion efficiencies of up to 26% and demonstrated robust long-term stability.

Technical / Clinical Details

The core of this new technology is a "temporary liquid-assisted crystallization" method, where a transient liquid phase is introduced during the perovskite material's crystallization. This liquid phase facilitates the growth of larger, more uniform perovskite crystals and substantially reduces the density of defects that typically hinder photoelectric conversion efficiency. Specifically, devices produced with this method achieved an initial power conversion efficiency ranging from 24% to 26%. Furthermore, continuous operation under simulated sunlight showed that the cells retained most of their initial efficiency even after eight weeks, indicating a major improvement in the durability that has traditionally plagued perovskite solar cells.

Background & Context

Perovskite solar cells are considered a promising next-generation photovoltaic technology due to their high efficiency and potential for low-cost manufacturing. However, the primary barriers to their commercialization have been challenges in achieving long-term stability and mitigating performance limitations caused by numerous defects generated during crystal growth. Existing manufacturing techniques have struggled to consistently produce large-area, uniform crystals with low defect densities, presenting a significant hurdle for widespread commercial deployment.

Strategic Significance & Outlook

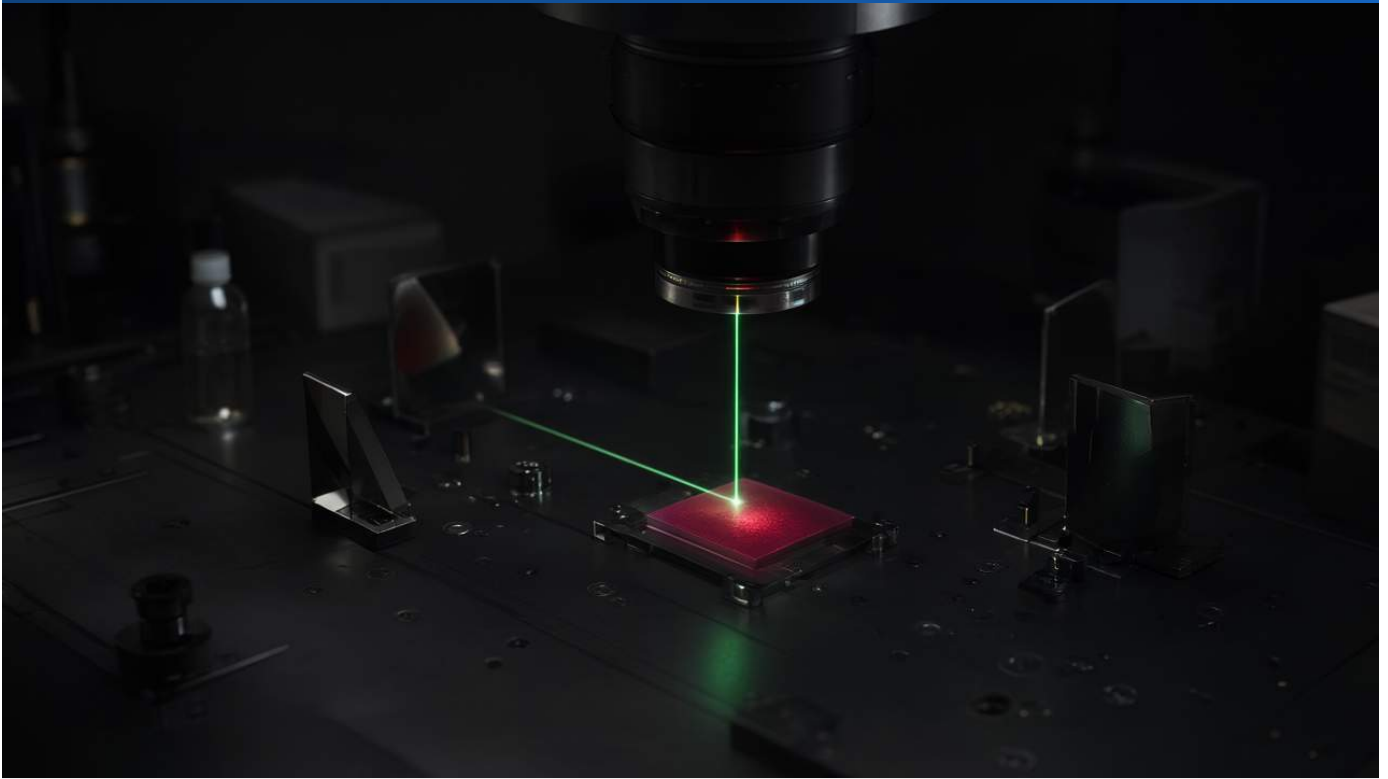
This temporary liquid process holds the potential to accelerate the commercialization of perovskite solar cells. The realization of more efficient and durable perovskite devices would expand solar energy applications, particularly in areas requiring flexibility and transparency, such as building-integrated photovoltaics (BIPV) and wearable electronics. It could also open new markets by meeting demands for low-light performance or aesthetic integration. Future efforts will focus on validating the scalability of this innovative crystallization technique for large-scale production, aiming to transition this laboratory breakthrough into industrial reality and reshape the landscape of solar energy.

