PerovskiteSolarCells

Weekly Intelligence Report

2026-08-09 | 35 articles | 14 countries

troy-technical.jp

This Week's Keyword

Perovskite Tandem PV

Efficiency records & commercialization hurdles

35 articles	14 countries	34.85 %	2.78 m²
Total Articles Analyzed	Source Countries	Highest Lab Efficiency	Largest Module Area

All 35 Articles This Week — 5-Axis Evaluation Matrix

How to read columns — Tech Novelty: degree of breakthrough Market Proximity: closeness to commercialization Market Impact: industry-wide effect Data Reliability: quantitative data & peer review US/EU Relevance: direct impact on US/European companies & supply chains

#	Article Title	Type	Tech Novelty	Market Proximity	Market Impact	Data Reliability	US/EU Relevance	Summary
#01	Korean Flexible 33.6%	Research	●●●●○	●●○○○	●●●●○	●●●●○	●●●●○	Korean team achieves 33.6% efficiency in flexible perovskite/silicon tandem with high durability (91% after 5k bends, 1k hrs damp-heat).
#02	LONGi 34.85% Record	Research	●●●●○	●●○○○	●●●●●	●●●●○	●●●●○	LONGi sets world record 34.85% efficiency for perovskite-silicon tandem, but long-term stability remains key challenge.
#03	Trina Solar 29.2% Module	New Product	●●●●○	●●●○○	●●●●○	●●●●○	●●●●○	Trina Solar achieves world record 29.2% efficiency, 907W for perovskite-silicon tandem module, TÜV SÜD certified.
#04	Space-grade 27.49% AM0	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●○○	Chinese researchers achieve 27.49% AM0 efficiency for space-grade perovskite/silicon tandem, withstanding radiation and thermal shock.
#05	Tandem >34% Lab, Challenges	Analysis	●●●○○	●○○○○	●●●○○	●●●○○	●●●○○	Perovskite tandem cells exceed 34% lab efficiency, but long-term stability and GW-scale manufacturing are key commercial hurdles.
#06	Perovskite/CIGS 30.57%	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●○○	Monolithic perovskite/CIGS tandem achieves 30.57% efficiency with enhanced stability via interface redesign.
#07	China Perovskite-Organic	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●●○	Chinese scientists achieve world record 28.04% steady-state efficiency for flexible perovskite-organic tandem, with high stability.
#08	PolyU Reverse-Bias Stable	Research	●●●●○	●●○○○	●●●●○	●●●●○	●●●●○	Hong Kong PolyU develops perovskite-organic tandem with enhanced reverse-bias stability, retaining >90% efficiency under -40V stress.
#09	US DOE $3M Startup Prize	Corporate Strategy	●○○○○	●●●●●	●●●●○	●●●○○	●●●●●	US DOE launches $3M Perovskite Startup Prize to accelerate US commercialization of flexible, ink, and tandem technologies.
#10	Dynamic Stress Control	Research	●●●○○	●○○○○	●●○○○	●●●●●	●●●○○	Academic paper reveals dynamic stress/strain causes perovskite degradation, offering strategies to control defects and ion migration.
#11	Sulfur Passivation 21.15%	Research	●●●●○	●●○○○	●●●○○	●●●●●	●●●○○	Dual-site passivation with sulfur molecule achieves 21.15% efficiency and high humidity stability for inverted PSCs.
#12	DLR Solar Thermal Storage	Research	●●●●○	●●○○○	●●●○○	●●●○○	●●●●●	DLR presents all-perovskite porous structures for hybrid solar thermal storage, showing potential for large-scale energy storage.

#	Article Title	Type	Tech Novelty	Market Proximity	Market Impact	Data Reliability	US/EU Relevance	Summary
#13	China CAS Sulfide CIGS	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●●○	Chinese CAS develops 29.71% efficient four-terminal perovskite/CIGS tandem with improved stability via sulfide coordination.
#14	Qcells IEC/UL Certified	New Product	●●●○○	●●●●○	●●●●●	●●●●○	●●●●●	Qcells perovskite-silicon tandem panel receives IEC/UL certification, demonstrating extreme durability for commercial deployment.
#15	Inorganic HTM Review	Research	●●○○○	●○○○○	●●○○○	●●●●●	●●●○○	Review highlights critical role of inorganic hole transport materials in improving efficiency and stability of n-i-p perovskite solar cells.
#16	Bandgap Defects Passivation	Research	●●●●○	●○○○○	●●○○○	●●●●●	●●●○○	Research reveals bandgap-dependent defects in mixed-halide perovskites, with new passivation strategy improving performance.
#17	Power Roll POP-PV Project	Corporate Strategy	●●●○○	●●●○○	●●●○○	●●●○○	●●●●●	UK-Sweden POP-PV project launched to commercialize Power Roll's micro-groove perovskite solar film for flexible applications.
#18	Mixed-ligand 2D Perovskite	Research	●●●●○	●○○○○	●●○○○	●●●●●	●●●○○	Mixed-ligand driven phase-pure 2D perovskite enhances interface passivation, boosting efficiency and stability of PSCs.
#19	WBG Crystallization Review	Research	●●●○○	●●○○○	●●●○○	●●●○○	●●●○○	Review highlights crystallization modulation strategies for WBG perovskites, reporting 31.2% tandem efficiency and improved stability.
#20	Surface Termination Impact	Research	●●●●○	●○○○○	●●○○○	●●●●●	●●●○○	Research reveals perovskite surface termination dictates molecular interactions, impacting interface energy and phase stability for inverted PSCs.
#21	FAI Eutectics Thermal Evap	Research	●●●●●	●●●○○	●●●●●	●●●●●	●●●●○	New thermal evaporation method using FAI eutectics achieves 31.5% (1cm²) and 30.0% (200cm²) efficiency for perovskite-silicon tandem, enabling large-area manufacturing.
#22	NMEE-Pho' 26 Conference	Market Overview	●○○○○	●○○○○	●○○○○	●●○○○	●●○○○	NMEE-Pho' 26 conference to focus on perovskite/silicon tandem PV and flexible solar films, covering materials, charge separation, and device integration.
#23	ARAID Stability Seminar	Research	●●○○○	●○○○○	●○○○○	●●○○○	●●●●●	Spanish researcher presents new approaches to improve perovskite solar cell stability, focusing on degradation mechanisms and real-world monitoring.
#24	China CAS Copper Corrosion	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●●○	Chinese CAS discovers copper electrode edge corrosion in PSCs during operation, successfully protecting it with a thin bismuth layer.
#25	EU JRC Measurement/Std	Corporate Strategy	●○○○○	●●●●○	●●●●○	●●●○○	●●●●●	EU JRC contributes to accurate measurement and standardization for new PV modules, including perovskites, at EU PVSEC 2026.
#26	Hanyang 2D Exciton Model	Research	●●●●●	●○○○○	●●○○○	●●●●○	●●●○○	Hanyang University develops predictive model for 2D perovskite exciton behavior, accelerating design of next-gen solar cells and LEDs.
#27	Cu/MoO3 Interface Corrosion	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●●●	Research warns of unexpected copper corrosion at copper/MoO3 interface in perovskite solar cells, posing reliability concerns.
#29	Oxford PV Shipments 2024	New Product	●●●○○	●●●●●	●●●●●	●●●○○	●●●●●	Oxford PV initiated first shipments of perovskite-silicon tandem panels in 2024, achieving 24.5% efficiency in commercial modules.
#33	Sydney 30.2% on 10cm²	Research	●●●●○	●●○○○	●●●●○	●●●●○	●●●○○	University of Sydney achieves world-record 30.2% efficiency in 10 cm² perovskite-silicon tandem cell, certified by CSIRO.

