TROY TECHNICAL

PEROVSKITE SOLAR CELLS

WEEKLY REPORT

September 12 - September 18, 2026 | Issue 2026-W37

Bankable module performance, durability, manufacturing yield and market entry

23	10
ANALYZED ARTICLES	PRIORITY THEMES

Issued 2026-09-18 | English edition | fixed approved cover artwork

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

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

SIGNAL 01 | PRECURSORS

IDTechEx Report: Perovskite Solar Cells Shift from Lab to Fab, Highlighting Manufacturing Race

An IDTechEx report dated September 10, 2026, emphasizes the rapid transition of perovskite photovoltaics from lab milestones to scalable industrial products.

SIGNAL 02 | CELL STACK

TCL Technology Invests $30 Million in Flexible Perovskite Manufacturer TJ Solar, Securing 20%

TCL Technology invested 200 million RMB (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a Chinese manufacturer of flexible perovskite photovoltaic modules, acquiring about 20% equity.

SIGNAL 03 | MODULE PROCESS

All-Perovskite Triple-Junction Solar Cell Achieves Record 30.1% Efficiency, Patented by RenShine Solar for

An international research collaboration, including Nanjing University and RenShine Solar, has achieved a groundbreaking 30.1% power conversion efficiency (29.3% certified) in an all-perovskite triple-junction solar cell, marking a new world record.

SIGNAL 04 | QUALIFICATION

Chinese Team Achieves 34.0% Efficiency and 2.01V Open-Circuit Voltage in Perovskite-Silicon Tandem Solar

A Chinese research collaboration from Soochow University, LONGi Green Energy Technology, and Xi'an Jiaotong University has pushed perovskite-silicon tandem solar cell efficiency to a world-leading 34.0%.

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

200 million
A15

SOURCE-BOUND CONDITION
TCL Technology invested 200 million RMB (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a Chinese manufacturer of flexible perovskite photovoltaic modules, acquiring about 20% equity.

30.1%
A23

SOURCE-BOUND CONDITION
An international research collaboration, including Nanjing University and RenShine Solar, has achieved a groundbreaking 30.1% power conversion efficiency (29.3% certified) in an all-perovskite triple-junction solar cell.

34.0%
A01

SOURCE-BOUND CONDITION
A Chinese research collaboration from Soochow University, LONGi Green Energy Technology, and Xi'an Jiaotong University has pushed perovskite-silicon tandem solar cell efficiency to a world-leading 34.0%.

$29.8 million
A19

SOURCE-BOUND CONDITION
Chinese technology giant TCL Technology has invested ¥200 million (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a flexible perovskite PV module manufacturer, acquiring about a 20% stake.

29.3%
A05

SOURCE-BOUND CONDITION
Researchers at Nanjing University have achieved a world-record power conversion efficiency of 30.1% (certified 29.3%) for all-perovskite triple-junction solar cells by precisely controlling the crystallization of.

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

An IDTechEx report dated September 10, 2026, emphasizes the rapid transition of perovskite photovoltaics from lab milestones.

2

Cell stack

P02/P07

TCL Technology invested 200 million RMB (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a Chinese.

3

Module process

P03/P08

An international research collaboration, including Nanjing University and RenShine Solar, has achieved a groundbreaking 30.1%.

4

Qualification

P04/P09

A Chinese research collaboration from Soochow University, LONGi Green Energy Technology, and Xi'an Jiaotong University has.

5

Deployment & recycling

P05/P10

Chinese technology giant TCL Technology has invested ¥200 million (approximately $29.8 million) in Xi'an Tianjiao New Energy.

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 business impact

P01	IDTechEx Report: Perovskite Solar Cells Shift from Lab to Fab, Highlighting Manufacturing Race
P02	TCL Technology Invests $30 Million in Flexible Perovskite Manufacturer TJ Solar, Securing 20%
P03	All-Perovskite Triple-Junction Solar Cell Achieves Record 30.1% Efficiency, Patented by RenShine Solar for
P04	Chinese Team Achieves 34.0% Efficiency and 2.01V Open-Circuit Voltage in Perovskite-Silicon Tandem Solar
P05	TCL Technology Invests ¥200 Million ($29.8M) in Flexible Perovskite Manufacturer TJ Solar, Acquiring
P06	Nanjing University Achieves World-Record 30.1% (Certified 29.3%) Efficiency for All-Perovskite Triple-Junction Solar Cells
P07	Shanghai Jiao Tong University and Collaborators Achieve World-Record 33.64% Efficiency in Perovskite-Silicon Tandem
P08	Sekisui Chemical Stock Potentially 20% Undervalued Amid Ausbuild Deal Review, Analysts Suggest
P09	Nanjing University Sets Record 27.35% Efficiency for Perovskite-Organic Tandem Solar Cell with 744-Hour
P10	Toshiba, Shin-Etsu Chemical, and Niigata University Develop Perovskite Solar Cells with 1.5x Durability

REPRODUCIBLE POSITIONING RULE

Horizontal position uses five discrete stages: Research, Prototype, Joint evaluation, Product adoption and Scale. Vertical position uses three impact levels: single use, multiple customers and multiple supply tiers. Bubble diameter reflects the editorial score inherited from the weekly selection rubric.

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

P01 IDTechEx Report: Perovskite Solar Cells Shift from Lab to Fab, Highlighting Manufacturing Race

A17 | Precursors | Product adoption

Date not stated

FACT

An IDTechEx report dated September 10, 2026, emphasizes the rapid transition of perovskite photovoltaics from lab milestones to scalable industrial products. Key industrial engineering challenges include large-area manufacturability, scalability, yield optimization, cost reduction, and securing a robust supply chain.

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 4/5 | IMPACT 2/3

P02 TCL Technology Invests $30 Million in Flexible Perovskite Manufacturer TJ Solar, Securing 20%

A15 | Cell stack | Product adoption

Date not stated

FACT

TCL Technology invested 200 million RMB (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a Chinese manufacturer of flexible perovskite photovoltaic modules, acquiring about 20% equity. This capital will primarily support the construction and operation of a 100MW perovskite production line, R&D, and market expansion. TJ Solar specializes in lightweight, flexible perovskite PV modules with proprietary technologies for low-light power generation and flexible thin-film encapsulation.

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 22/25 | MATURITY 4/5 | IMPACT 2/3

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

P03 All-Perovskite Triple-Junction Solar Cell Achieves Record 30.1% Efficiency, Patented by RenShine Solar for

A23 | Module process | Research

Date not stated

FACT

An international research collaboration, including Nanjing University and RenShine Solar, has achieved a groundbreaking 30.1% power conversion efficiency (29.3% certified) in an all-perovskite triple-junction solar cell, marking a new world record. This advancement stems from a novel surface reconstruction and halogen homogenization strategy, combining solvent engineering with chloride additives to suppress defects and enhance charge carrier mobility.

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 1/5 | IMPACT 2/3

P04 Chinese Team Achieves 34.0% Efficiency and 2.01V Open-Circuit Voltage in Perovskite-Silicon Tandem Solar

A01 | Qualification | Research

Date not stated

FACT

A Chinese research collaboration from Soochow University, LONGi Green Energy Technology, and Xi'an Jiaotong University has pushed perovskite-silicon tandem solar cell efficiency to a world-leading 34.0%. This device simultaneously achieved an impressive open-circuit voltage of 2.014 V, verified by independent certification.

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 21/25 | MATURITY 1/5 | IMPACT 2/3

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

P05 TCL Technology Invests ¥200 Million ($29.8M) in Flexible Perovskite Manufacturer TJ Solar, Acquiring

A19 | Deployment & recycling | Scale-up

Date not stated

FACT

Chinese technology giant TCL Technology has invested ¥200 million (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a flexible perovskite PV module manufacturer, acquiring about a 20% stake. This strategic investment will primarily fund TJ Solar's establishment and operation of a 100MW perovskite production line, bolster R&D, and support market expansion.

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 21/25 | MATURITY 5/5 | IMPACT 2/3

P06 Nanjing University Achieves World-Record 30.1% (Certified 29.3%) Efficiency for All-Perovskite Triple-Junction Solar Cells

A05 | Precursors | Pilot

Date not stated

FACT

Researchers at Nanjing University have achieved a world-record power conversion efficiency of 30.1% (certified 29.3%) for all-perovskite triple-junction solar cells by precisely controlling the crystallization of ultra-wide bandgap perovskite films. This breakthrough elevates solution-processed, low-cost all-perovskite technology to efficiency levels comparable to the best perovskite-silicon tandems, without using silicon.

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 21/25 | MATURITY 2/5 | IMPACT 1/3

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

P07 Shanghai Jiao Tong University and Collaborators Achieve World-Record 33.64% Efficiency in Perovskite-Silicon Tandem

A06 | Cell stack | Pilot

Date not stated

FACT

A research collaboration led by Shanghai Jiao Tong University has developed a breakthrough technology that resolves long-standing energy alignment issues in p-i-n perovskite/silicon tandem solar cells. By implementing a " p-n switch" to invert the electronic properties of a 2D perovskite capping layer from p-type to n-type, the team achieved a world-record certified power conversion efficiency of 33.64%.

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 21/25 | MATURITY 2/5 | IMPACT 1/3

P08 Sekisui Chemical Stock Potentially 20% Undervalued Amid Ausbuild Deal Review, Analysts Suggest

A24 | Module process | Product adoption

Date not stated

FACT

Analysts suggest Sekisui Chemical (TSE:4204) stock may be up to 20% undervalued following a review of its Ausbuild deal. The company is making steady progress in expanding high-performance plastics production and mass-producing perovskite solar cells, positioning itself as a key supplier for next-generation mobility, electronics, and solar applications.

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 21/25 | MATURITY 4/5 | IMPACT 2/3

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

P09 Nanjing University Sets Record 27.35% Efficiency for Perovskite-Organic Tandem Solar Cell with 744-Hour

A02 | Qualification | Pilot

Date not stated

FACT

Researchers at Nanjing University have achieved a world-record power conversion efficiency of 27.35% for perovskite-organic tandem solar cells by employing a novel low-bandgap acceptor to enhance near-infrared light harvesting and photocurrent matching. This breakthrough device also demonstrates remarkable stability, retaining 80% of its initial performance after 744 hours of continuous illumination in an unencapsulated state.

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 2/5 | IMPACT 1/3

P10 Toshiba, Shin-Etsu Chemical, and Niigata University Develop Perovskite Solar Cells with 1.5x Durability

A16 | Deployment & recycling | Product adoption

Date not stated

FACT

A Japanese research team from Toshiba, Shin-Etsu Chemical, and Niigata University has developed perovskite solar cells with 1.5 times greater durability than existing products. These novel cells achieved approximately 3,000 hours of stable operation under harsh heat and humidity conditions. The team aims for a lifespan exceeding 20 years and commercialization by the 2030s, potentially boosting Japan's competitiveness against dominant Chinese manufacturers in the global solar market.

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 4/5 | IMPACT 2/3

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 01-14

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	Chinese Team Achieves 34.0% Efficiency and 2.01V Open-Circuit Voltage in Perovskite-Silicon Tandem Solar Cells with Novel Interfacial Design	https://www.perovskite-info.com/new-interfacial-design-pushes-perovskite-silicon-tandem-cells-past-201-v-open
A02	Nanjing University Sets Record 27.35% Efficiency for Perovskite-Organic Tandem Solar Cell with 744-Hour Stability	https://www.pv-magazine.com/2026/09/11/chinese-scientists-achieve-record-breaking-27-35-efficiency-for-perovskite-organic-tandem-solar-cell/
A03	Chlorinated Cation Boosts Open-Air Durability of Lead-Free Tin Perovskite Solar Cells, Maintaining 16.2% Efficiency for Over 1,000 Hours	https://now.solar/2026/09/13/chlorinated-cation-unlocks-durable-tin-perovskite-solar-cells-in-open-air-bioengineer-org/
A04	International Team Achieves 17% Semi-Transparent Perovskite Solar Cell Efficiency with Sputter-Resistant Aluminum Oxide Layer	https://www.pv-magazine.com/2026/09/17/scientists-build-17-efficient-semi-transparent-perovskite-solar-cell-based-on-sputter-resistant-aluminum-oxide-layer/
A05	Nanjing University Achieves World-Record 30.1% (Certified 29.3%) Efficiency for All-Perovskite Triple-Junction Solar Cells via Crystallization Control	https://bioengineer.org/crystallization-control-unlocks-30-1-efficient-all-perovskite-triple-junction-solar-cells/
A06	Shanghai Jiao Tong University and Collaborators Achieve World-Record 33.64% Efficiency in Perovskite-Silicon Tandem Solar Cells with 2D Perovskite p-n Switch	https://www.perovskite-info.com/2d-perovskite-p-n-switch-clears-voltage-bottleneck-p-i-n-tandem-solar-cells
A08	Oxford PV Ships First Commercial Perovskite-on-Silicon Tandem Solar Panels with 24.5% Efficiency to US Client	https://now.solar/2026/09/11/how-stacked-solar-panels-work-interestingengineering-com/
A09	Novel 'Raincoat' Layer Boosts Lead-Free Perovskite Solar Cell Stability, Retaining 95% Efficiency After 1,600 Hours	https://www.industrytap.com/a-raincoat-for-solar-cells-helps-lead-free-panels-keep-95-of-their-power/81461
A10	Chinese Space Perovskite Startup Xingyi Core Energy Technology Secures $14 Million Pre-A Funding for Flexible Solar Wings	https://www.perovskite-info.com/space-perovskite-startup-xingyi-core-energy-technology-raises-pre-funding
A11	Meta-Analysis Reveals Perovskite Solar Cells Achieve 26%+ Efficiency but Face Over 20% Degradation Within 1,000 Hours	https://www.irejournals.com/paper-details/1723060
A13	Penn State University Achieves 36.2% Power Conversion Efficiency in Indoor Perovskite Thin Film with Enhanced Stability	https://www.psu.edu/news/earth-and-mineral-sciences/story/improved-thin-film-harnesses-indoor-light-power-devices
A14	Swift Solar CEO Highlights 45% Efficiency Potential of Perovskite-on-Silicon Tandem Cells, Pinpointing Durability as Commercialization Hurdle	https://finance.biggo.com/news/fadec3e34014713c