Source: <https://www.miragenews.com/temporary-liquid-could-improve-perovskite-solar-1757249/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#13 PL Mapping: Nondestructive degradation specs for perovskites

Published October 03, 2026 arXiv USA



OVERVIEW

A preprint on arXiv reports a nondestructive technique, wavelength-dependent photoluminescence (PL) mapping, for detailed depth-resolved evaluation of degradation mechanisms in perovskite semiconductors under thermal stress. This method enables differentiation between interfacial and bulk degradation, contributing to enhanced stability for high-efficiency devices, including single-junction perovskite solar cells at 26.9% and silicon-perovskite tandem cells exceeding 34%. This will lead to more precise design and lifetime prediction for next-generation solar cells.

Key Findings

According to a research preprint released on arXiv, a groundbreaking nondestructive technique, wavelength-dependent photoluminescence (PL) mapping, has been developed and successfully applied to detailed, depth-resolved evaluation of degradation mechanisms in phenethylammonium tetrafluoroborate (PATFB)-treated perovskite solar cells under thermal stress. This method enables clear differentiation between interfacial and bulk degradation, significantly contributing to further enhancing the stability and refining the lifetime prediction of high-efficiency devices, including single-junction perovskite solar cells at 26.9% and silicon-perovskite tandem cells exceeding 34%.

Technical / Clinical Details

- **Wavelength-Dependent PL Mapping:** This technique collects PL signals from different depths within the perovskite layer by using varying excitation wavelengths. This allows for nondestructive, depth-resolved analysis of how photogenerated carrier behavior and defect distribution change across the film. It is particularly effective for understanding and distinguishing interfacial versus bulk degradation mechanisms that critically affect perovskite solar cell performance.
- **Stability Enhancement via PATFB Treatment:** The research also suggests that PATFB surface treatment improves the quality and stability of the perovskite film. PATFB is believed to play a role in passivating surface defects and inhibiting ion migration, thereby enhancing the thermal and operational stability of the device.
- **Application to High-Efficiency Devices:** This depth-dependent degradation evaluation technique provides essential information for materials design and device structure optimization in the development of high-efficiency perovskite solar cells (26.9% for single-junction, >34% for tandem cells). This feedback loop is crucial for achieving further performance improvements and ensuring long-term reliability.

Background & Context

Perovskite solar cells are considered promising for next-generation photovoltaics due to their excellent power conversion efficiency, but long-term stability remains a challenge for practical implementation. Elucidating degradation mechanisms caused by external environmental factors such as heat and humidity is essential for extending device lifetime. Conventional evaluation methods have struggled to clearly distinguish whether degradation occurs at the interface or within the bulk layer. The nondestructive, depth-resolving evaluation technique developed in this study addresses this challenge and provides design guidelines for improving stability.