#	Article Title	Type	Tech Novelty	Market Proximity	Market Impact	Data Reliability	US/EU Relevance	Summary
#38	First Solar/Oxford PV IP	Corporate Strategy	●○○○○	●●●●●	●●●●●	●●●○○	●●●●●	First Solar and Oxford PV sign perovskite patent licensing deal for US markets, accelerating commercialization.
#40	SCAPS-1D Lead-Free Sim	Research	●●●○○	●○○○○	●●○○○	●●●●●	●●●○○	SCAPS-1D simulation analyzes lead-free double perovskite solar cells, highlighting efficiency improvement challenges for future R&D.;
#41	DLXN Report: 34.6% Lab	Analysis	●●●○○	●●●○○	●●●●○	●●●○○	●●●●○	DLXN Solar reports perovskite-silicon tandem reaches 34.6% lab efficiency, 26% commercial, but manufacturing yield, encapsulation, lead regulations remain bottlenecks.
#42	PFAA Boosts PSC Stability	Research	●●●●○	●●○○○	●●●○○	●●●●●	●●●○○	Perfluoroadipic acid boosts PSC efficiency from 20.71% to 22.60% and maintains 80.2% stability for 45 days in atmosphere.
#43	GCL Funding 2.78m² Modules	Corporate Strategy	●●●○○	●●●●○	●●●●●	●●●●○	●●●●○	GCL Photoelectric secures >¥100M funding, accelerating commercialization with 26.8% efficiency in 2.78m² perovskite modules and GW line.
#44	Tandem PV Acquires nexTC	Corporate Strategy	●●○○○	●●●●○	●●●○○	●●●○○	●●●●●	Tandem PV acquires thin-film coating specialist nexTC, fortifying manufacturing for high-durability perovskite-silicon solar cells.

●●●●○ High ●●●○○ Med-High ●●○○○ Med ●○○○○ Low | Yellow highlight = featured article

Three Questions That Demand Your Decision This Week

❶ Is your R&D; keeping pace with Asian efficiency records?

Chinese and Korean firms are consistently setting new efficiency benchmarks (e.g., LONGi 34.85%, GCL 26.8% on 2.78m² modules). Are your internal targets competitive, and do you have a clear roadmap to match or exceed these? What specific material science or manufacturing breakthroughs are needed?

❷ How will certified reliability impact your market strategy?

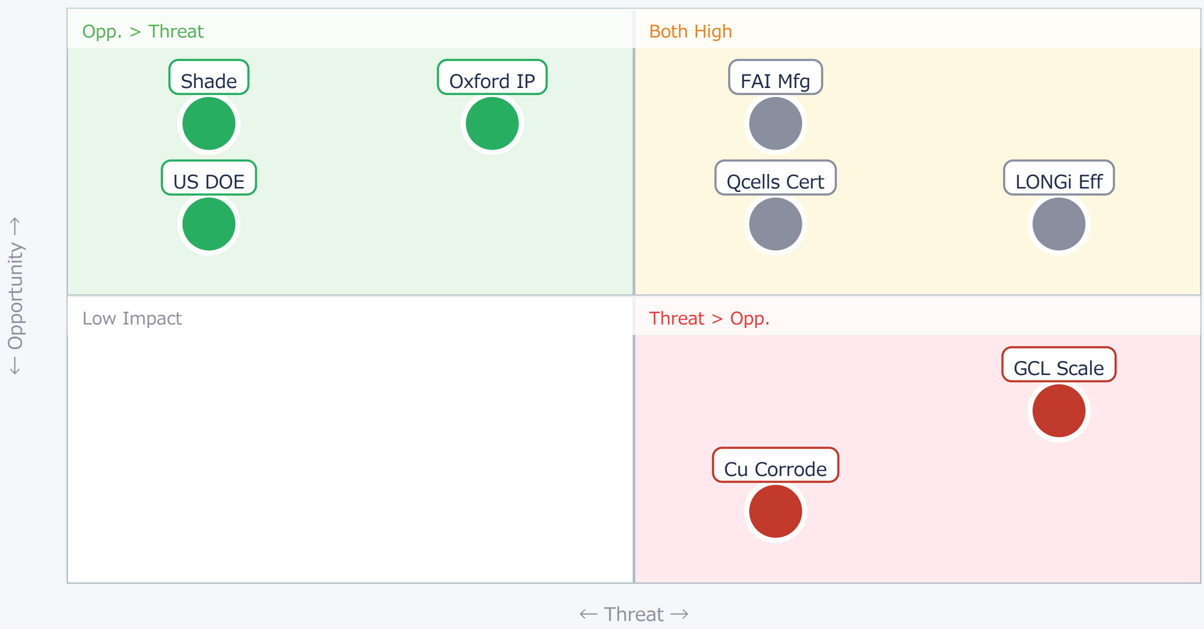
Qcells' IEC/UL certification for perovskite-silicon tandem panels (28.6% efficiency) signals market readiness. This raises the bar for reliability and commercial financing. Are your products on track for similar certifications, and how will this affect your market entry timeline and competitive positioning?