ANALYZED ARTICLES | ITEMS 15-26

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
A15	TCL Technology Invests $30 Million in Flexible Perovskite Manufacturer TJ Solar, Securing 20% Stake to Fund 100MW Production Line	https://dealroom.co/news/151136-tcl-technology-backs-perovskite-maker-tj-solar-in-30-million-deal/
A16	Toshiba, Shin-Etsu Chemical, and Niigata University Develop Perovskite Solar Cells with 1.5x Durability, Targeting 2030s Commercialization	https://www.einpresswire.com/article/941430183/japanese-economic-and-business-weekly-newsletter-05-september-11-september-2026
A17	IDTechEx Report: Perovskite Solar Cells Shift from Lab to Fab, Highlighting Manufacturing Race with China Leading and Japan Targeting BIPV	https://www.idtechex.com/en/research-article/from-lab-to-fab-the-manufacturing-and-scalability-race-in-perovskite/35258
A18	Shandong Energy Group Unveils Perovskite Solar Sunroof Capable of Adding 30km Daily EV Range	https://www.perovskite-info.com/shandong-energy-group-shows-perovskite-solar-sunroof-said-add-30km-daily-ev
A19	TCL Technology Invests ¥200 Million ($29.8M) in Flexible Perovskite Manufacturer TJ Solar, Acquiring 20% Stake	https://www.perovskite-info.com/tcl-technology-invests-perovskite-manufacturer-tj-solar
A20	Soochow University and LONGi Unveil 34.0% Perovskite-Silicon Tandem Solar Cell Based on Dual-Anchored Interfacial Design	https://www.pv-magazine.com/2026/09/10/longi-soochow-university-unveil-34-0-perovskite-silicon-tandem-solar-cell-based-on-dual-anchored-interfacial-design/
A22	Chinese Scientists Demonstrate Underwater Perovskite Solar Cells Operating at 10m Depth, Unlocking Subaquatic Photovoltaic Potential	https://www.techradar.com/home/energy-saving/scientists-test-underwater-solar-panels-that-work-10-meters-beneath-the-waves-breakthrough-perovskite-tech-could-support-self-powered-marine-drones
A23	All-Perovskite Triple-Junction Solar Cell Achieves Record 30.1% Efficiency, Patented by RenShine Solar for Manufacturing	https://www.perovskite-info.com/crystallization-control-pushes-all-perovskite-triple-junction-solar-cell-301
A24	Sekisui Chemical Stock Potentially 20% Undervalued Amid Ausbuild Deal Review, Analysts Suggest	https://simplywall.st/stocks/jp/capital-goods/tse-4204/sekisui-chemical-shares/news/sekisui-chemical-tse4204-could-be-20-undervalued-on-ausbuild
A25	Japan's 7th Strategic Energy Plan Targets 23-29% Solar Power by 2040, with 20 GW from Next-Gen Perovskite Solar Cells	https://www.scix.co.jp/en/column-somosomo-11
A26	'Raincoat' Technology Dramatically Boosts Durability of Lead-Free Solar Cells, Achieving Both Efficiency and Stability	https://compoundsemiconductor.net/article/125343/%E2%80%98Raincoat%E2%80%99_protects_lead-free_solar_cells_from_the_elements

PerovskiteSolarCells — Selected Articles

Date: 2026-09-20

Articles: 23

Table of Contents

#19 TCL Technology Invests ¥200 Million ($29.8M) in Flexible Perovskite Manufacturer TJ Solar, Acquiring 20% Stake

#20 Soochow University and LONGi Unveil 34.0% Perovskite-Silicon Tandem Solar Cell Based on Dual-Anchored Interfacial Design

#22 Chinese Scientists Demonstrate Underwater Perovskite Solar Cells Operating at 10m Depth, Unlocking Subaquatic Photovoltaic Potential

#23 All-Perovskite Triple-Junction Solar Cell Achieves Record 30.1% Efficiency, Patented by RenShine Solar for Manufacturing

#24 Sekisui Chemical Stock Potentially 20% Undervalued Amid Ausbuild Deal Review, Analysts Suggest

#25 Japan's 7th Strategic Energy Plan Targets 23-29% Solar Power by 2040, with 20 GW from Next-Gen Perovskite Solar Cells

#26 'Raincoat' Technology Dramatically Boosts Durability of Lead-Free Solar Cells, Achieving Both Efficiency and Stability

#01 Chinese Team Achieves 34.0% Efficiency and 2.01V Open-Circuit Voltage in Perovskite-Silicon Tandem Solar Cells with Novel Interfacial Design

Published September 13, 2026 pv-magazine.com China

OVERVIEW

A Chinese research collaboration from Soochow University, LONGi Green Energy Technology, and Xi'an Jiaotong University has pushed perovskite-silicon tandem solar cell efficiency to a world-leading 34.0%. This device simultaneously achieved an impressive open-circuit voltage of 2.014 V, verified by independent certification. The breakthrough relies on a nanoscale interfacial scaffold, combining zirconium dioxide nanoparticles and a self-assembled monolayer, which effectively mitigates defects while enabling efficient charge transport and maintaining over 84% of initial efficiency after 2,000 hours of continuous operation.

IN DEPTH

Key Findings

A collaborative research team from Soochow University, LONGi Green Energy Technology, and Xi'an Jiaotong University in China has set a new benchmark in perovskite-silicon tandem solar cell efficiency, achieving a remarkable 34.0% power conversion. This milestone was independently certified and represents one of the highest efficiencies recorded for this technology. Concurrently, the device demonstrated an exceptionally high open-circuit voltage (Voc) of 2.014 V, significantly surpassing the theoretical limits of single-junction silicon solar cells.

Technical / Clinical Details

The core of this advancement lies in a novel nanoscale interfacial scaffold, ingeniously designed using a combination of zirconium dioxide (ZrO_2) nanoparticles and a self-assembled monolayer (SAM). This innovative interfacial architecture effectively passivates defects at the interface, which are notorious for reducing efficiency, while simultaneously facilitating highly efficient charge carrier transport. This design successfully overcomes a conventional trade-off where interfacial passivation layers often hinder carrier mobility. Beyond efficiency, the unencapsulated device exhibited impressive operational stability, retaining over 84% of its initial efficiency after 2,000 hours of continuous operation, a critical step towards real-world applications.

Background & Context

Perovskite-silicon tandem solar cells are at the forefront of photovoltaic research, aiming to break the theoretical efficiency limit of conventional single-junction silicon cells (approximately 29%). By combining perovskites, which excel at absorbing visible to near-ultraviolet light, with silicon, which efficiently captures infrared light, these tandem cells can utilize a much broader spectrum of solar radiation. China is a global leader in solar energy technology, and this record-breaking achievement further solidifies its position in advanced photovoltaic research and industrial competitiveness. The rapid progress in tandem cell technology underscores the global race to develop more powerful and cost-effective solar solutions.

Strategic Significance & Outlook

The achievement of 34.0% efficiency, coupled with a high open-circuit voltage and excellent stability, represents a significant leap forward for the commercial viability of perovskite-silicon tandem solar cells. High Voc directly translates to greater power output, while enhanced stability is crucial for long-term reliability in the field. Should this technology prove scalable for mass production, it has the potential to further reduce the cost of solar energy, thereby accelerating the global energy transition. Future efforts will likely focus on optimizing this interfacial design for large-scale manufacturing and establishing robust production processes to bring these ultra-efficient cells to market.

Source: https://www.perovskite-info.com/new-interfacial-design-pushes-perovskite-silicon-tandem-cells-past-201-v-open

Collected: September 18, 2026 | Automated Research System (Gemini API)

#02 Nanjing University Sets Record 27.35% Efficiency for Perovskite-Organic Tandem Solar Cell with 744-Hour Stability

Published September 11, 2026 pv magazine Global China

OVERVIEW

Researchers at Nanjing University have achieved a world-record power conversion efficiency of 27.35% for perovskite-organic tandem solar cells by employing a novel low-bandgap acceptor to enhance near-infrared light harvesting and photocurrent matching. This breakthrough device also demonstrates remarkable stability, retaining 80% of its initial performance after 744 hours of continuous illumination in an unencapsulated state. The findings, published in Joule, mark a significant advance for flexible and high-efficiency photovoltaic technologies.

IN DEPTH

Key Findings

A research team at Nanjing University in China has established a new world record in perovskite-organic tandem solar cell technology, achieving an unprecedented power conversion efficiency of 27.35%. This groundbreaking efficiency was realized through the strategic incorporation of a novel low-bandgap acceptor, which significantly enhances near-infrared light absorption. Furthermore, the unencapsulated device exhibited impressive operational stability, maintaining 80% of its initial performance after 744 hours of continuous light exposure.

Technical / Clinical Details

The core of this achievement lies in the development and integration of a new low-bandgap acceptor material, which crucially improves photocurrent matching within the tandem structure. By optimally combining the perovskite and organic layers, the device is able to capture a much broader range of the solar spectrum more efficiently. While traditional organic solar cells primarily absorb visible light, this advancement extends light utilization into the near-infrared region, boosting overall conversion efficiency. A particularly notable aspect is the stability demonstrated by the unencapsulated device, which retained 80% of its initial efficiency after 744 hours under continuous standard AM1.5G illumination. This level of durability represents a substantial step forward in overcoming the inherent stability challenges often associated with hybrid perovskite-organic material systems.

Background & Context

Perovskite solar cells are celebrated for their high efficiency potential and low manufacturing costs, while organic solar cells offer unique advantages such as flexibility and transparency. The combination of these two technologies into perovskite-organic tandem solar cells seeks to leverage the strengths of both, positioning them as a promising next-generation photovoltaic solution. Their lightweight and flexible attributes open up vast application possibilities, including Building-Integrated Photovoltaics (BIPV), wearable electronics, and IoT sensors. China continues to lead global research and development in renewable energy technologies, and this achievement further underscores its robust innovative capacity in the field.

Strategic Significance & Outlook

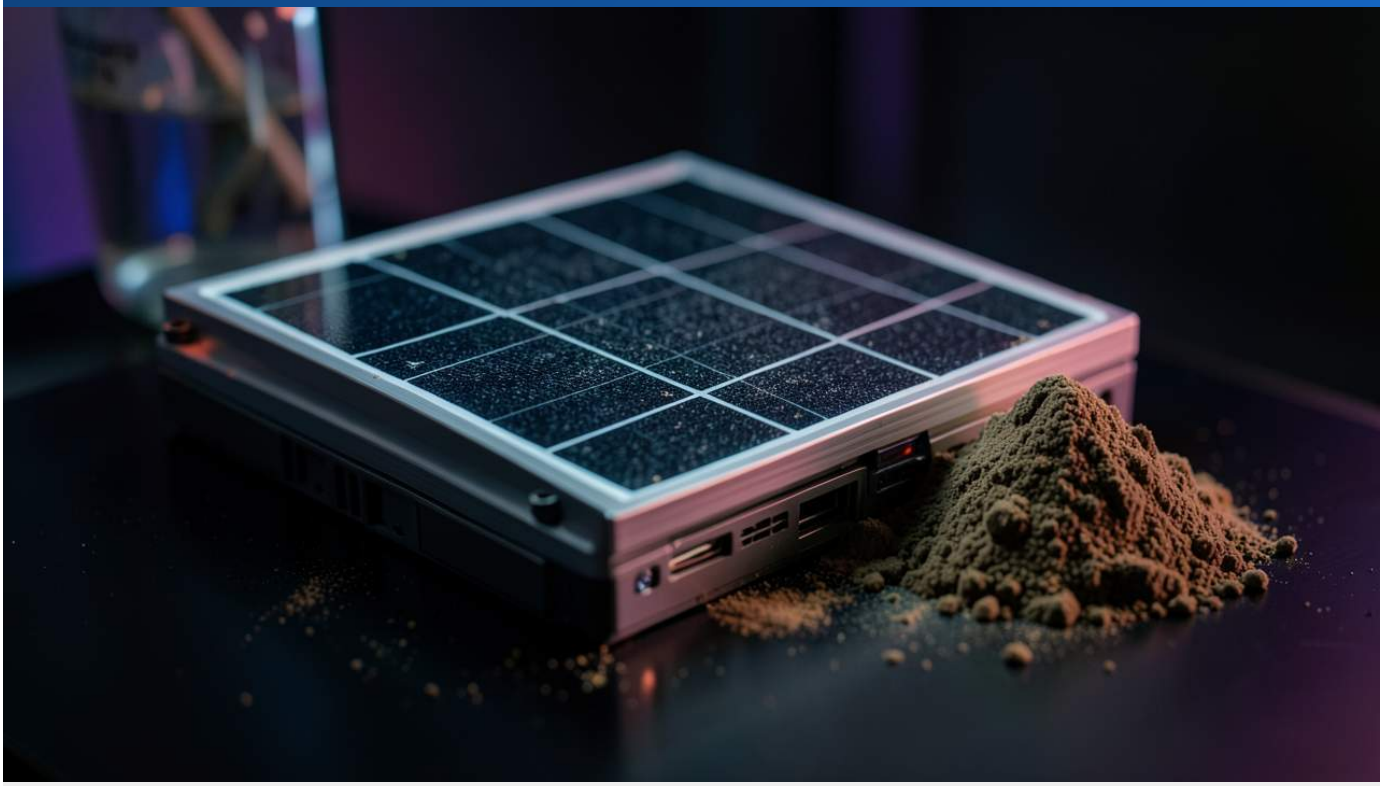
The record-setting 27.35% efficiency, coupled with the demonstrated 744-hour stability for an unencapsulated device, marks a critical milestone towards the commercialization of perovskite-organic tandem solar cells. The discovery of the new low-bandgap acceptor will undoubtedly influence future material design strategies. If this technology can be scaled up and its long-term durability further established, it promises to introduce new high-performance and multi-functional options into the solar energy market. This could accelerate the diversification of solar power deployment, enabling its integration into a wider array of products and environments.