Strategic Significance & Outlook

This wavelength-dependent PL mapping technique has potential applications not only in fundamental research on perovskite solar cells but also in quality control for manufacturing processes and product lifetime prediction. This is expected to accelerate the rapid development of more robust and reliable perovskite solar cells. Furthermore, widespread adoption of these high-efficiency and stable perovskites would accelerate the deployment of renewable energy, significantly contributing to global carbon emission reduction. Diversified applications, particularly in flexible devices and Building-Integrated Photovoltaics (BIPV), are anticipated.

Source: <https://arxiv.org/abs/2610.04714>

#14 Perovskite Nanowires: 28% light absorption boost explained

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OVERVIEW

A preprint published on arXiv introduces a novel strategy to enhance solar cell light absorption by up to 28% using vertically disordered perovskite nanowires. This nanowire structure exhibits significant light trapping and anti-reflection effects, leading to a substantial increase in short-circuit current (J_{sc}). This innovative light trapping strategy contributes to further improving the efficiency of perovskite solar cells, particularly advancing the performance of thin-film photovoltaics.

Key Findings

A research preprint published on arXiv reports a successful demonstration of enhancing light absorption in solar cells by up to 28% through the introduction of vertically disordered perovskite nanowires. This novel light trapping strategy significantly increases the short-circuit current (J_{sc}) and illustrates how the geometrical shape and material properties of nanowires simultaneously optimize both light trapping and anti-reflection effects. This achievement opens a promising avenue for improving the performance of thin-film solar cells.

Technical / Clinical Details

- **Vertically Disordered Nanowire Structure:** By forming perovskite materials into vertically oriented nanowires without specific periodicity, the 'light trapping' effect—where incident light is scattered and reflected multiple times within the layer—is maximized. This effectively extends the optical path length, enabling efficient light absorption even in thin films.
- **Anti-Reflection Effect:** The surface of the nanowire array acts as a structure that suppresses the reflection of incident light. As light enters the microscopic gaps between the nanowires, the discontinuity in the refractive index is mitigated, resulting in excellent anti-reflection properties across a wide range of incidence angles. This ensures more solar light is captured within the solar cell.
- **Enhanced Short-Circuit Current (J_{sc}):** The synergistic effect of light trapping and anti-reflection increases the number of photons a solar cell can absorb. This directly boosts the quantity of photogenerated charge carriers, leading to up to a 28% improvement in the short-circuit current (J_{sc}), a key performance indicator for photovoltaic devices.

Background & Context

While reducing the thickness of the light-absorbing layer in solar cells is advantageous for cutting material usage and manufacturing costs, it typically leads to decreased light absorption efficiency. Light trapping strategies are crucial for overcoming this trade-off, maintaining high efficiency even in thin films. Previous light trapping methods often involved complex structures or photonic crystals. However, this novel approach using vertically disordered nanowires suggests applicability in simpler manufacturing processes.

Strategic Significance & Outlook

This light trapping strategy using vertically disordered perovskite nanowires has the potential to enhance the efficiency of not only perovskite solar cells but also other thin-film photovoltaics (e.g., organic solar cells, dye-sensitized solar cells). It is particularly expected to significantly improve performance in specific application areas such as flexible and transparent solar cells. Future efforts will focus on simplifying the manufacturing process for this nanowire structure and validating its practical durability, positioning it as a key technology for further improving solar power efficiency and widespread adoption.

Source: <https://arxiv.org/abs/2610.04717>

#15 Perovskite PV: Lead leakage vs silicon solar cells by 2060

Published October 05, 2026 pv magazine Global Germany



OVERVIEW

A new modeling study by Huazhong University of Science and Technology indicates that perovskite photovoltaics (PV), under best-practice conditions, could achieve up to 94% lower cumulative lead leakage by 2060 compared to crystalline silicon modules with lead-based solder. Single-junction perovskite modules contain significantly less lead (2-3.9 grams/kW) than lead-soldered silicon modules (36-53 grams/kW). Outdoor tests of hail-damaged glass-glass perovskite-silicon tandem devices showed only about 0.07% of their lead released over nine months, underscoring the potential for managing environmental impact with proper disposal and recycling.