❸ Is your supply chain exposed to emerging manufacturing methods?

Breakthroughs like FAI eutectics for large-area thermal evaporation (#21) could revolutionize manufacturing. Are your procurement and R&D; teams evaluating these new processes, and are you prepared for potential shifts in material and equipment suppliers, especially from Asian innovators?

Opportunities vs. Threats for US/European Companies

Opportunity vs. Threat Matrix for US/European Companies



Item	Quadrant	↑ Opportunity	↓ Threat
● Shade	Opp.	Robust products	Old designs
● Oxford IP	Opp.	US market access	IP landscape
● US DOE	Opp.	US funding	Foreign reliance
● FAI Mfg	Critical	Scale Mfg	Lagging production
● LONGi Eff	Critical	Efficiency bar	Stability gap
● Qcells Cert	Critical	Market entry	Reliability bar
● GCL Scale	Threat	Learn scale	Asian dominance

● Cu Corrode	Threat	New materials	Reliability risk

Deep Dive ① — Large-Area Perovskite Tandem Manufacturing Breakthrough

#21 | 2026/08/05 | ScienceDaily | Tech Novelty●●●●● Proximity●●●○○ Market Impact●●●●● Data Reliability●●●●● US/EU Relevance●●●●○

A research team developed an innovative thermal evaporation method using formamidinium iodide (FAI) eutectics, achieving 31.5% efficiency for 1 cm² perovskite-silicon tandem cells and a remarkable 30.0% on 200 cm² wafers.

This breakthrough resolves the long-standing challenge of FAI degradation during thermal evaporation, enabling high uniformity and precise compositional control crucial for large-scale production, significantly accelerating commercial mass production.

▶ Strategic Analyst's Perspective

Strategic Analyst's Perspective: This is a critical manufacturing breakthrough. Published numbers (30.0% on 200cm²) are highly realistic and directly address a major scalability hurdle. The technical barrier of FAI decomposition during thermal evaporation has been a key bottleneck for large-area, high-efficiency perovskite films. [Opportunity] for US/EU OEMs to license or adopt this thermal evaporation technique to achieve high-efficiency, large-area modules. [Threat] for those relying solely on solution-processing, as this method offers superior uniformity and defect control for industrial scale. Next actions: [R&D;] Evaluate thermal evaporation process for perovskite films by Q4 2026. [Procurement] Identify potential equipment and material suppliers for FAI eutectics and thermal evaporation systems by Q1 2027.

Deep Dive ② — Qcells Achieves Key IEC/UL Certification for Tandem Panels

#14 | 2026/07/31 | Autonocion.com | Tech Novelty●●●○○ Proximity●●●●○ Market Impact●●●●● Data Reliability●●●●○ US/EU Relevance●●●●●

Qcells' perovskite-silicon tandem panels received IEC 61215 (reliability) and UL 61730 (safety) certifications from TÜV Rheinland, a crucial milestone for commercialization and market adoption.

The panels demonstrated superior durability, passing extreme thermal cycling (-40°C to 85°C for 200 cycles) and damp-heat tests (85°C, 85% RH for 1,000 hours), proving long-term reliability under harsh conditions.

▶ Strategic Analyst's Perspective

Strategic Analyst's Perspective: The published numbers and certifications are highly reliable, indicating Qcells' perovskite tandem technology is nearing market readiness. This is a significant validation of perovskite durability, moving beyond lab-scale claims. [Opportunity] for US/EU OEMs to accelerate their own certification processes and leverage this precedent to gain investor confidence. [Threat] for any company whose perovskite products cannot meet these stringent international standards, risking market exclusion or delayed commercial financing. Next actions: [Business Dev] Engage with Qcells to understand their commercialization roadmap and potential partnerships by Q4 2026. [R&D;] Benchmark internal reliability testing against IEC/UL standards and identify gaps by Q1 2027.

Deep Dive ③ — GCL Photoelectric Secures Funding, Scales Perovskite Modules

#43 | 2026/08/03 | EnergyTrend | Tech Novelty●●●○○ Proximity●●●●○ Market Impact●●●●● Data Reliability●●●●○ US/EU Relevance●●●●○

GCL Photoelectric secured over ¥100 million in Series D1 funding, accelerating commercialization of its perovskite solar cells for ground-mounted PV and space applications.

The company activated a gigawatt-scale production line and achieved a certified efficiency of 26.8% with large 2.78 m² perovskite modules, demonstrating significant progress towards mass production and market entry.