Source: https://www.pv-magazine.com/2026/09/11/chinese-scientists-achieve-record-breaking-27-35-efficiency-for-perovskite-organic-tandem-solar-cell/

Collected: September 18, 2026 | Automated Research System (Gemini API)

#03 Chlorinated Cation Boosts Open-Air Durability of Lead-Free Tin Perovskite Solar Cells, Maintaining 16.2% Efficiency for Over 1,000 Hours

Published September 13, 2026 bioengineer.org USA



OVERVIEW

A novel approach utilizing chlorinated cations has dramatically improved the open-air durability of lead-free tin perovskite solar cells. This 2D/3D perovskite solar cell achieved a power conversion efficiency of 16.2% and demonstrated stable operation for over 1,000 hours in ambient air at 55°C. This represents a significant breakthrough in overcoming the rapid degradation, a major drawback of tin-based devices, paving the way for safer and more sustainable solar cell commercialization.

IN DEPTH

Key Findings

A significant breakthrough has been achieved in lead-free tin perovskite solar cells: the incorporation of chlorinated cations has dramatically enhanced their stability in ambient air. This 2D/3D hybrid perovskite solar cell not only reached a power conversion efficiency of 16.2% but also demonstrated stable operation for over 1,000 hours at 55°C in open air, directly addressing the critical issue of rapid degradation in tin-based perovskites.

Technical / Clinical Details

The research team employed an innovative strategy of integrating specific chlorinated cations into the 2D/3D perovskite structure. These cations effectively passivate defects within the perovskite crystal lattice and simultaneously protect the material from oxidative decomposition caused by oxygen and moisture. Tin-based perovskites offer the advantage of being lead-free, thus reducing environmental toxicity, but historically have suffered from the facile oxidation of tin ions (Sn^{2+} to Sn^{4+}), leading to rapid performance degradation. The chlorinated cations effectively slow down this oxidation process, thereby dramatically improving the device's stability. Extensive testing confirmed that this enhanced device achieved 16.2% power conversion efficiency and, more importantly, maintained its initial performance for over 1,000 hours under challenging conditions of 55°C in ambient air. This is an exceptional level of durability for unencapsulated devices in this class.

Background & Context

While perovskite solar cells hold great promise for high efficiency, many formulations contain toxic lead, prompting an urgent demand for alternative, environmentally benign materials. Tin perovskites emerged as a promising lead-free substitute, but their extreme instability in air has been the primary impediment to their practical application. This breakthrough using chlorinated cations provides a crucial answer to this long-standing challenge, significantly contributing to the commercialization of lead-free and environmentally friendly solar cells. This represents a vital technological advance in the global transition towards more sustainable societies.

Strategic Significance & Outlook

The improved open-air durability of tin perovskite solar cells via chlorinated cation incorporation is a decisive step towards the commercialization of lead-free solar technology. An efficiency of 16.2% combined with over 1,000 hours of stability suggests that this technology is robust enough for practical applications. Future efforts will likely focus on further optimizing this stabilization technique, improving efficiency, and validating its scalability for large-scale manufacturing processes. This is expected to bring a new generation of safe and environmentally sustainable solar cells to the market, opening new directions for the photovoltaic industry and accelerating green energy adoption.

Source: https://now.solar/2026/09/13/chlorinated-cation-unlocks-durable-tin-perovskite-solar-cells-in-open-air-bioengineer-org/

#04 International Team Achieves 17% Semi-Transparent Perovskite Solar Cell Efficiency with Sputter-Resistant Aluminum Oxide Layer

Published September 17, 2026 pv magazine Global International

OVERVIEW

An international research team has achieved over 17% efficiency for semi-transparent perovskite solar cells and 26% for perovskite-silicon tandems by incorporating a thin aluminum oxide (AlO_x) buffer layer grown by atomic layer deposition (ALD) in inverted perovskite devices. This AlO_x layer effectively protects the perovskite layer from sputtering damage while suppressing interfacial charge recombination. This technology enables reduced material usage and manufacturing time, improving both efficiency and operational stability.

IN DEPTH

Key Findings

An international research team has significantly enhanced the performance of inverted perovskite solar cells by employing an innovative thin aluminum oxide (AlO_x) buffer layer. This technology has enabled the achievement of over 17% power conversion efficiency for semi-transparent perovskite solar cells and an impressive 26% efficiency for perovskite-silicon tandem devices. The AlO_x layer serves a dual purpose: protecting the perovskite layer during sputtering processes and effectively suppressing interfacial charge recombination.

Technical / Clinical Details

The research team utilized atomic layer deposition (ALD) to grow an ultra-thin AlO_x layer, only a few nanometers thick, directly onto the perovskite layer. This ultra-thin film plays two crucial roles. Firstly, physical vapor deposition techniques like sputtering, commonly used to form top transparent electrodes, can damage the underlying perovskite crystal structure due to high-energy ion bombardment. The AlO_x buffer layer acts as a robust protective barrier against this sputtering damage, preserving the integrity of the perovskite layer. Secondly, the AlO_x layer also functions as an effective passivation layer, suppressing interfacial charge recombination. This enhances carrier extraction efficiency, leading to improvements in open-circuit voltage (Voc) and fill factor (FF). This combined effect resulted in efficiencies exceeding 17% for semi-transparent cells and a high 26% for tandem configurations.

Background & Context

Perovskite solar cells are recognized as a promising next-generation technology due to their high efficiency and flexibility, but challenges related to manufacturing damage and long-term stability persist. Specifically, the high-performance sputtering method for transparent electrodes posed a dilemma due to its potential for damaging the underlying perovskite layer. The development of this AlO_x buffer layer resolves this manufacturing challenge, enabling the seamless integration of high-performance transparent electrodes with delicate perovskite layers. Semi-transparent perovskites are expected to find widespread applications in windows, Building-Integrated Photovoltaics (BIPV), and greenhouses, and this technological advance accelerates their practical deployment.

Strategic Significance & Outlook

The introduction of a sputter-resistant AlO_x buffer layer represents a groundbreaking advancement that simultaneously improves the manufacturability and performance of perovskite solar cells. This technology simplifies the manufacturing process and reduces material usage, enabling the cost-effective production of high-performance perovskite devices. Future efforts will focus on further optimizing this AlO_x layer and evaluating its applicability for large-scale production. This is expected to accelerate the market introduction of transparent and high-efficiency tandem solar cells, bringing new value and application opportunities to the renewable energy sector and broadening the scope of solar power implementation globally.

Source: https://www.pv-magazine.com/2026/09/17/scientists-build-17-efficient-semi-transparent-perovskite-solar-cell-based-on-sputter-resistant-aluminum-oxide-layer/

Collected: September 18, 2026 | Automated Research System (Gemini API)

#05 Nanjing University Achieves World-Record 30.1% (Certified 29.3%) Efficiency for All-Perovskite Triple-Junction Solar Cells via Crystallization Control

Published September 11, 2026 Nature Energy China

OVERVIEW

Researchers at Nanjing University have achieved a world-record power conversion efficiency of 30.1% (certified 29.3%) for all-perovskite triple-junction solar cells by precisely controlling the crystallization of ultra-wide bandgap perovskite films. This breakthrough elevates solution-processed, low-cost all-perovskite technology to efficiency levels comparable to the best perovskite-silicon tandems, without using silicon. The achievement also demonstrates robust operational stability, marking a significant milestone for perovskite solar cell commercialization.

IN DEPTH

Key Findings

A research team from Nanjing University has achieved a world-record power conversion efficiency of 30.1%, with a certified value of 29.3%, for all-perovskite triple-junction solar cells. This significant advancement was made possible through precise crystallization control of ultra-wide bandgap perovskite films. This breakthrough positions low-cost, solution-processed all-perovskite technology at an efficiency level comparable to the highest-performing perovskite-silicon tandem cells, crucially without the use of silicon, signaling a major impact on the solar industry.

Technical Details

The core of this breakthrough lies in the enhanced performance of wide bandgap subcells within a triple-junction perovskite solar cell architecture. The team meticulously manipulated the dynamics of perovskite crystallization, leading to a substantial improvement in the quality of the ultra-wide bandgap perovskite material. This optimization extended carrier lifetimes and suppressed non-radiative recombination losses, resulting in a dramatic increase in overall conversion efficiency.

- **Triple-Junction Architecture:** A triple-junction design stacks three different absorber layers with varying bandgaps, enabling a broader and more efficient capture of the solar spectrum compared to single or dual-junction devices, thus promising higher theoretical efficiencies.
- **Crystallization Control:** In solution-processed perovskite film formation, crystal size, orientation, and defect density critically influence device performance. The Nanjing University approach developed novel methods for precise control over these parameters.
- **Stability:** Alongside high efficiency, robust operational stability was also achieved, addressing a key challenge for the commercial viability of perovskite solar cells.

Background and Industry Context

All-perovskite solar cells are widely recognized as a next-generation photovoltaic technology due to their lower manufacturing costs, lightweight, and flexibility compared to traditional silicon solar cells. Tandem and triple-junction architectures, in particular, hold the promise of exceeding the efficiency limits of single-junction devices. While perovskite-silicon tandems have previously led in efficiency, this achievement of over 30% efficiency with an all-perovskite triple-junction device demonstrates comparable performance without silicon, opening new avenues for material selection and manufacturing processes.

Strategic Significance and Outlook

This research significantly advances the commercial feasibility of all-perovskite technology. High-efficiency solar cells independent of silicon can contribute to diversifying supply chains, further reducing manufacturing costs, and enabling new applications such as building-integrated photovoltaics and wearable devices. Future efforts will focus on scaling up this technology, verifying long-term reliability, and continuing materials research and process improvements for even higher efficiencies. These advancements are expected to accelerate the transition towards a sustainable energy future.

Source: https://bioengineer.org/crystallization-control-unlocks-30-1-efficient-all-perovskite-triple-junction-solar-cells/

Collected: September 18, 2026 | Automated Research System (Gemini API)

#06 Shanghai Jiao Tong University and Collaborators Achieve World-Record 33.64% Efficiency in Perovskite-Silicon Tandem Solar Cells with 2D Perovskite p-n Switch

Published September 13, 2026 pv magazine China

OVERVIEW

A research collaboration led by Shanghai Jiao Tong University has developed a breakthrough technology that resolves long-standing energy alignment issues in p-i-n perovskite/silicon tandem solar cells. By implementing a "p-n switch" to invert the electronic properties of a 2D perovskite capping layer from p-type to n-type, the team achieved a world-record certified power conversion efficiency of 33.64%. This innovation significantly improves energy level alignment at the perovskite/electron transport layer interface, suppressing voltage-limiting non-radiative recombination and paving the way for higher-performance tandem solar cells.

IN DEPTH

Key Findings

A collaborative research team from Shanghai Jiao Tong University, Jilin University, Jinko Solar, and Shanghai Institute of Carbon-Free Energy Conversion and Utilization has achieved a world-record certified power conversion efficiency of 33.64% for p-i-n perovskite/silicon tandem solar cells. This breakthrough was accomplished by resolving the long-standing energy alignment mismatch at the interfaces. The core innovation is a "p-n switch" that inverts the electronic properties of a 2D perovskite capping layer from p-type to n-type, promising to significantly accelerate the efficiency and commercial viability of tandem solar cells.

Technical Details

The developed "p-n switch" dynamically alters the charge transport characteristics of a two-dimensional (2D) perovskite capping layer. Specifically, by effectively inverting this layer from its typical p-type (hole-transporting) to an n-type (electron-transporting) state, the team dramatically improved the energy level alignment between the perovskite absorber and the electron transport layer (ETL). This enhancement profoundly suppressed non-radiative recombination, which was a primary source of voltage loss at the interface, leading to improved open-circuit voltage (V_{OC}) and fill factor (FF).

- **Addressing Energy Alignment Mismatch:** In conventional tandem solar cells, mismatches in energy levels between different material layers impede carrier transport and cause recombination losses, limiting overall efficiency. The p-n switch fundamentally removes this barrier.
- **Leveraging 2D Perovskites:** 2D perovskites are gaining attention for their excellent stability and carrier transport properties. This research demonstrates new possibilities for interface engineering by precisely controlling their electronic characteristics.
- **Certified Efficiency:** The 33.64% efficiency has been independently certified, highlighting the importance of this lab-scale achievement being validated as a concrete, record-setting number.

Background and Industry Context

Perovskite/silicon tandem solar cells are considered strong candidates for next-generation photovoltaics due to their higher theoretical efficiency compared to conventional single-junction silicon cells. However, achieving optimal performance has been bottlenecked by energy level mismatches at the interfaces. This novel technology provides an innovative solution to this challenge, opening the path for even higher efficiencies in tandem solar cells. This progress is crucial for improving the cost-effectiveness of solar power generation and fostering its wider adoption.

Strategic Significance and Outlook

This p-n switch technology represents a major stride towards the commercialization of perovskite/silicon tandem solar cells. The 33.64% efficiency significantly surpasses the highest efficiencies of currently commercialized solar cells, making it a promising candidate for deployment across various applications, from large-scale solar farms to residential panels. Future efforts will focus on validating the scalability, long-term stability, and compatibility of this technology with mass production processes. This innovation is expected to set a new standard for clean energy technologies and accelerate the energy transition.