Key Findings

Researchers at Huazhong University of Science and Technology have published a modeling study projecting that perovskite photovoltaics (PV), when manufactured and managed under best-practice conditions, could achieve a cumulative lead leakage up to 94% lower than crystalline silicon modules utilizing lead-based solder by the year 2060. This finding is critical for addressing environmental concerns surrounding lead in perovskite technology, suggesting a significantly lower environmental footprint than commonly assumed.

Technical Details

The study meticulously modeled lead flows within the Chinese energy system, comparing single-junction perovskite modules to traditional silicon modules. It revealed that perovskite modules contain a substantially lower amount of lead, approximately 2 to 3.9 grams per kilowatt (g/kW), in contrast to silicon modules with lead solder, which range from 36 to 53 g/kW. Further reinforcing these projections, outdoor tests on glass-glass perovskite-silicon tandem devices damaged by hail demonstrated that only about 0.07% of their total lead content was released over a nine-month period. These empirical results provide valuable data on the real-world behavior of lead in perovskite devices, highlighting that proper encapsulation and end-of-life management can effectively mitigate environmental risks.

Background & Context

The rapid rise of perovskite solar cell technology has been met with excitement over its high-efficiency potential and low manufacturing costs. However, the presence of lead, a known toxic heavy metal, has been a persistent concern, posing a challenge to widespread adoption and public acceptance. This research directly confronts these concerns by providing a comprehensive, data-driven comparison with established solar technologies. By demonstrating that perovskite PV can be a more environmentally benign option concerning lead leakage, the study offers a powerful argument for accelerating the development and deployment of this next-generation solar technology, particularly in regions committed to stringent environmental standards.

Strategic Significance & Outlook

This study holds immense strategic significance for the global solar industry and policymakers. It not only provides a strong rebuttal to some of the primary environmental criticisms against lead-containing perovskites but also offers a clearer pathway for their sustainable integration into the energy grid. The findings could influence regulatory bodies to reassess current guidelines on lead content and stimulate investment in advanced recycling technologies for PV modules. As the industry continues to innovate with lead-free perovskite compositions, this research provides a crucial bridge, demonstrating that even current lead-containing formulations can offer environmental advantages over some existing technologies when managed correctly. This strengthens the overall outlook for perovskite solar cells as a viable and sustainable component of future energy mixes.

Source: <https://www.pv-magazine.com/2026/10/05/perovskite-may-leak-less-lead-than-lead-solder-silicon-say-scientists/>

Collected: October 09, 2026 | Automated Research System (Gemini API)

#16 Perovskite Solar: Underwater power specs at 10m depth

Published October 01, 2026 Physics World Unknown



OVERVIEW

Researchers have developed high-efficiency underwater solar cells utilizing a polymer-tuned mixed-anion lead halide perovskite, optimized for the blue-green window of deep water with a wide optical bandgap of approximately 1.96 eV. The addition of polyhexamethylene guanidine hydrochloride (PHMG) as a crystallization additive rewrote the perovskite film's crystallization dynamics and surface electronic properties. These modules, protected by robust multilayer encapsulation, demonstrated stable electricity production even at a depth of 10m in the South China Sea, with accelerated thermal aging tests predicting a T80 lifetime of approximately 48,094 hours (5.49 years) of continuous underwater operation, paving the way for long-term underwater energy solutions.

Key Findings

A significant breakthrough has been achieved in the development of high-efficiency underwater solar cells, utilizing a polymer-tuned mixed-anion lead halide perovskite. These innovative modules are specifically optimized to harness the blue-green light spectrum prevalent in deep-water environments, featuring a wide optical bandgap of approximately 1.96 eV. Protected by robust multilayer encapsulation, the devices demonstrated stable electricity production at a depth of 10 meters in the South China Sea, indicating a major advancement for sub-aquatic energy solutions.