▶ Strategic Analyst's Perspective

Strategic Analyst's Perspective: GCL's funding and large-area module efficiency (26.8% on 2.78m²) are realistic and demonstrate aggressive commercialization by a Chinese leader. The technical barrier of scaling perovskite manufacturing to GW-level with high yield is being actively addressed. [Opportunity] for US/EU materials suppliers to engage with GCL's supply chain for high-volume materials. [Threat] for US/EU OEMs who lag in large-scale manufacturing and market penetration, as Chinese companies are rapidly establishing dominance in perovskite production. Next actions: [Strategy] Conduct a competitive analysis of GCL's manufacturing capabilities and market strategy by Q4 2026. [Procurement] Assess potential for sourcing large-area perovskite modules from Asian suppliers to understand cost benchmarks by Q1 2027.

Other Notable Articles

韓国研、フレキシブルペロブスカイト/シリコンタンデムで33.6%効率を達成し高耐久性も実証 (AZoCleantech)

Tech Novelty●●●●○ Proximity●●○○○ Market Impact●●●●○

High efficiency (33.6%) and exceptional durability for flexible perovskite tandems open new markets for wearables and IoT.

ペロブスカイト/CIGSタンデム太陽電池が30.57%効率を達成、界面電荷輸送層の再設計で安定性も大幅向上 (Bioengineer.org)

Tech Novelty●●●●○ Proximity●●○○○ Market Impact●●●○○

New record for perovskite/CIGS tandem (30.57%) with improved stability, offering an alternative to silicon tandems for thin-film PV.

CIMTEC 2026会議、DLRが全ペロブスカイト多孔質構造を用いた太陽熱ハイブリッド貯蔵の成果を発表 (2026 CIMTEC Conference)

Tech Novelty●●●●○ Proximity●●○○○ Market Impact●●●○○

DLR's work on all-perovskite porous structures for hybrid solar thermal storage shows novel application beyond PV, with scale-up potential.

中国科学院、ペロブスカイト太陽電池の銅電極に動作中のエッジ腐食を発見、ビスマス薄層で保護し安定性向上 (PV Magazine)

Tech Novelty●●●●○ Proximity●●○○○ Market Impact●●●○○

Discovery of copper electrode corrosion and bismuth protection offers crucial insights for long-term reliability of low-cost PSCs.

EU PVSEC 2026、共同研究センター（JRC）がペロブスカイトを含む新規PVモジュールの正確な測定・標準化技術に貢献 (Joint Research Centre (JRC))

Tech Novelty●○○○○ Proximity●●●●○ Market Impact●●●●○

EU's JRC is actively developing measurement and standardization for perovskite PV, essential for market trust and adoption.

Recommended Actions This Week

Action recommendations based on article evaluation matrix and opportunity/threat analysis.

Immediate (this week)

- [Strategy] Assess competitive landscape, especially Asian firms' efficiency records and large-scale manufacturing progress.
- [R&D;] Review latest breakthroughs in perovskite stability (e.g., reverse-bias, interface passivation) and large-area deposition methods.
- [Procurement] Evaluate current supply chain exposure to potential shifts in perovskite materials and manufacturing processes.

Short-term (1 month)

- [R&D;] Initiate internal projects to explore advanced manufacturing techniques like FAI eutectic thermal evaporation for large-area perovskite films.
- [Business Dev] Explore potential partnerships or licensing opportunities with leading perovskite technology developers, particularly those with certified products.
- [Legal/IP] Monitor the evolving intellectual property landscape for perovskite tandem cells and manufacturing processes to identify risks and opportunities.

Medium-long term (quarter+)

- [Executive] Develop a comprehensive long-term strategy for perovskite solar cell integration into product portfolios, considering market entry and competitive positioning.
- [R&D;] Invest in advanced encapsulation technologies and lead-free perovskite materials to meet future environmental regulations and ensure long-term durability.
- [Procurement] Diversify the supply chain for critical perovskite components and materials to mitigate risks associated with regional manufacturing dominance.

PerovskiteSolarCells — Selected Articles

Date: 2026-08-09

Articles: 48

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#18 混合配位子駆動型相純粋2Dペロブスカイトにより、界面パッシベーションを強化し太陽電池の効率と安定性を向上

#19 ワイドバンドギャップペロブスカイト太陽電池の結晶化変調技術レビュー、相分離・欠陥抑制で22.3%効率と31.2%タンデム効率を報告

#20 ペロブスカイト表面終端に依存する分子相互作用が界面エネルギーと相安定性に及ぼす影響を解明、逆型PSCの性能向上へ

#21 ホルムアミジニウム共晶体を利用した熱蒸着法でペロブスカイト-シリコンタンデムが31.5%効率を達成、大面積製造へ道

#22 NMEE-Pho' 26国際会議、ペロブスカイト/シリコンタンデムPVとフレキシブル太陽電池フィルムに焦点

#23 ARAID研究者Emilio J. Juárez-Pérez氏、ペロブスカイト太陽電池の安定性向上に関するセミナーを沖縄で開催

#24 中国科学院、ペロブスカイト太陽電池の銅電極に動作中のエッジ腐食を発見、ビスマス薄層で保護し安定性向上

#25 EU PVSEC 2026、共同研究センター（JRC）がペロブスカイトを含む新規PVモジュールの正確な測定・標準化技術に貢献

#26 Hanyang University Develops Predictive Model for 2D Perovskite Exciton Behavior, Accelerating Next-Gen Solar Cell Design

#27 Unexpected Copper Corrosion Detected at Perovskite Solar Cell Copper/MoO3 Interface, Posing Reliability Concerns

#28 Hong Kong PolyU Develops Perovskite-Organic Tandem Solar Cell with Enhanced Reverse-Bias Stability, Withstanding Shading Damage >90%

#29 Oxford PV Initiates First Shipments of Perovskite-Silicon Tandem Panels in 2024, Achieves 24.5% Efficiency in Commercial Modules