Source: https://www.perovskite-info.com/2d-perovskite-p-n-switch-clears-voltage-bottleneck-p-i-n-tandem-solar-cells

Collected: September 18, 2026 | Automated Research System (Gemini API)

#08 Oxford PV Ships First Commercial Perovskite-on-Silicon Tandem Solar Panels with 24.5% Efficiency to US Client

Published September 10, 2026 interestingengineering.com USA

OVERVIEW

Oxford PV announced the shipment of its first commercial perovskite-on-silicon tandem solar panels to a US customer in September 2024. These 72-cell panels achieve an efficiency of 24.5%, marking the first time a stacked solar cell has been sold for a real-world project, despite being a modest figure compared to laboratory records. This achievement signifies a critical milestone in bringing advanced perovskite solar technology to market, leveraging its ability to capture light wavelengths typically wasted by conventional silicon cells.

IN DEPTH

Key Findings

Oxford PV has achieved a significant commercial milestone, shipping its first commercial perovskite-on-silicon tandem solar panels to a US customer in September 2024. These 72-cell modules demonstrated an efficiency of 24.5%, representing the inaugural sale of stacked solar cells for a practical project. While this efficiency is conservative compared to current laboratory records, it is a crucial step in the real-world deployment and commercialization of perovskite technology, moving it beyond research settings.

Technical Details

The core innovation behind these panels lies in their tandem architecture, which involves coating a thin layer of perovskite, mere hundreds of nanometers thick, onto traditional silicon solar cells. Silicon cells primarily absorb the red and infrared spectrum of sunlight, while the perovskite layer excels at converting higher-energy blue and green light, which silicon typically allows to pass through or dissipates as heat. By combining these materials, the tandem cell can capture a broader spectrum of solar energy, significantly increasing overall power conversion efficiency beyond the theoretical limits of single-junction silicon cells. The reported 24.5% efficiency demonstrates a robust performance for a commercial-grade product.

Background & Context

Perovskite solar cells have garnered immense attention as a next-generation photovoltaic technology due to their high power conversion efficiency and potential for low manufacturing costs. Tandem configurations, in particular, are considered the most promising pathway to surpass the theoretical Shockley-Queisser limit of around 29% for single-junction silicon cells. Oxford PV's successful commercial shipment signifies a pivotal transition for this innovative technology from experimental validation to practical application. This move is expected to catalyze further investment and development in the perovskite sector, positioning it as a key contender in the future of renewable energy.

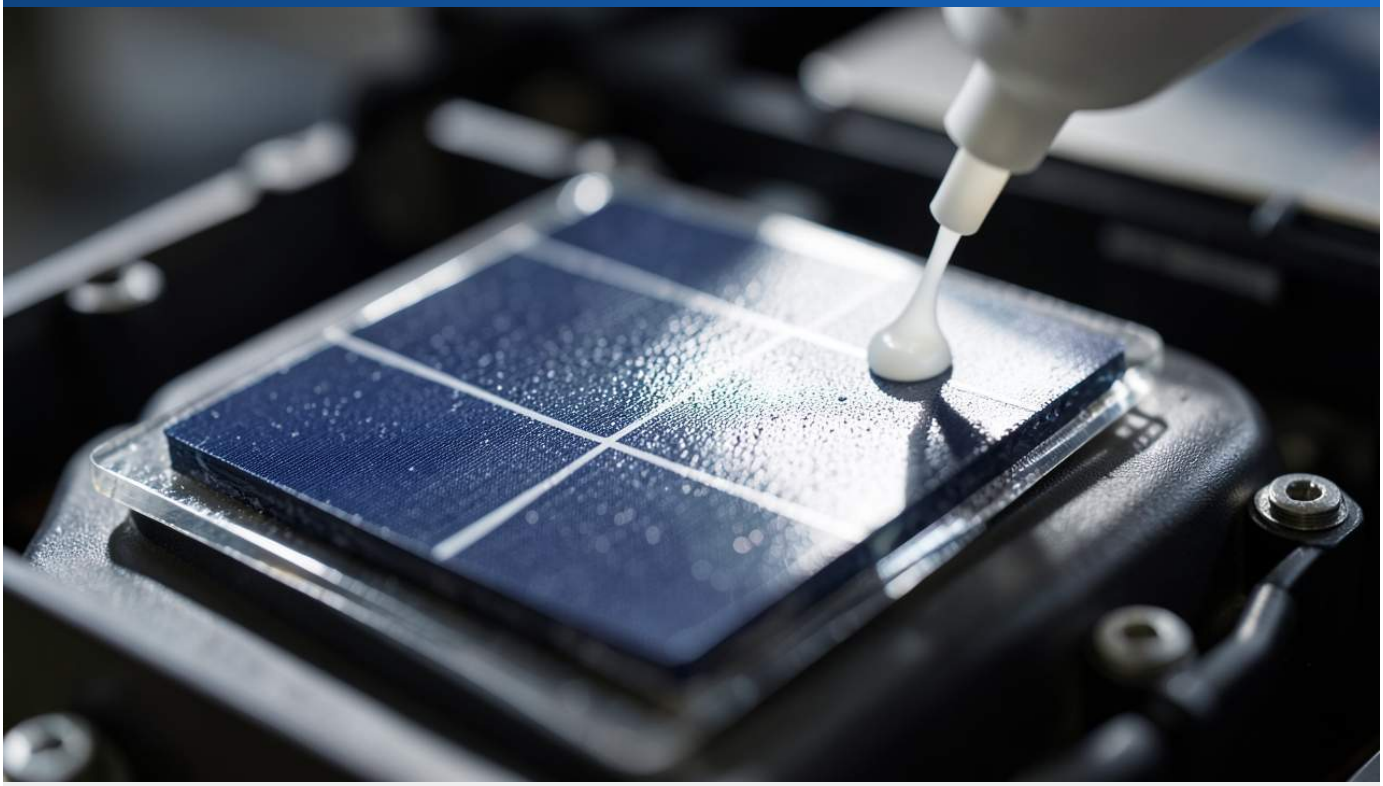
Strategic Significance & Outlook

This commercial deployment is a foundational step towards the mass production and widespread adoption of perovskite tandem solar cells. Future challenges will involve enhancing cost-effectiveness, proving long-term durability under diverse environmental conditions, and scaling up manufacturing processes efficiently. Oxford PV's pioneering effort will likely influence other perovskite developers and solar manufacturers, fostering a competitive landscape that could accelerate the introduction of even more efficient and affordable solar solutions. High-efficiency panels are particularly valuable in space-constrained applications, such as urban installations and rooftop solar, opening new market segments and driving greater global renewable energy penetration.

Source: https://now.solar/2026/09/11/how-stacked-solar-panels-work-interestingengineering-com/

#09 Novel 'Raincoat' Layer Boosts Lead-Free Perovskite Solar Cell Stability, Retaining 95% Efficiency After 1,600 Hours

Published September 11, 2026 Industry Tap USA



OVERVIEW

Scientists have developed a protective 'raincoat' layer that significantly enhances the stability of lead-free perovskite solar cells. By incorporating a chlorine-containing organic molecule (4-chlorophenethylammonium, 4ClPEA), devices achieved 16.2% power conversion efficiency and maintained over 95% of their initial efficiency after 1,600 hours in dry air. Furthermore, they retained approximately 80% efficiency after 1,000 hours under continuous simulated sunlight at 55°C, paving the way for environmentally friendly and durable solar technology.

IN DEPTH

Key Findings

Scientists have made a significant breakthrough in addressing the primary challenge of stability in environmentally friendly lead-free perovskite solar cells. A newly developed protective coating, dubbed a 'raincoat' layer, has demonstrated remarkable durability, allowing devices to retain over 95% of their initial efficiency after 1,600 hours in dry air and approximately 80% efficiency after 1,000 hours under continuous simulated sunlight at 55°C. This innovation substantially improves the long-term viability of these devices, accelerating the commercialization of lead-free solar technology.

Technical Details

The innovative 'raincoat' layer is composed of a chlorine-containing organic molecule, 4-chlorophenethylammonium (4ClPEA). When integrated into the perovskite material's crystalline structure, this molecule facilitates the formation of a more densely packed lattice. This tighter arrangement acts as an effective barrier, preventing the ingress of detrimental environmental factors such as moisture and oxygen, which are primary causes of degradation in perovskite solar cells. The lead-free devices employing this protection achieved a power conversion efficiency of 16.2%, indicating that this robust stability is achieved without compromising practical performance.

Background & Context

Perovskite solar cells are heralded as a next-generation photovoltaic technology due to their high power conversion efficiencies and low manufacturing costs. However, the most efficient perovskites typically contain lead, raising environmental concerns that have driven an urgent search for high-performing lead-free alternatives. Earlier lead-free perovskites generally suffered from inferior efficiency and, critically, poor long-term stability compared to their lead-containing counterparts. The development of this 'raincoat' layer represents a pivotal advancement in overcoming the stability challenge, contributing significantly to the realization of high-performance, eco-friendly solar cells.

Strategic Significance & Outlook

This new protective layer technology marks a major step towards the commercialization of lead-free perovskite solar cells. The research team intends to further boost conversion efficiency while rigorously validating stability under various environmental conditions and exploring its applicability in large-scale manufacturing processes. Widespread adoption of this technology could accelerate the deployment of perovskite solar cells as a sustainable, environmentally conscious energy source. This advancement is particularly promising for diverse applications such as building-integrated photovoltaics (BIPV) and flexible solar cells, where durability and environmental safety are paramount.

Source: https://www.industrytap.com/a-raincoat-for-solar-cells-helps-lead-free-panels-keep-95-of-their-power/81461

Collected: September 18, 2026 | Automated Research System (Gemini API)

#10 Chinese Space Perovskite Startup Xingyi Core Energy Technology Secures $14 Million Pre-A Funding for Flexible Solar Wings

Published September 14, 2026 Perovskite-Info China

OVERVIEW

Xingyi Core Energy Technology, a Chinese developer of space-grade perovskite solar cells and flexible packaging substrates, has completed a Pre-A funding round, raising approximately 100 million RMB (around $14 million USD). This capital will fuel technological iterations, space environment testing, and in-orbit validation of its perovskite photovoltaic cells and space-grade CPI flexible packaging substrates. The company plans to deploy perovskite flexible photovoltaic modules on the Ziwei spacecraft for in-orbit verification in October 2026.

IN DEPTH

Key Findings

Xingyi Core Energy Technology, a Chinese company specializing in space-grade perovskite solar cells and flexible packaging substrates, has successfully closed a Pre-A strategic funding round, securing approximately 100 million RMB (around $14 million USD). This substantial investment is earmarked for advancing the company's technology iterations, conducting rigorous space environment testing, and critically, for the in-orbit validation of its perovskite photovoltaic cells and space-grade colorless polyimide (CPI) flexible packaging substrates.

Technical / Clinical Details

Xingyi Core Energy Technology focuses on developing lightweight, high-efficiency flexible perovskite solar cells, alongside CPI flexible packaging substrates designed to withstand the harsh conditions of space. With this new funding, the company is poised to proceed with crucial validation processes. Notably, in October 2026, the company plans to integrate its perovskite flexible photovoltaic modules onto the Ziwei spacecraft. This mission will provide vital real-world data on the performance and durability of their technology in a live orbital environment, marking a significant step towards the practical application of perovskites in space power systems.

Background & Context

Power supply is a critical aspect of the space industry, driving advancements in satellite miniaturization, mission longevity, and the feasibility of new space endeavors. Traditional gallium arsenide solar cells, while effective, are expensive and contribute significantly to overall spacecraft mass. Perovskite solar cells, offering high power conversion efficiency, lightweight design, flexibility, and lower manufacturing costs, represent a promising next-generation solution for space applications. China's rapid expansion in space exploration positions Xingyi Core Energy Technology's efforts as a key contributor to enhancing technological independence and competitiveness in this vital sector.

Strategic Significance & Outlook

The successful funding round and planned in-orbit validation are pivotal for Xingyi Core Energy Technology to establish itself as a prominent player in the space perovskite solar cell market. A successful demonstration of performance in orbit would accelerate the adoption of their technology across various space missions, including commercial satellites, deep-space probes, and space stations. This advancement has the potential to significantly reduce the weight and cost of space power systems, thereby making a wider array of space missions more economically viable and fostering further innovation in space exploration.

Source: https://www.perovskite-info.com/space-perovskite-startup-xingyi-core-energy-technology-raises-pre-funding

Collected: September 18, 2026 | Automated Research System (Gemini API)

#11 Meta-Analysis Reveals Perovskite Solar Cells Achieve 26%+ Efficiency but Face Over 20% Degradation Within 1,000 Hours

Published September 14, 2026 IRE Journals International

OVERVIEW

A meta-analysis published on September 14, 2026, reveals that perovskite solar cells (PSCs) have achieved average power conversion efficiencies (PCEs) of 18-22% for single-junction and over 26% for tandem configurations, outperforming many established PV technologies. However, significant instability against moisture, heat, and irradiation stress remains, with many PSCs experiencing over 20% efficiency loss within 1,000 hours. The analysis underscores that substantial stability improvements are critical for PSC commercialization.

IN DEPTH

Key Findings

A comprehensive meta-analysis published on September 14, 2026, highlights the remarkable progress in power conversion efficiency (PCE) of perovskite solar cells (PSCs). Single-junction PSCs now exhibit average PCEs ranging from 18-22%, while tandem perovskite-silicon structures have surpassed 26% efficiency, outperforming many established photovoltaic technologies. Despite these impressive gains, the analysis critically points out that instability against moisture, heat, and irradiation stress remains a major impediment to PSC commercialization. A significant number of PSC devices experience over 20% efficiency loss within a mere 1,000 hours of operation.