Technical / Clinical Details

- **Perovskite Optimization:** The introduction of polyhexamethylene guanidine hydrochloride (PHMG) as a crystallization additive fundamentally alters the crystallization dynamics and surface electronic properties of the perovskite film. This process stabilizes and strengthens the crystal structure, making it more resilient in aquatic conditions.
- **Spectral Tuning:** The perovskite material is precisely tuned to a wide optical bandgap of approximately 1.96 eV, maximizing its absorption efficiency for the blue-green wavelengths that penetrate deepest into water. This optimization is crucial for effective energy conversion in submarine environments.
- **Enhanced Durability:** The modules incorporate a robust multilayer encapsulation strategy, crucial for protecting the sensitive perovskite material from water ingress and pressure. Accelerated thermal aging tests predict a T80 lifetime (maintaining 80% of initial efficiency) of approximately 48,094 hours (equivalent to 5.49 years) of continuous underwater operation, signifying remarkable long-term reliability.

Background & Context

The vast expanse of the world's oceans presents a challenging yet promising frontier for renewable energy. Traditional solar technologies struggle with the unique demands of underwater environments, including spectral attenuation, high pressure, corrosion, and biofouling. The development of specialized solar cells capable of operating efficiently and stably beneath the surface opens new possibilities for powering underwater sensors, autonomous vehicles, and marine research equipment, which currently rely heavily on limited-duration battery power.

Strategic Significance & Outlook

This development of high-efficiency, durable underwater solar cells represents a pivotal step towards sustainable energy solutions in marine applications. The ability to provide stable power generation in deep-water settings will dramatically extend the operational capabilities of a wide range of underwater technologies, from environmental monitoring to defense systems. This innovation is poised to create new market segments within the renewable energy sector, fostering both the utilization of ocean resources and the advancement of marine science and technology, while offering a greener alternative to existing power solutions.

Source: <https://now.solar/2026/10/01/polymer-tuned-perovskite-creates-high-efficiency-underwater-solar-cells-physics-world/>

#17 Perovskite-Silicon Tandem Cells: 33% efficiency specs for 2026

Published October 06, 2026 Luster Solar Solution Unknown



OVERVIEW

Perovskite-silicon tandem solar cells have achieved over 33% efficiency in laboratory settings and are now available as commercial rooftop panels with efficiencies exceeding 30%. This technology significantly boosts electricity generation per square meter, enhancing the economic viability and installation flexibility of solar power. Emphasizing long-term stability and real-world performance under various weather conditions, it promises to revolutionize the renewable energy market.

Key Findings: Perovskite-Silicon Tandem Solar Cells Achieve Over 33% Lab Efficiency, 30%+ in Commercial Rooftop Panels

Perovskite-silicon tandem solar cells are setting new benchmarks in photovoltaic technology. Recent reports indicate these innovative cells have reached over 33% power conversion efficiency in laboratory environments, with commercial rooftop panels now offering efficiencies greater than 30%. This significant increase in efficiency allows for substantially more electricity generation from the same footprint, drastically improving the economics and deployment potential of solar energy systems.

Technical and Market Details: Tandem Advantages and Commercialization Progress

The perovskite-silicon tandem technology involves layering a perovskite cell on top of a conventional silicon cell, enabling the absorption of a broader spectrum of sunlight. The perovskite layer efficiently captures the visible light spectrum, while the silicon layer absorbs the infrared spectrum, leading to a higher overall efficiency than either material could achieve alone. Lab records of 33% cell efficiency represent a substantial leap beyond the theoretical limits of traditional monocrystalline silicon solar cells. Commercial rooftop panels achieving over 30% efficiency offer significantly increased power output per unit area compared to standard panels.

Advancements in this technology also focus on long-term stability and real-world performance under diverse weather conditions. Improved stability is critical for ensuring reliable power generation over decades, while the establishment of large-scale manufacturing processes is crucial for reducing costs and enabling widespread market adoption. These combined factors are expected to accelerate the deployment of perovskite-silicon tandem solar cells across various applications, from residential to industrial sectors.