#30 Hong Kong PolyU Achieves >90% Initial Efficiency Retention with Shade-Tolerant, Reverse-Bias Stable Perovskite-Organic Tandem Solar Cell

#31 Korean Energy Institute Achieves 23.64% Efficiency in Flexible Perovskite Tandem Solar Cells, Lead-Free Technology Advances

#32 US DOE Funds Perovskite Solar Cell R&D to Accelerate Commercialization, Targeting Over 34% Tandem Efficiency

#33 University of Sydney Achieves World-Record 30.2% Efficiency in 10 cm² Perovskite-Silicon Tandem Solar Cell

#34 Rayzon Solar Report: Perovskite Tandem Modules Achieve >34% Efficiency, Face Manufacturing and Stability Challenges

#35 Chinese Team Develops Perovskite/CIGS Tandem Solar Cell with 29.71% Efficiency and Enhanced Stability via Sulfur Compound Addition

#36 UK-Sweden 'POP-PV' Project Launches to Power Underutilized Building Spaces with Power Roll's Lightweight Perovskite Films

#37 Chinese Team Achieves 27.49% AM0 Efficiency in Space-Grade Perovskite/Silicon Tandem Solar Cell, Withstands High-Altitude Flight

#38 First Solar and Oxford PV Sign Perovskite Patent Licensing Deal for US Markets, Accelerating Commercialization

#39 Qcells Unveils IEC/UL Certified M10 Perovskite Tandem Panel with 28.6% Efficiency, Demonstrating Extreme Durability

#40 SCAPS-1D Simulation Analyzes Lead-Free Double Perovskite Solar Cells, Highlighting Efficiency Improvement Challenges

#41 DLXN Solar Report: Tandem Perovskite-Silicon Reaches 34.6% Efficiency, But Manufacturing Yield, Encapsulation, and Lead Regulations Remain Commercial Bottlenecks

#42 Perfluoroadipic Acid Boosts Perovskite Solar Cell Efficiency from 20.71% to 22.60%, Maintaining 80.2% Stability for 45 Days

#43 GCL Photoelectric Secures Over ¥100 Million in Series D1 Funding, Accelerating Commercialization with 26.8% Efficiency in 2.78m² Perovskite Modules

#44 Tandem PV Acquires Thin-Film Coating Specialist nexTC, Fortifying Manufacturing Process for High-Durability Perovskite-Silicon Solar Cells

#45 Chinese Research Team Sets New World Record for Perovskite Solar Cell Efficiency at 28.04%

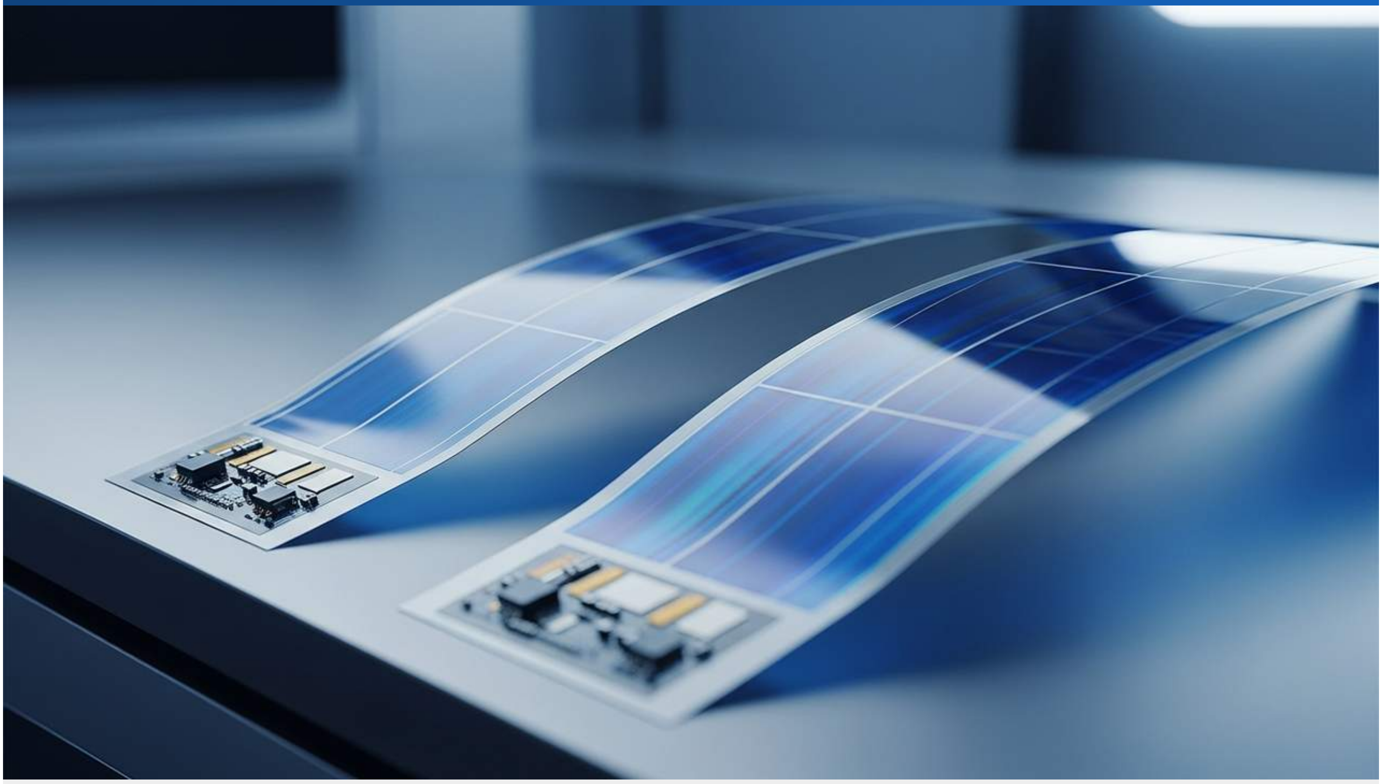
#46 UK-Swedish Joint Project POP-PV to Tackle Commercialization Challenges of Lightweight Perovskite Solar Cells for Underutilized Rooftops