Technical / Clinical Details

The meta-analysis attributes the efficiency improvements in PSCs to advancements in interface engineering, gradient composition control, and the deployment of novel materials. Specifically, defect passivation techniques at the interfaces between active and transport layers, along with compositional tuning to optimize bandgaps, have been shown to enhance carrier extraction and suppress non-radiative recombination. Conversely, the inherent stability issues of PSCs stem from their material properties, citing intrinsic vulnerabilities to moisture, oxygen, heat, and UV light. These factors accelerate device degradation, making long-term performance difficult to sustain. Current research indicates that robust encapsulation technologies and the development of more intrinsically stable perovskite compositions are essential to protect devices from these environmental stressors.

Background & Context

Perovskite solar cells have garnered significant global attention as a next-generation photovoltaic technology due to their high PCE and potential for low-cost manufacturing. Their adaptability allows for diverse applications beyond traditional silicon panels, including flexible substrates and transparent devices. This meta-analysis reaffirms the immense potential of PSCs while squarely focusing on stability as the paramount barrier to practical implementation. The findings suggest that the research and development trajectory must shift from solely pursuing efficiency to prioritizing long-term reliability as an urgent challenge.

Strategic Significance & Outlook

As indicated by this meta-analysis, a dramatic improvement in device stability is indispensable for the widespread commercial deployment of perovskite solar cells. Future research will likely accelerate in areas such as innovative material design, advanced encapsulation methods, and optimized device architectures to enhance resistance against moisture, heat, and light stress. The development of devices capable of achieving less than 20% efficiency loss after more than 1,000 hours of continuous operation will be a crucial benchmark for establishing market competitiveness. Overcoming this stability challenge will enable PSCs to play a transformative role in the renewable energy market.

Source: https://www.irejournals.com/paper-details/1723060

#13 Penn State University Achieves 36.2% Power Conversion Efficiency in Indoor Perovskite Thin Film with Enhanced Stability

Published September 14, 2026 Penn State University USA

OVERVIEW

A Penn State University research team has developed an indoor-light-optimized perovskite thin film, achieving an impressive 36.2% power conversion efficiency (PCE) for a 0.093 cm² aperture area. This breakthrough was realized by tuning the bromine-to-iodine ratio to match indoor illumination, forming a more compact crystalline film using dichlorobenzene as an antisolvent, and applying a phenethylammonium bromide (PEABr) passivation layer to suppress surface defects. This innovation has the potential to revolutionize power supply for IoT devices and smart home sensors.

IN DEPTH

Key Findings

Researchers at Penn State University have reported a significant breakthrough in perovskite thin-film technology, specifically optimized for indoor lighting conditions. The team achieved an astonishing 36.2% power conversion efficiency (PCE) from a device with an aperture area of just 0.093 square centimeters. This advancement successfully enhances both the indoor light absorption capability and the stability of the device under high light intensity.

Technical / Clinical Details

This high efficiency was enabled by a series of technical innovations. Firstly, the research team precisely tuned the ratio of bromine to iodine, thereby optimizing the perovskite's bandgap to match the narrow spectrum of indoor illumination, allowing for more efficient absorption of limited indoor light energy. Secondly, using dichlorobenzene as an antisolvent facilitated the formation of a more compact and uniform perovskite crystalline film, which contributed to improved device performance and stability. Furthermore, by incorporating a passivation layer of phenethylammonium bromide (PEABr) on top of the perovskite layer, surface defects were effectively suppressed, reducing non-radiative recombination and thus achieving both high PCE and robust stability.

Background & Context

The proliferation of Internet of Things (IoT) devices has created a rapidly growing demand for self-sustaining power sources that can operate reliably in low-light environments. Conventional solar cells are typically optimized for strong outdoor sunlight, leading to a significant drop in efficiency under weak indoor illumination. Perovskite materials, with their inherent flexibility in bandgap tuning, hold immense potential for indoor light harvesting applications. Penn State's achievement represents a world-leading efficiency in this domain, marking a crucial step towards eliminating battery changes and fostering a more sustainable IoT ecosystem.

Strategic Significance & Outlook

The success of this indoor light-harvesting perovskite thin film has the potential to revolutionize power supply for a wide range of IoT applications, including wireless sensors, smart home devices, and wearables. Further research to enhance device stability and manufacturing scalability could soon make a battery-free future for these devices a reality. This technology holds profound implications for sustainable living and could fundamentally transform how technology integrates into our daily lives.

Source: https://www.psu.edu/news/earth-and-mineral-sciences/story/improved-thin-film-harnesses-indoor-light-power-devices

Collected: September 18, 2026 | Automated Research System (Gemini API)

#14 Swift Solar CEO Highlights 45% Efficiency Potential of Perovskite-on-Silicon Tandem Cells, Pinpointing Durability as Commercialization Hurdle

Published September 16, 2026 Perovskite-Info USA

OVERVIEW

Swift Solar CEO Joel Jean announced that perovskite-on-silicon tandem cells could push solar cell efficiency limits to approximately 45%, presenting the first significant opportunity for Western solar manufacturing in two decades. The primary challenge remains proving 30-year stability, an area Swift Solar is heavily focused on. The company anticipates achieving gigawatt-scale competitiveness within 3-5 years.

IN DEPTH

Key Findings

Joel Jean, CEO and co-founder of Swift Solar, revealed on the Core Memory Podcast that perovskite-on-silicon tandem cells hold the potential to elevate the theoretical efficiency limit of solar photovoltaics to around 45%. This breakthrough technology represents a pivotal opportunity for revitalizing Western solar manufacturing, especially as traditional silicon-based cells approach their performance ceiling.

Technical / Clinical Details

Perovskite-on-silicon tandem cells involve stacking a perovskite layer on top of a conventional silicon solar cell, enabling a broader absorption of the solar spectrum and significantly boosting overall energy conversion efficiency. However, Jean emphasized that the paramount hurdle for commercial success is demonstrating 30 years of operational stability. Swift Solar is channeling significant R&D efforts into enhancing device durability, particularly against environmental stressors like moisture and heat, which are critical for long-term deployment.

Background & Context

The silicon solar cell industry, while mature, is confronting inherent physical limits to efficiency improvements. Perovskite solar cells, with their promise of high efficiency, low manufacturing costs, and flexibility, are emerging as a leading candidate for next-generation photovoltaics. The tandem configuration, specifically integrating perovskites with established silicon technology, offers a pragmatic pathway to substantial efficiency gains by leveraging existing manufacturing infrastructure while introducing advanced material science.

Strategic Significance & Outlook

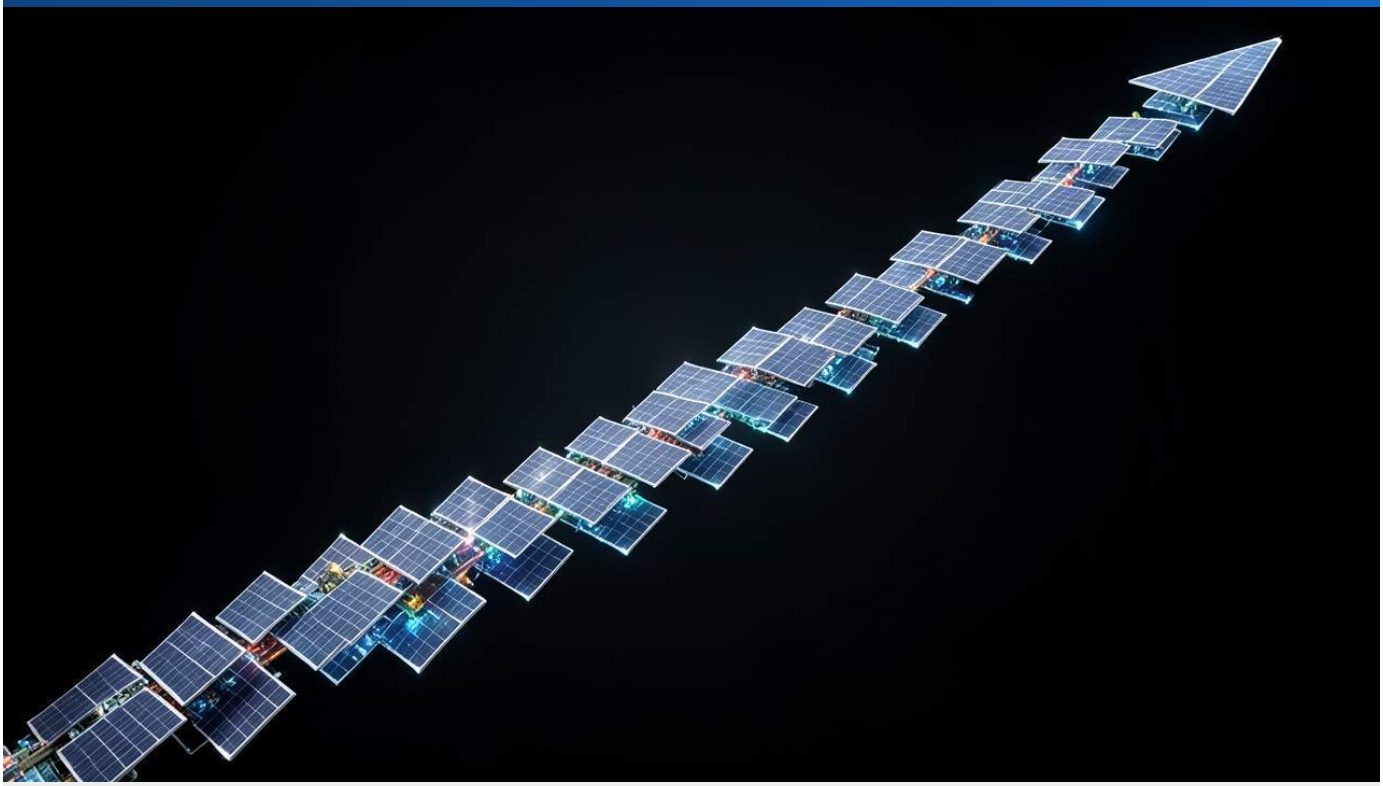
Swift Solar is committed to overcoming the stability challenges, aiming to achieve competitive gigawatt-scale production capabilities within the next three to five years. If successfully commercialized, this technology could dramatically expand the economic viability and deployment scope of solar power, potentially leading to a resurgence in solar manufacturing in Western countries. The validation of long-term stability is a formidable challenge, but its achievement promises to revolutionize the renewable energy landscape globally.

Source: https://finance.biggo.com/news/fadec3e34014713c

Collected: September 18, 2026 | Automated Research System (Gemini API)

#15 TCL Technology Invests $30 Million in Flexible Perovskite Manufacturer TJ Solar, Securing 20% Stake to Fund 100MW Production Line

Published September 16, 2026 Dealroom News China



OVERVIEW

TCL Technology invested 200 million RMB (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a Chinese manufacturer of flexible perovskite photovoltaic modules, acquiring about 20% equity. This capital will primarily support the construction and operation of a 100MW perovskite production line, R&D, and market expansion. TJ Solar specializes in lightweight, flexible perovskite PV modules with proprietary technologies for low-light power generation and flexible thin-film encapsulation.

IN DEPTH

Key Findings

Chinese conglomerate TCL Technology has made a significant strategic investment of 200 million RMB (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a flexible perovskite photovoltaic module manufacturer, acquiring an approximate 20% stake in the company. This substantial capital injection is poised to accelerate the industrialization and market penetration of perovskite solar cell technology.

Technical / Clinical Details

The newly secured funding will primarily be channeled towards the construction and operation of a 100MW perovskite production line. This manufacturing facility will enable TJ Solar to mass-produce its lightweight and flexible perovskite PV modules, contributing to reduced manufacturing costs and expanded supply capacity. TJ Solar's core technological strengths lie in its high power generation efficiency under low-light conditions and its advanced flexible thin-film encapsulation techniques, which are expected to enable product deployment in diverse installation environments.

Background & Context

Perovskite solar cells are garnering significant attention as a next-generation photovoltaic technology due to numerous advantages over conventional silicon solar cells, including simplified manufacturing processes, lower material costs, and inherent flexibility. Flexible modules, in particular, are highly anticipated for applications such as Building-Integrated Photovoltaics (BIPV), mobile devices, and wearable electronics—areas where traditional solar cells have faced limitations. Investments from major corporations like TCL Technology are crucial for bridging the gap between research and mass production, thereby fostering market growth.

Strategic Significance & Outlook

With the backing of TCL Technology, TJ Solar aims to further bolster its research and development efforts, enhance product performance and reliability, and expand its market presence. The operationalization of the 100MW production line will serve as a critical milestone in perovskite solar cells' transition from laboratory-scale research to a full-fledged industrial product. This move is consistent with China's broader strategy to establish international leadership in renewable energy technologies, especially in the advanced solar sector.

Source: https://dealroom.co/news/151136-tcl-technology-backs-perovskite-maker-tj-solar-in-30-million-deal/

#16 Toshiba, Shin-Etsu Chemical, and Niigata University Develop Perovskite Solar Cells with 1.5x Durability, Targeting 2030s Commercialization

Published September 11, 2026 EIN Presswire Japan

OVERVIEW

A Japanese research team from Toshiba, Shin-Etsu Chemical, and Niigata University has developed perovskite solar cells with 1.5 times greater durability than existing products. These novel cells achieved approximately 3,000 hours of stable operation under harsh heat and humidity conditions. The team aims for a lifespan exceeding 20 years and commercialization by the 2030s, potentially boosting Japan's competitiveness against dominant Chinese manufacturers in the global solar market.