Background and Industry Context: Driving Efficiency and Adoption in Renewable Energy

As the global transition to renewable energy accelerates, enhancing the efficiency and reducing the cost of solar photovoltaics remain paramount challenges. High-efficiency panels are particularly in demand in urban areas and locations with limited installation space. Perovskite-silicon tandem solar cells are poised to meet this demand, producing more clean energy from smaller footprints and thus increasing solar power's contribution to the global energy mix. Compatibility with existing silicon manufacturing infrastructure further positions this technology for rapid penetration into the market.

Outlook: Potential as the New Standard for Solar Power

With their high efficiency and rapid commercialization progress, perovskite-silicon tandem solar cells have the potential to become the new standard for solar power generation. Their ability to deliver equivalent or greater energy output with fewer panels contributes to reductions in installation and transportation costs. Ongoing developments in flexible and transparent versions also open doors for diverse applications, including building-integrated photovoltaics (BIPV) and IoT devices. The widespread adoption of this technology will significantly contribute to global carbon emission reductions and the realization of a sustainable society.

Source: <https://lustersolarsolution.com/new-technology-change-solar-energy-perovskite-tandem-solar-panels-with-30-efficiency/>

#18 UNSW & UtmoLight: 23.5% efficiency for 676 cm² Perovskite PV

Published October 07, 2026 pv magazine Global Germany



OVERVIEW

Researchers at UNSW Sydney and Chinese manufacturer UtmoLight have set a new world record, achieving a certified stabilized power conversion efficiency of 23.5% for a 30 cm × 30 cm perovskite solar submodule with an aperture area of 676 cm². This significant milestone dramatically narrows the efficiency gap between small lab cells and industrially relevant large-area modules, demonstrating the technology's strong potential for scalable manufacturing. The team aims to scale up to 2.8 m² modules with a target efficiency of 18-19%.

Key Findings

A collaboration between researchers at UNSW Sydney and Chinese manufacturer UtmoLight has resulted in a new world record for large-area perovskite solar submodules, achieving a certified stabilized power conversion efficiency of 23.5%. This groundbreaking achievement was recorded on a 30 cm × 30 cm submodule with an aperture area of 676 cm², significantly closing the efficiency gap between small laboratory-scale devices and large-area modules required for industrial applications. This milestone strongly validates the potential for scalable manufacturing of perovskite photovoltaic technology.

Technical Details

- The 23.5% efficiency was independently certified, ensuring the robustness and reliability of the measurement. This efficiency figure, achieved on a substantial area of 676 cm², contrasts sharply with previous record efficiencies often reported on much smaller, millimeter-scale cells, where performance translation to larger areas is a well-known challenge.
- The teams utilized advanced materials engineering and interface optimization strategies to achieve high efficiency while maintaining stability during the upscaling process. Key aspects included meticulous control over perovskite film uniformity and defect passivation across the larger substrate.
- This success demonstrates that the inherent high efficiency of perovskite materials can be effectively preserved and translated to larger, commercially viable module sizes, overcoming a critical hurdle in the technology's development pathway.

Background & Context

Perovskite solar cells have garnered immense attention globally due to their unprecedented efficiency gains and potential for low-cost, high-throughput manufacturing processes. However, a major bottleneck to their commercialization has been the difficulty in maintaining high efficiencies when scaling from small research cells to large modules that can generate substantial power. Issues such as non-uniform film deposition, increased resistive losses, and diminished stability at larger areas have historically plagued efforts to transition this technology from lab to industry. This new record directly addresses these concerns, offering a compelling case for accelerated industrial investment.

Strategic Significance & Outlook

This world record is a pivotal moment for perovskite solar technology, providing tangible evidence of its readiness for practical applications and large-scale deployment. The UNSW and UtmoLight team now plans to further scale their technology to full-size 2.8 m² modules, targeting an efficiency of 18-19%. Such performance would make perovskite modules highly competitive with conventional silicon panels, potentially disrupting the existing solar market by offering lower cost-per-watt solutions. The next critical steps involve verifying the long-term durability and performance of these larger modules under real-world operating conditions to satisfy stringent industry requirements and unlock broader market adoption.

Source: <https://www.pv-magazine.com/2026/10/07/unsw-researchers-achieve-23-5-efficiency-record-for-large-scale-perovskite-pv-submodule/>