#47 Review Paper Highlights Critical Role of Inorganic Hole Transport Materials in Advancing n-i-p Perovskite Solar Cells, Contributing to 27% Efficiency and Enhanced Stability

#48 Chinese Researchers Achieve 29.71% Overall Efficiency and Over 91% Stability After 2000 Hours with Sulfide-Based Four-Terminal Perovskite/CIGS Tandem Solar Cell

#01 韓国研、フレキシブルペロブスカイト/シリコンタンデムで33.6%効率を達成し高耐久性も実証

Published Published July 31, 2026 AZoCleantech South Korea



OVERVIEW

A Korean research team has achieved a certified 33.6% power conversion efficiency in flexible perovskite-silicon tandem solar cells, while also demonstrating remarkable durability. These devices maintained 91% of their initial output after 5,000 bending cycles and passed 1,000 hours of damp-heat testing, significantly broadening their application potential in extreme environments. This breakthrough, alongside advancements in flexible perovskite/CIGS and lead-free tin-based perovskites, marks a crucial step toward the commercialization of flexible solar cells.

IN DEPTH

Background

Flexible solar cells are in high demand across diverse applications—such as wearables, IoT sensors, curved building surfaces, and mobility—where rigid silicon panels are impractical. Perovskite solar cells, with their excellent light absorption properties and ease of solution processing, are considered a promising next-generation technology for flexible devices. However, balancing high PCE with long-term stability and durability has been a major hurdle for commercialization. This research represents a significant step towards overcoming these challenges.

Key Findings

A Korean research team has achieved a certified power conversion efficiency (PCE) of 33.6% for flexible perovskite-silicon tandem solar cells. Crucially, these devices demonstrated exceptional physical durability, retaining 91% of their initial output after 5,000 bending cycles and successfully passing 1,000 hours of damp-heat testing. This marks a significant advancement in addressing the reliability challenges crucial for the commercialization of flexible photovoltaics.

Technical Details

This breakthrough was realized through advancements in stacking perovskite and silicon layers on flexible substrates. The research also reported a 23.64% PCE for flexible perovskite/CIGS tandem cells, expanding the potential for multi-junction solar devices. Furthermore, lead-free tin-based perovskite solar cells achieved a certified efficiency of 15.7%, indicating progress in reducing reliance on lead-containing materials. Notably, mixed tin-lead perovskite single-junction cells recorded efficiencies exceeding 24%, reflecting the ongoing material science developments contributing to PCE enhancements.

Strategic Significance & Outlook

These achievements significantly boost the potential for flexible perovskite solar cells to be adopted in a wider range of markets. By combining high efficiency with superior bending resistance and damp-heat stability, the technology is poised to accelerate integration into portable power sources, mobile applications, and next-generation smart city infrastructure, particularly in harsh environments. Future milestones for practical implementation include further scaling up production, reducing manufacturing costs, and achieving compliance with stringent international standards.

Source: https://www.azocleantech.com/article.aspx?ArticleID=3354

Collected: August 07, 2026 | Automated Research System (Gemini API)

#02 LONGi、ペロブスカイト-シリコンタンデムで34.85%効率記録、屋上PV普及に向けた安定性課題が焦点に

Published Published August 01, 2026 GreenLancer USA

OVERVIEW

LONGi has set a new world record with a 34.85% power conversion efficiency for its perovskite-silicon tandem solar cell, pushing beyond the theoretical limits of silicon. Concurrently, Oxford PV demonstrated 26.9% efficiency at the module level, signaling commercial potential. While these tandem cells promise significantly higher energy yields, persistent challenges with long-term stability against environmental factors like moisture, oxygen, and UV radiation remain the primary barrier to their widespread adoption in rooftop PV.

IN DEPTH

Background

As global energy demand continues its upward trajectory, solar photovoltaics (PV) are increasingly recognized as a cornerstone of the renewable energy transition. However, maximizing power generation within limited installation areas and driving down generation costs necessitates continuous improvements in conversion efficiency. Perovskite solar cells, with their high theoretical efficiency limits and potential for low-cost manufacturing, are widely heralded as a 'next-generation' PV technology. Yet, ensuring their long-term reliability and stability is paramount for their successful market entry and widespread deployment.

Key Findings

In a significant leap forward for solar energy technology, LONGi has achieved a new certified world record for perovskite-silicon tandem solar cells, registering an impressive 34.85% power conversion efficiency. This monumental achievement not only surpasses the long-standing theoretical limits of single-junction silicon solar cells but also underscores the transformative potential of tandem architectures. Complementing this, Oxford PV has independently demonstrated a remarkable 26.9% efficiency at the module level, further validating the commercial viability and scalability prospects of perovskite tandem technology beyond laboratory settings.

Technical Details

Perovskite-silicon tandem solar cells leverage a synergistic design to enhance solar spectrum utilization. The top perovskite layer is engineered to efficiently absorb shorter-wavelength, high-energy photons, while the underlying silicon layer captures longer-wavelength light that penetrates the perovskite. This combined spectral harvesting enables significantly higher power generation compared to conventional single-junction silicon cells. Despite these advantages, perovskite materials exhibit an inherent susceptibility to degradation when exposed to common environmental stressors, including moisture, oxygen, ultraviolet (UV) radiation, and thermal cycling. This intrinsic instability represents the most formidable barrier to their broad market adoption. Current research efforts are primarily focused on developing robust lead-free perovskite compositions and pioneering advanced encapsulation techniques designed to effectively seal the cells against the ingress of water and oxygen, thereby dramatically extending their operational lifespan.