IN DEPTH

Key Findings

A collaborative research team comprising Japan's Toshiba, Shin-Etsu Chemical, and Niigata University has successfully developed innovative perovskite solar cells demonstrating 1.5 times the durability of current products. This achievement signifies a substantial improvement in long-term stability, which has been one of the most critical challenges for perovskite solar cell commercialization.

Technical / Clinical Details

The developed perovskite solar cells demonstrated stable operation for approximately 3,000 hours, particularly under severe conditions of elevated heat and humidity. This performance is a crucial indicator for anticipating long-term outdoor deployment. The research team aims to leverage this technology to ultimately realize perovskite solar cells with a lifespan exceeding 20 years. The specific mechanisms for enhanced durability likely involve optimized material selection and advanced device architectural designs.

Background & Context

Perovskite solar cells are often lauded as 'dream solar cells' due to their high power conversion efficiency, potential for low-cost manufacturing, and flexibility. However, their practical application has been hampered by vulnerabilities to water and heat. Japanese research institutions and corporations have been intensely focused on overcoming these durability issues, and the current breakthrough represents a culmination of these efforts. Globally, Chinese companies dominate the solar energy market, but Japan seeks to differentiate itself through high-value, next-generation technologies.

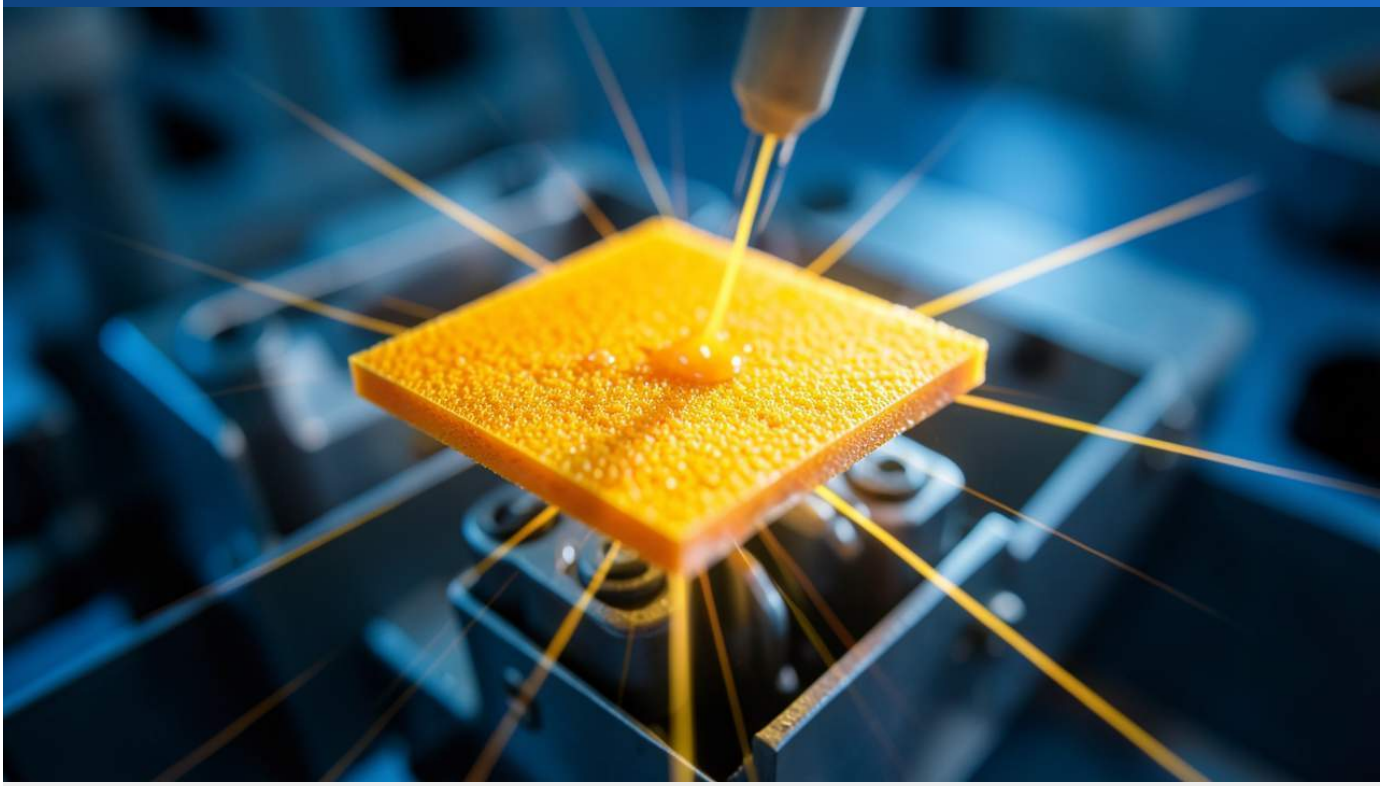
Strategic Significance & Outlook

Toshiba, Shin-Etsu Chemical, and Niigata University are targeting the commercialization of these highly durable perovskite solar cells by the 2030s. Achieving a lifespan of over 20 years would position them to rival or even surpass conventional silicon solar cells in operational longevity, dramatically increasing their market competitiveness. This Japanese technological innovation has the potential to further accelerate the adoption of solar power and enable Japanese industry to reclaim a leading role in the next-generation energy sector.

Source: https://www.einpresswire.com/article/941430183/japanese-economic-and-business-weekly-newsletter-05-september-11-september-2026

#17 IDTechEx Report: Perovskite Solar Cells Shift from Lab to Fab, Highlighting Manufacturing Race with China Leading and Japan Targeting BIPV

Published September 10, 2026 IDTechEx Research Article International



OVERVIEW

An IDTechEx report dated September 10, 2026, emphasizes the rapid transition of perovskite photovoltaics from lab milestones to scalable industrial products. Key industrial engineering challenges include large-area manufacturability, scalability, yield optimization, cost reduction, and securing a robust supply chain. China is spearheading early commercialization efforts, while Japan, with strong government policies and subsidies, is accelerating commercialization with a specific focus on Building-Integrated Photovoltaics (BIPV).

IN DEPTH

Key Findings

An IDTechEx research report, published on September 10, 2026, provides a comprehensive analysis of the rapid evolution of perovskite photovoltaic technology from laboratory-based milestones to scalable industrial products. This transition underscores the intensifying competition within the next-generation solar cell market.

Technical / Clinical Details

The report highlights several critical industrial engineering challenges for the commercialization of perovskite solar cells. These include ensuring large-area manufacturability, scaling up production volumes, optimizing manufacturing yields, achieving significant cost reductions, and establishing resilient supply chains. Addressing these aspects is crucial for translating high-efficiency laboratory results into viable market products.

Background & Context

Perovskite solar cells are widely considered a promising next-generation technology with the potential to surpass existing silicon-based photovoltaics, owing to their high theoretical efficiencies and potential for low-cost manufacturing. However, fully realizing this potential requires successfully replicating lab-scale achievements in a factory setting and establishing mass production capabilities. Regionally, China is aggressively leading early commercialization efforts, leveraging strong government support and an established manufacturing infrastructure. In contrast, Japan is accelerating commercialization by focusing on specific niche markets like Building-Integrated Photovoltaics (BIPV), supported by robust government policies and R&D subsidies.

Strategic Significance & Outlook

The 'Lab to Fab' transition for perovskite solar cells is expected to accelerate further in the coming years. The distinct strategies of various nations, particularly China's broad industrialization and Japan's focused application development, will be pivotal in shaping the global deployment of this technology. Once these manufacturing challenges are overcome and mass production technologies are firmly established, perovskite solar cells are poised to play a significant role in the global energy mix, bringing about transformative changes in the renewable energy market.

Source: https://www.idtechex.com/en/research-article/from-lab-to-fab-the-manufacturing-and-scalability-race-in-perovskite/35258

Collected: September 18, 2026 | Automated Research System (Gemini API)

#18 Shandong Energy Group Unveils Perovskite Solar Sunroof Capable of Adding 30km Daily EV Range

Published September 12, 2026 Perovskite-Info China

OVERVIEW

China's state-owned Shandong Energy Group showcased its self-developed perovskite solar cell technology, introducing a translucent sunroof designed for vehicles. This technology is projected to add approximately 30km of daily EV range when integrated into a standard SUV sunroof. The perovskite technology also demonstrates potential for Building-Integrated Photovoltaics (BIPV), suggesting diverse applications beyond automotive.

IN DEPTH

Key Findings

At the 'Qilu Manufacturing Salon' event, China's state-owned energy giant, Shandong Energy Group, unveiled its innovative perovskite solar cell technology. A highlight was a translucent perovskite photovoltaic glass panel designed as a panoramic sunroof replacement for vehicles, claiming to add approximately 30km of daily driving range to a typical SUV under normal daylight conditions. This represents a significant new solution for extending EV range.

Technical / Clinical Details

The translucent perovskite photovoltaic glass panel is engineered to fit the dimensions of a standard SUV sunroof (roughly 1.2 to 1.7 square meters), generating electricity efficiently under ambient daylight. This power is fed into the vehicle's battery, providing the additional range. The high power conversion efficiency and tunable transparency of perovskite solar cells are key to the practicality of this sunroof application. Furthermore, the technology is also applicable as Building-Integrated Photovoltaics (BIPV), suitable for incorporating power generation capabilities into architectural elements like windows and facades without compromising aesthetic design.

Background & Context

As electric vehicles become more prevalent, range anxiety remains a significant concern for consumers. Vehicle-integrated photovoltaics are an active area of research, offering a promising method to reduce battery strain and extend driving range. Perovskite solar cells, being thinner, lighter, and more flexible than conventional silicon cells, are particularly advantageous for seamless integration into the curved surfaces of automobiles. The fact that a major entity like Shandong Energy Group is advancing this technology clearly indicates its transition from laboratory research to practical applications.

Strategic Significance & Outlook

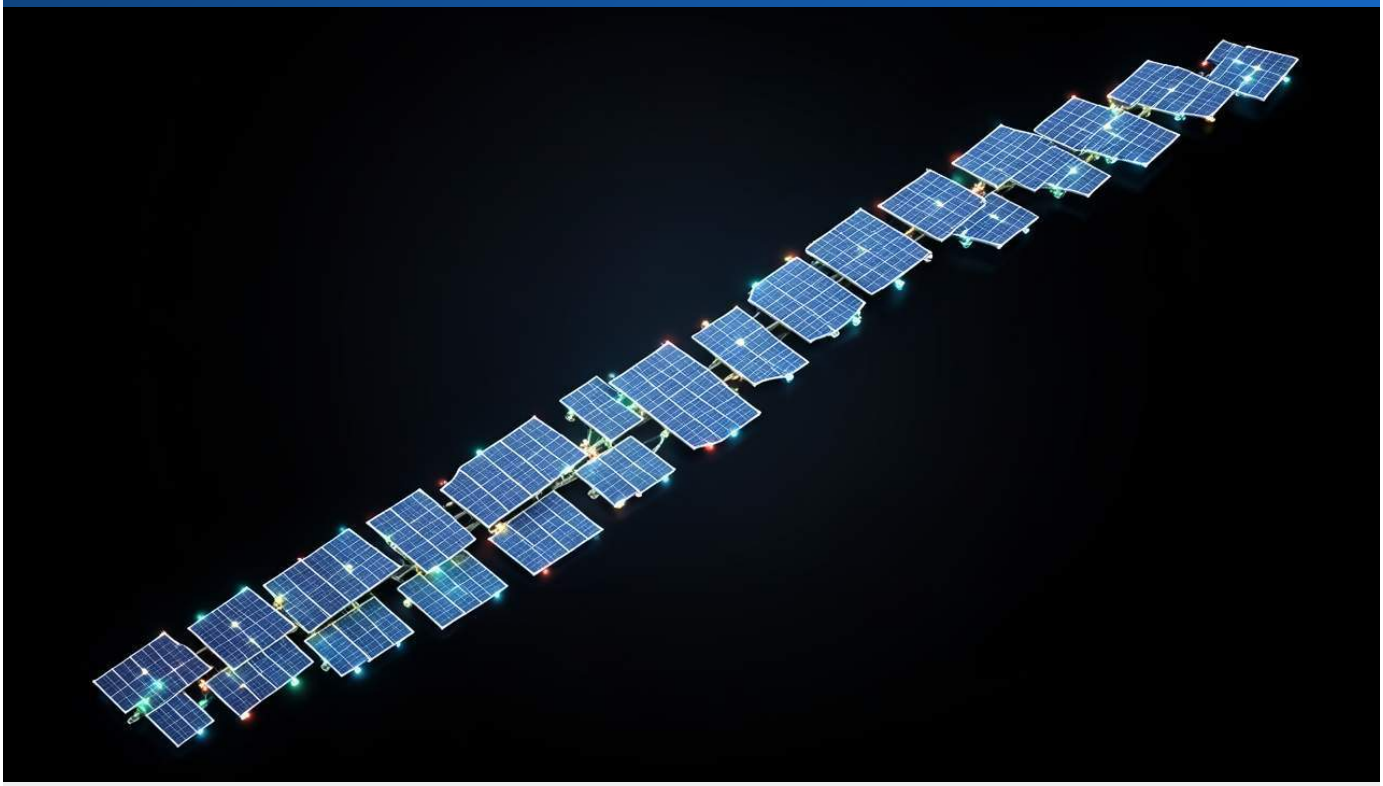
Shandong Energy Group's technology announcement has the potential to not only mitigate EV range issues but also to profoundly influence the design of future mobility and urban infrastructure. If adopted by mass-produced vehicles through collaborations with automotive manufacturers, this perovskite sunroof could create new value in the EV market. Moreover, its diverse BIPV applications are expected to contribute to the realization of zero-energy buildings in the construction sector, marking it as a crucial technology for accelerating renewable energy adoption.