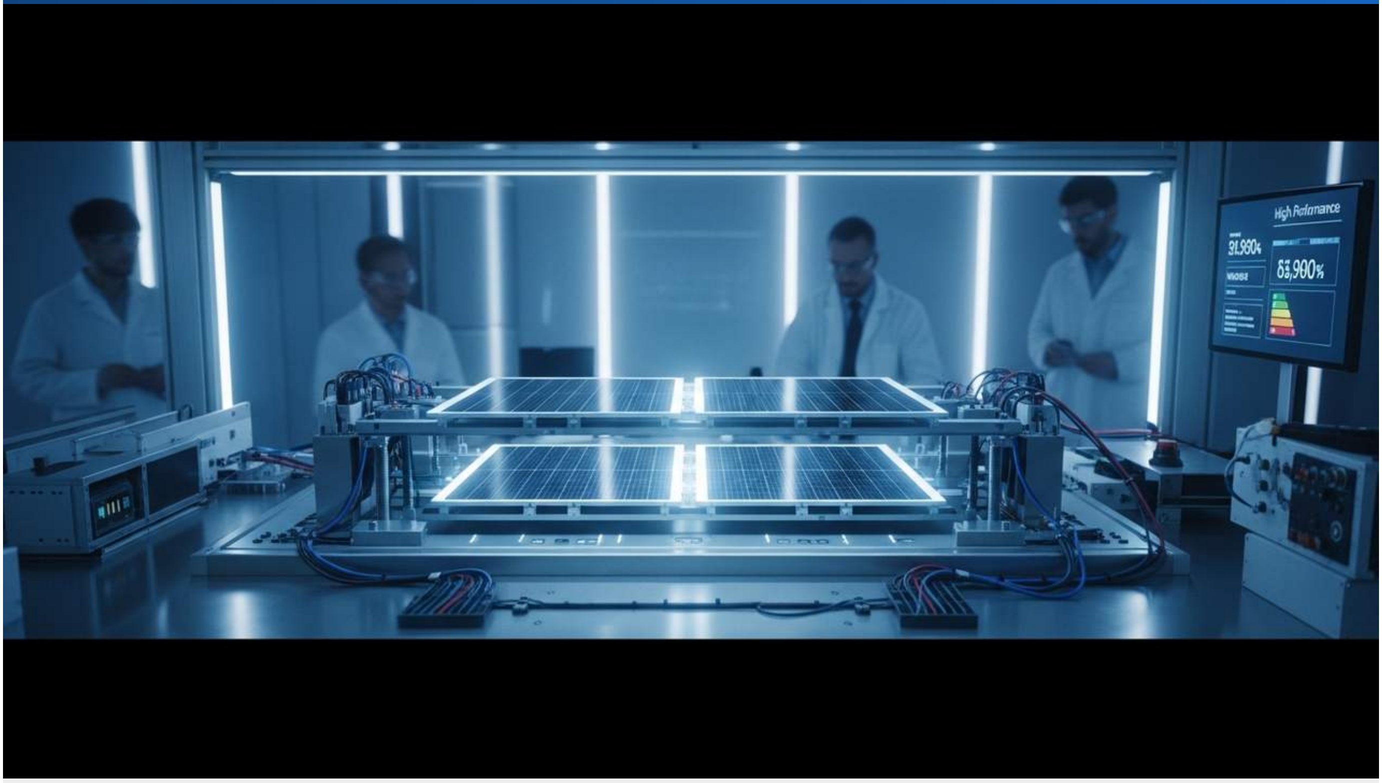
Strategic Significance & Outlook

For perovskite-silicon tandem solar cells to transition from record-breaking laboratory demonstrations to widespread adoption in the critical rooftop solar market, they must not only deliver unparalleled efficiency but also guarantee operational stability for a minimum of 25 years—a standard benchmark for conventional PV technologies. Achieving this necessitates rigorous advancements in robust, lead-free material science, the discovery and implementation of highly effective encapsulants, and the establishment of scalable, cost-efficient mass production technologies. Should these formidable challenges be successfully navigated, perovskite tandem technology holds the promise to become a formidable competitor, potentially even surpassing, conventional silicon solar cells. Such a development would have a profound impact on global energy supply, significantly accelerating the worldwide transition to sustainable renewable energy sources.

Source: https://www.greenlancer.com/perovskite-solar-cell-vs-silicon/

#03 Trina Solar、TÜV SÜD認証でペロブスカイト-シリコンタンデムモジュールが29.2%効率、907Wの世界記録を達成

Published Published August 02, 2026　OkDiario　スペイン



OVERVIEW

Trina Solar has achieved a new world record for its perovskite-crystalline silicon tandem module, demonstrating an astounding 907 watts peak power and 29.2% full-area efficiency, independently verified by TÜV SÜD. This breakthrough highlights the significant potential of tandem technology to dramatically improve solar photovoltaic efficiency, though long-term durability, scalable manufacturing, cost competitiveness, and environmental considerations remain key challenges for commercialization.

IN DEPTH

Key Findings

Trina Solar has achieved a new world record with its perovskite-crystalline silicon tandem module, demonstrating an astonishing 29.2% full-area conversion efficiency and a peak power output of 907 watts. This groundbreaking achievement has been independently verified by the internationally recognized certification body TÜV SÜD, ensuring its credibility and robust measurement. Such high performance for a commercial solar module is unprecedented and marks a significant step towards the realization of next-generation solar cell technology.