Source: https://www.perovskite-info.com/shandong-energy-group-shows-perovskite-solar-sunroof-said-add-30km-daily-ev

Collected: September 18, 2026 | Automated Research System (Gemini API)

#19 TCL Technology Invests ¥200 Million ($29.8M) in Flexible Perovskite Manufacturer TJ Solar, Acquiring 20% Stake

Published September 16, 2026 Perovskite-Info China



OVERVIEW

Chinese technology giant TCL Technology has invested ¥200 million (approximately $29.8 million) in Xi'an Tianjiao New Energy (TJ Solar), a flexible perovskite PV module manufacturer, acquiring about a 20% stake. This strategic investment will primarily fund TJ Solar's establishment and operation of a 100MW perovskite production line, bolster R&D, and support market expansion. TJ Solar targets diverse consumer applications, including low-power devices, vehicle auxiliary power, e-paper, and smart home solutions, accelerating their mass production capabilities and product portfolio enhancement.

IN DEPTH

Key Findings

TCL Technology, a multinational technology conglomerate based in China, has invested ¥200 million (approximately $29.8 million USD) in Xi'an Tianjiao New Energy (TJ Solar), a manufacturer of flexible perovskite PV modules, acquiring approximately a 20% equity stake. This significant investment represents a strategic move aimed at advancing the commercialization and market expansion of perovskite solar cells, thereby accelerating the development of next-generation photovoltaic technology in China.

Technical / Clinical Details

The capital injection from TCL Technology will primarily be allocated to the construction and operation of TJ Solar's planned 100-megawatt (MW) perovskite production line. This facility is designed to mass-produce flexible and lightweight perovskite PV modules, enabling their deployment in diverse applications previously challenging for conventional solar cells. Additionally, the investment will support TJ Solar's research and development activities and its market expansion strategies. TJ Solar targets a wide array of consumer applications, including low-power devices, auxiliary power for electric vehicles, electronic paper, and smart home devices. These products stand to revolutionize existing power solutions by leveraging the flexibility, thinness, lightness, and superior low-light performance of perovskite solar cells. With this investment, TJ Solar will enhance its production capacity and accelerate R&D, significantly boosting its competitive edge in these niche markets.

Background & Context

Perovskite solar cells have garnered global attention as a next-generation photovoltaic technology due to their high conversion efficiency and potential for low-cost manufacturing. China, in particular, has been aggressively investing in perovskite technology to establish leadership in renewable energy. The investment by a major player like TCL Technology in TJ Solar indicates that flexible perovskite solar cells are transitioning from the R&D stage to full-scale commercialization. Applications in consumer electronics are crucial for establishing an initial market for perovskite technology, with future prospects extending to Building-Integrated PV (BIPV) and large-scale power plants. This investment is not merely financial; it potentially allows TJ Solar to leverage TCL Technology's manufacturing expertise, supply chain, and global distribution networks, which will be critical factors in accelerating the market penetration of perovskite technology.

Strategic Significance & Outlook

TCL Technology's investment in TJ Solar is expected to introduce new dynamics into the flexible perovskite solar cell market. The operationalization of a 100MW production line will be a significant milestone for the mass production of perovskite solar cells, contributing to cost reduction and supply stability. TJ Solar is anticipated to utilize this investment to expand its product offerings in target consumer application sectors and increase its market share. In the long term, as perovskite solar cells are integrated into various electronic devices and smart gadgets, new opportunities for energy harvesting will be created, contributing to the realization of a sustainable society. This move further solidifies China's position in technological innovation and market dominance within the perovskite solar cell sector.

Source: https://www.perovskite-info.com/tcl-technology-invests-perovskite-manufacturer-tj-solar

Collected: September 18, 2026 | Automated Research System (Gemini API)

#20 Soochow University and LONGi Unveil 34.0% Perovskite-Silicon Tandem Solar Cell Based on Dual-Anchored Interfacial Design

Published September 10, 2026 pv magazine Global China

OVERVIEW

Researchers from Soochow University and solar power leader LONGi have achieved an impressive 34.0% conversion efficiency in perovskite-silicon tandem solar cells through an innovative dual-anchored interfacial design. This novel strategy effectively suppresses non-radiative recombination at the interface while maintaining efficient charge extraction, simultaneously delivering high efficiency, high voltage, and long-term operational stability. The breakthrough underscores the critical role of interfacial engineering in the commercialization of perovskite tandem solar cells, accelerating the practical application of next-generation high-efficiency photovoltaics.

IN DEPTH

Key Findings

A research team from Soochow University in China and global photovoltaic leader LONGi has developed a groundbreaking dual-anchored interfacial design strategy, achieving an astounding 34.0% conversion efficiency in perovskite-silicon tandem solar cells. This novel approach demonstrates an effective method to simultaneously realize high efficiency, high voltage output, and long-term operational stability, marking a significant advancement in next-generation solar cell technology.

Technical / Clinical Details

The core of this breakthrough lies in the dual-anchored interfacial design, which effectively suppresses non-radiative recombination at the interface while maintaining efficient extraction of photo-generated charge carriers. In conventional perovskite-silicon tandem solar cells, charge loss at the interface between different material layers has been a critical challenge, leading to reduced efficiency and stability. The research team introduced a 'dual-anchor' layer with a specific molecular structure, creating a strong bond between the perovskite crystal and the electron transport layer. This meticulously engineered interface passivates defects and significantly reduces charge recombination. As a result, the developed tandem solar cell achieved a high open-circuit voltage (Voc) and a remarkable 34.0% conversion efficiency, alongside excellent long-term operational stability. This method not only enhances efficiency but also critically addresses the durability issue, one of the biggest challenges for the commercialization of perovskite solar cells.

Background & Context

Perovskite-silicon tandem solar cells are at the forefront of a global research and development race, poised to surpass the physical efficiency limits of single-junction silicon solar cells. This technology combines a high-bandgap perovskite layer with a low-bandgap silicon layer, allowing for broader utilization of the solar spectrum and converting more light energy into electricity. China is heavily investing in perovskite technology, with government and industry working in tandem to establish leadership in the renewable energy sector. LONGi, a company already holding a 35.5% world record in the field, is a frontrunner, and its collaboration with Soochow University represents a powerful model fusing academic insight with industrial application. This latest achievement, by balancing high efficiency and reliability, further solidifies the commercial viability of perovskite tandem solar cells.

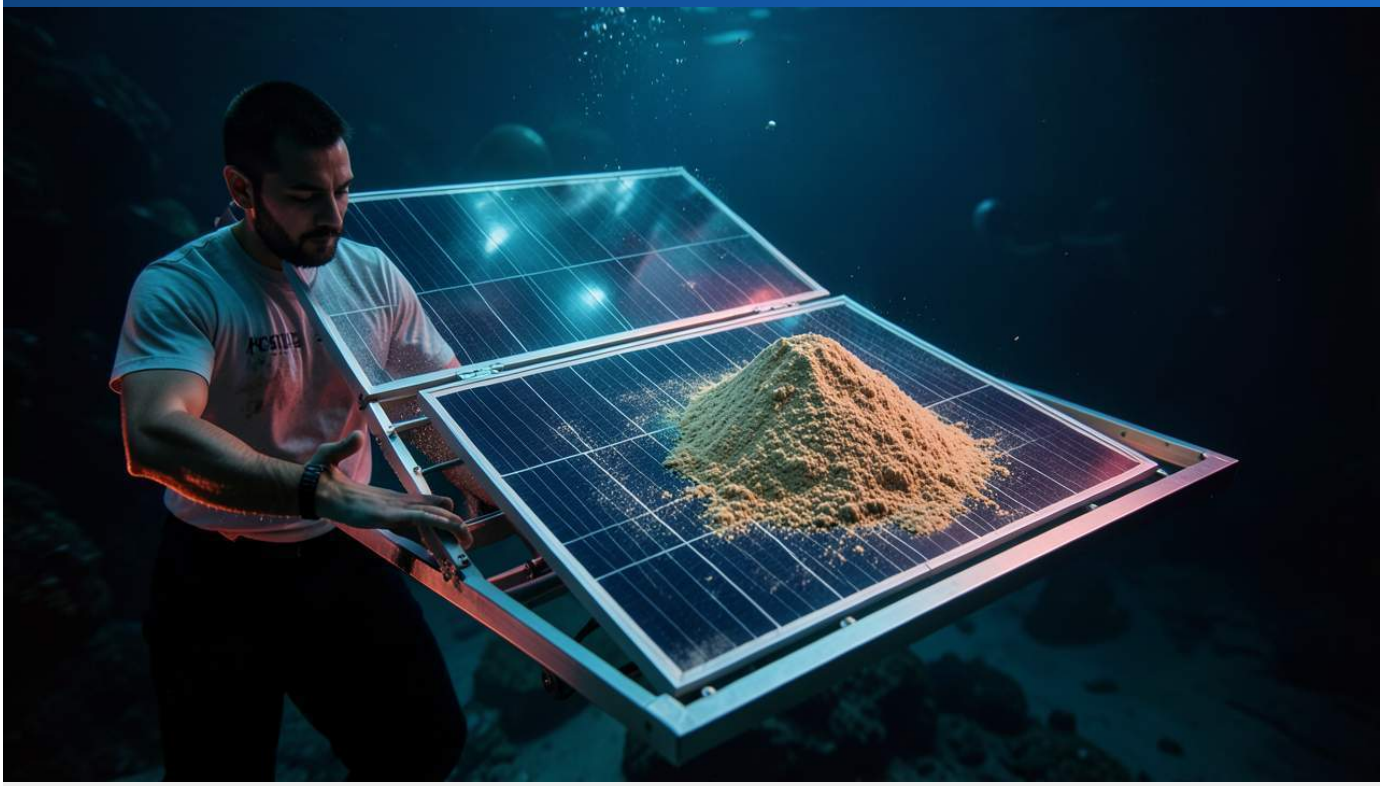
Strategic Significance & Outlook

The success of the dual-anchored interfacial design by Soochow University and LONGi will be a significant driving force for the practical application of perovskite-silicon tandem solar cells. This interfacial engineering strategy has the potential to become a foundational technology for mass production, large-area fabrication, and ensuring long-term reliability of high-efficiency devices. Future developments are expected to accelerate product development and optimize manufacturing processes based on this technology. For LONGi, which plans to commence commercial module shipments, this achievement further strengthens its product competitiveness. Ultimately, widespread adoption of perovskite tandem solar cells, which combine high efficiency and long-term stability, could significantly reduce the cost of solar electricity, contribute to the expansion of renewable energy, and accelerate the global energy transition, opening new pathways for a sustainable future.

Source: https://www.pv-magazine.com/2026/09/10/longi-soochow-university-unveil-34-0-perovskite-silicon-tandem-solar-cell-based-on-dual-anchored-interfacial-design/

#22 Chinese Scientists Demonstrate Underwater Perovskite Solar Cells Operating at 10m Depth, Unlocking Subaquatic Photovoltaic Potential

Published September 17, 2026 TechRadar UK



OVERVIEW

Researchers at China's Yunnan University have successfully demonstrated perovskite solar cells (PSCs) functioning efficiently at a depth of 10 meters, proving new possibilities for underwater solar power generation. These specialized panels can harvest 324 mWh of energy at 10 meters deep, with an expected device lifetime of 5.5 years. This groundbreaking achievement extends renewable energy applications to marine environments and paves the way for powering autonomous underwater devices like drones.

IN DEPTH

Key Findings

A research team at Yunnan University in China has successfully developed a groundbreaking technology enabling perovskite solar cells (PSCs) to operate efficiently in an underwater environment at a depth of 10 meters. This achievement pioneers the use of underwater solar power as a new application area for photovoltaics, demonstrating the ability to harvest 324 milliwatt-hours (mWh) of energy at that depth. Furthermore, laboratory tests reported conversion efficiencies nearing 35%, with each device expected to have a relatively long lifespan of 5.5 years.

Technical / Clinical Details

The research team combined specialized encapsulation techniques and material design to ensure the perovskite solar cells maintain their performance under harsh underwater conditions. While conventional solar cells are typically vulnerable to water, Yunnan University's technology prevents water-induced degradation while efficiently converting attenuated sunlight underwater into electricity. As depth increases, the light spectrum shifts, with blue-green light preferentially penetrating. Optimizing the perovskite material to match these specific light characteristics was crucial. The near 35% conversion efficiency strongly suggests the high theoretical potential of perovskite materials for underwater applications. The 5.5-year lifespan is a practical duration for long-term operations required by applications such as underwater observation equipment and autonomous underwater drones.

Background & Context

The world's oceans represent a vast, untapped energy resource, and power supply in underwater environments has long been a challenge for marine science research, environmental monitoring, subsea resource exploration, and autonomous underwater vehicle operations. Traditional underwater power sources have relied on batteries or external supply via cables, both limited by operational duration and high costs. The underwater application of perovskite solar cells offers an innovative solution to these challenges. This breakthrough will significantly enhance the autonomy of equipment in marine environments, enabling more sustainable and extensive oceanographic activities.

Strategic Significance & Outlook

This research by Yunnan University in China marks a crucial step towards the commercialization and practical implementation of underwater solar power technology. Future efforts are expected to accelerate research and development focused on performance evaluation at greater depths, long-term stability validation, and cost reduction and durability improvements for mass production. If realized, underwater solar power could provide clean and sustainable energy to various marine applications, including ocean buoys, subsea sensor networks, and autonomous underwater vehicles (AUVs), potentially revolutionizing the entire marine industry. This technology holds the potential to expand the frontier of renewable energy into the oceans, fundamentally transforming how humanity utilizes marine resources.

Source: https://www.techradar.com/home/energy-saving/scientists-test-underwater-solar-panels-that-work-10-meters-beneath-the-waves-breakthrough-perovskite-tech-could-support-self-powered-marine-drones

Collected: September 18, 2026 | Automated Research System (Gemini API)

#23 All-Perovskite Triple-Junction Solar Cell Achieves Record 30.1% Efficiency, Patented by RenShine Solar for Manufacturing

Published September 16, 2026 Perovskite-Info China

OVERVIEW

An international research collaboration, including Nanjing University and RenShine Solar, has achieved a groundbreaking 30.1% power conversion efficiency (29.3% certified) in an all-perovskite triple-junction solar cell, marking a new world record. This advancement stems from a novel surface reconstruction and halogen homogenization strategy, combining solvent engineering with chloride additives to suppress defects and enhance charge carrier mobility. The underlying technology is already patented with RenShine Solar, signaling a clear path towards commercial manufacturing and significantly pushing the practical viability of next-generation perovskite photovoltaics.

IN DEPTH

Key Findings: Record 30.1% Efficient All-Perovskite Triple-Junction Solar Cell

A collaborative research effort involving Nanjing University, the National University of Defense Technology, Australian National University, ULVAC-PHI Instruments, and RenShine Solar has set a new benchmark for all-perovskite triple-junction solar cells, reaching a remarkable 30.1% power conversion efficiency (PCE), with a certified value of 29.3%. This breakthrough not only establishes a new world record for this specific architecture but also demonstrates robust operational stability, addressing a critical hurdle for perovskite technology's commercial viability. This achievement surpasses previous efficiency records for all-perovskite multi-junction devices and positions the technology closer to widespread adoption.

Technical Details: Advanced Crystallization Control and Interface Engineering

The record efficiency was achieved through a sophisticated crystallization control strategy that leverages a combination of solvent engineering and chloride additives for surface reconstruction and halogen homogenization. This innovative approach effectively mitigates defects within the perovskite layers and significantly boosts charge carrier mobility. Defect passivation is crucial for minimizing energy losses and enhancing charge extraction, while improved carrier mobility facilitates faster and more efficient current generation. The triple-junction design allows for a broader spectrum of sunlight absorption, with each sub-cell optimized to convert different energy bands of light, thereby maximizing overall efficiency beyond the theoretical limits of single-junction cells.

Background and Industry Context: Accelerating Commercialization with Patented Technology

Perovskite solar cells are widely recognized as a leading contender for next-generation photovoltaics due to their high efficiency potential, low manufacturing cost, and versatility (lightweight, flexible, semi-transparent). However, achieving both high efficiency and long-term stability has been a persistent challenge. This research directly tackles these issues, demonstrating a stable device with world-record efficiency. The fact that the foundational technology is already covered by a joint patent with RenShine Solar is particularly significant. It indicates a strategic intent to translate laboratory success into industrial production, suggesting that the team has addressed key scalability and manufacturing considerations. This intellectual property protection provides RenShine Solar with a competitive edge in the rapidly evolving solar market.

Strategic Significance and Outlook: Impact on Renewable Energy Landscape

This development carries profound implications for the renewable energy sector. A 30.1% efficient all-perovskite triple-junction solar cell could significantly reduce the physical footprint required for solar energy generation, making it more feasible for diverse applications, including building-integrated photovoltaics (BIPV), portable electronics, and even space applications where lightweight and high-efficiency are paramount. The collaboration's success, particularly with the involvement of an industrial partner like RenShine Solar, suggests a potential acceleration in the manufacturing and deployment of these advanced solar cells. As the technology moves from research to mass production, it could drive down the levelized cost of electricity (LCOE), making solar power even more competitive and contributing substantially to global decarbonization efforts. Future efforts will likely focus on scaling up manufacturing processes while maintaining efficiency and stability over larger areas.

Source: https://www.perovskite-info.com/crystallization-control-pushes-all-perovskite-triple-junction-solar-cell-301

#24 Sekisui Chemical Stock Potentially 20% Undervalued Amid Ausbuild Deal Review, Analysts Suggest

Published September 11, 2026 Simply Wall St Australia

OVERVIEW

Analysts suggest Sekisui Chemical (TSE:4204) stock may be up to 20% undervalued following a review of its Ausbuild deal. The company is making steady progress in expanding high-performance plastics production and mass-producing perovskite solar cells, positioning itself as a key supplier for next-generation mobility, electronics, and solar applications. This trajectory could significantly boost Sekisui Chemical's revenue growth and net profit margins, indicating the market is not fully appreciating its future potential.

IN DEPTH

Key Findings: Sekisui Chemical Stock Potentially Undervalued by up to 20%

According to a recent analyst report from Simply Wall St, Sekisui Chemical Co., Ltd. (TSE:4204), a major Japanese chemical manufacturer, may be undervalued by as much as 20% in the current market. This assessment primarily stems from the market's apparent underestimation of the company's strategic progress, including its revised agreement with Ausbuild, its expansion of high-performance plastics production capacity, and, critically, its steady advancements toward mass production of innovative perovskite solar cells, which are considered key future growth drivers.

Technical and Clinical Details: Contributing to Next-Generation Mobility, Electronics, and Solar Markets

Sekisui Chemical is systematically executing its strategy to become a leading supplier in the burgeoning next-generation mobility, electronics, and solar application markets. In the high-performance plastics sector, the company is actively expanding its production capacity to meet the rising demand from electric vehicles (EVs) and advanced electronic devices. Furthermore, the development and mass production of perovskite solar cells represent one of the company's most promising growth engines. Sekisui Chemical's film-type perovskite solar cells, leveraging their lightweight, flexible, and thin characteristics, are expected to bring new value to the renewable energy market by enabling applications such as Building-Integrated Photovoltaics (BIPV) and installations in locations previously challenging for solar cells.

Background and Industry Context: Gap Between Growth Strategy and Market Valuation

Analysts believe that the strategic position Sekisui Chemical is establishing in these high-growth sectors is not adequately reflected in its current share price. The company's technological innovations and market entry initiatives hold the potential for substantial future revenue growth and increased net profit margins. In an accelerating global transition towards clean energy, companies possessing innovative technologies like perovskite solar cells should be valued for their significant long-term growth potential. This valuation gap may present an attractive opportunity for investors.

Future Outlook: Realizing Potential Value and Investment Opportunities

If Sekisui Chemical's stock price corrects from its current undervalued state to a more appropriate valuation, it could generate significant returns for shareholders. Through continuous investment in research and development and strategic business expansion, the company is solidifying its position as a critical supplier supporting next-generation industries. As the mass production of perovskite solar cells scales up and market penetration increases, it is expected that the company's underlying value will be recognized by the market and reflected in its stock price. Investors may consider this a opportune moment to evaluate investment in this potentially undervalued company, closely monitoring Sekisui Chemical's technological advantages and long-term growth strategy.

Source: https://simplywall.st/stocks/jp/capital-goods/tse-4204/sekisui-chemical-shares/news/sekisui-chemical-tse4204-could-be-20-undervalued-on-ausbuild

Collected: September 18, 2026 | Automated Research System (Gemini API)

#25 Japan's 7th Strategic Energy Plan Targets 23-29% Solar Power by 2040, with 20 GW from Next-Gen Perovskite Solar Cells

Published September 13, 2026 ScienceX Japan

OVERVIEW

Japan's 7th Strategic Energy Plan, formulated in February 2025, sets an ambitious target for solar power to account for 23-29% of the nation's total electricity supply by fiscal year 2040. To achieve this, approximately 20 GW of next-generation perovskite solar cells, applicable to roofs and walls, are slated for introduction by 2040. The government also plans to establish gigawatt-scale production capabilities for perovskite solar cells by 2030, aiming to accelerate renewable energy adoption.

IN DEPTH

Key Findings: Japan Sets Ambitious Solar and Perovskite Targets for 2040

In its 7th Strategic Energy Plan, formulated in February 2025, the Japanese government has set an ambitious goal for solar power to constitute between 23% and 29% of the nation's total electricity supply by fiscal year 2040. As a cornerstone for achieving this target, the plan includes the deployment of approximately 20 GW of next-generation perovskite solar cells by 2040. These innovative cells are specifically designed for applications on roofs and building facades, where conventional solar panels have been challenging to install. This commitment underscores Japan's strong resolve to accelerate the transition to renewable energy sources.

Technical and Clinical Details: Versatile Applications and Gigawatt-Scale Production for Perovskites

Perovskite solar cells, owing to their lightweight, flexibility, and high conversion efficiency, can be installed in a wide range of locations where traditional silicon solar cells were impractical. Film-type perovskite solar cells, in particular, are extremely thin, about 1 millimeter thick, allowing them to be easily "pasted" onto curved surfaces and locations with load limitations. In addition to the 20 GW deployment target by 2040, the plan also includes establishing gigawatt-scale production capabilities for perovskite solar cells by 2030. This strategy aims to reduce manufacturing costs and expand supply capacity, thereby strongly promoting the widespread adoption of perovskite solar cells. This large-scale introduction is expected to significantly contribute to Japan's energy self-sufficiency and the realization of a decarbonized society.

Background and Industry Context: Energy Security and Carbon Neutrality Goals

Japan heavily relies on imports for most of its energy resources, making the enhancement of energy security a critical national strategic imperative. Furthermore, to combat global warming, the maximum deployment of renewable energy is essential for achieving the 2050 carbon neutrality goal. Perovskite solar cells, with their high degree of installation freedom, possess significant potential for deployment in urban areas and existing infrastructure, making them a crucial tool for expanding renewable energy in Japan's limited land area. The government's clear deployment targets and production system establishment plans are expected to stimulate investment in related industries, accelerating both technological development and market formation.

Future Outlook: Transforming the Renewable Energy Market and Enhancing Global Competitiveness

The target of deploying 20 GW of perovskite solar cells by 2040 will have a significant impact on Japan's renewable energy market. If this large-scale deployment is realized, it will not only contribute to reducing electricity costs for households and businesses but also lead to the creation of new industries and expanded employment opportunities. Furthermore, Japan's establishment of mass production technology for perovskite solar cells and its attainment of a leading position in the global market are crucial for enhancing its international competitiveness. While challenges such as long-term stability, lead-free solutions, and recycling, as well as further improvements in cost competitiveness, need to be addressed, this ambitious plan is expected to be a powerful driving force in accelerating the evolution and widespread adoption of solar photovoltaic technology.

Source: https://www.scix.co.jp/en/column-somosomo-11

Collected: September 18, 2026 | Automated Research System (Gemini API)

#26 'Raincoat' Technology Dramatically Boosts Durability of Lead-Free Solar Cells, Achieving Both Efficiency and Stability

Published September 10, 2026 Compound Semiconductor UK

OVERVIEW

Researchers have developed a protective "raincoat" layer, demonstrating its effectiveness in shielding lead-free perovskite solar cells, particularly tin-based devices, from degradation due to oxygen and moisture. This technology significantly enhances the durability, a critical challenge for tin-based perovskites, preventing rapid performance decay. This breakthrough marks a crucial step towards the commercial deployment of environmentally friendly, high-efficiency solar cells, by addressing stability and contributing to manufacturing scale-up.

IN DEPTH

Key Findings: 'Raincoat' Technology Significantly Boosts Durability of Lead-Free Solar Cells

Researchers have developed an innovative protective layer, dubbed a "raincoat," effectively demonstrating its ability to shield lead-free perovskite solar cells, especially tin-based devices, from environmental degradation caused by oxygen and moisture. This technological breakthrough marks a substantial improvement in the durability, which has been the primary challenge for lead-free perovskite solar cells, thereby preventing rapid performance decay. This opens a significant pathway for the commercial deployment of next-generation solar cells that balance environmental considerations with high efficiency.

Technical and Clinical Details: Overcoming the Vulnerability of Tin-Based Perovskites

Lead-free perovskite solar cells are garnering attention as environmentally friendly alternatives to conventional lead-containing devices, mitigating toxicity concerns. However, tin-based perovskites have historically faced a severe drawback: extreme vulnerability to oxygen and moisture, leading to rapid performance degradation. The newly developed "raincoat" layer physically protects these sensitive perovskite layers from external environmental factors and enhances their chemical stability, dramatically improving the device's lifespan and performance retention. The integration of this protective layer significantly boosts both the efficiency and stability of lead-free perovskite solar cells, substantially lowering the barrier to their practical implementation.

Background and Industry Context: Increasing Demand for Sustainable Solar Cells

As global efforts accelerate towards combating climate change and achieving a sustainable society, there is a growing demand for solar cell technologies with enhanced efficiency and reduced environmental impact. Lead-free solar cells have been actively developed to meet these environmental requirements, but their previous durability issues hindered commercialization. The "raincoat" technology addresses this critical challenge, significantly elevating the potential for lead-free perovskite solar cells to become major players in the clean energy market. This represents a pioneering advancement that will foster the greening of the entire solar photovoltaic industry.

Future Outlook: Scaling Up and Cost Reduction for Commercialization

The enhanced durability of lead-free perovskite solar cells achieved through the "raincoat" technology is of immense importance for future research and commercial deployment. Building upon this achievement, researchers will continue efforts to further improve efficiency and stability, while focusing on technological innovations to scale up manufacturing processes and reduce costs. Key areas of focus will include the uniform formation of protective layers over large areas and the development of low-cost manufacturing methods suitable for mass production. If this technology is established on a commercial scale, it is expected to accelerate the widespread adoption of lead-free solar cells across various applications, such as building-integrated photovoltaics (BIPV) and flexible electronics, thereby making a substantial contribution to a more environmentally friendly and sustainable energy society.

Source:
https://compoundsemiconductor.net/article/125343/%E2%80%98Raincoat%E2%80%99_protects_lead-free_solar_cells_from_the_elements