Technical Details

The record-breaking tandem module employs a sophisticated architecture, featuring a high-performance perovskite solar cell as the top layer and a well-established crystalline silicon solar cell as the bottom layer. The perovskite layer efficiently absorbs high-energy photons in the blue region of the spectrum, while the underlying silicon layer effectively captures transmitted lower-energy red and near-infrared light. This tandem configuration inherently allows for the conversion of a broader spectrum of sunlight into electricity compared to conventional single-junction solar cells. Trina Solar achieved this by optimizing its proprietary process and material development, meticulously maximizing overall module efficiency while also integrating considerations for long-term stability into its design.

Background & Context

The global solar photovoltaic industry faces continuous pressure to enhance efficiency and reduce costs, driven by urgent climate change mitigation goals and increasing energy security concerns. While crystalline silicon solar cells represent a mature and dominant technology, their theoretical efficiency is approaching inherent physical limits. Perovskite tandem technology is widely regarded as the most promising candidate to surpass these limitations, leading to intense development competition among research institutions and corporations worldwide. Trina Solar's latest record clearly signifies a crucial transition from laboratory-scale achievements to the module level, signaling that commercialization is becoming a tangible and imminent reality.

Strategic Significance & Outlook

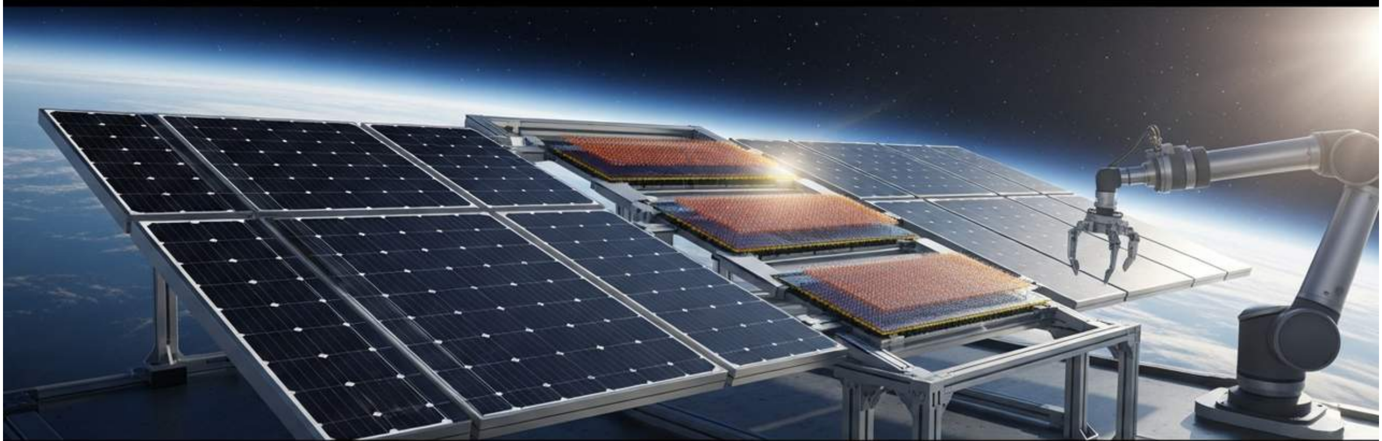
While Trina Solar's record powerfully showcases the profound commercial potential of perovskite tandem technology, several critical challenges must be addressed for its widespread market adoption. Beyond achieving high efficiency, indispensable factors include demonstrating robust long-term durability (ideally exceeding 25 years), stabilizing manufacturing yield at gigawatt-scale production, and achieving cost competitiveness on par with or even below existing crystalline silicon panels. Furthermore, navigating and addressing environmental regulations pertaining to the use of lead-containing materials remains a crucial consideration. Successfully overcoming these multifaceted hurdles could enable perovskite tandem modules to catalyze a significant transformation in the global solar power market within the coming years.

Source: https://okdiario.com/economia/trina-solar-set-world-record-commercial-panel-29-2-efficiency-907-watts-verified-independently-tuv-sud-13175865

Collected: August 07, 2026 | Automated Research System (Gemini API)

#04 宇宙用途向けペロブスカイト/シリコンタンデム太陽電池、27.49%効率を認証、高放射線・熱衝撃・高高度飛行に耐性

Published Published August 04, 2026　Perovskite-Info　イスラエル



OVERVIEW

Chinese researchers have developed a perovskite/silicon tandem solar cell for space applications, achieving a certified power conversion efficiency of 27.49% under AM0 conditions. This device demonstrated exceptional durability, resisting electron and proton radiation and maintaining 96.8% of its initial efficiency after severe thermal shock cycles from -90°C to 90°C. High-altitude balloon tests further confirmed its stable power supply capability in near-space conditions, paving the way for future satellite and deep-space probe applications.

IN DEPTH

Background

Solar cells are indispensable power sources for artificial satellites, space stations, and deep-space probes. However, outer space presents an extremely harsh environment, with constant exposure to high-energy radiation, extreme temperature fluctuations, and micrometeoroid impacts, all of which degrade solar cell performance. Traditional silicon-based space solar cells are often costly and complex to manufacture. Perovskite solar cells, with their inherent lightweight properties, high efficiency potential, and prospects for low-cost production, are emerging as a promising next-generation power source for space applications. This research specifically demonstrates that perovskites can meet these stringent demands, offering a crucial validation for their widespread adoption in space.

Key Findings

A Chinese research team has achieved a certified power conversion efficiency (PCE) of 27.49% under AM0 (outer space) conditions for a novel perovskite/silicon tandem solar cell tailored for space applications. This device showcased exceptional durability in extreme environments: it exhibited high resistance to both electron and proton radiation, retained 96.8% of its initial efficiency after rigorous thermal shock cycles spanning -90°C to 90°C, and demonstrated stable power output during a high-altitude balloon flight. These results significantly expand the applicability of perovskite technology in outer space.

Technical Details

AM0 conditions specify the solar spectrum outside Earth's atmosphere, serving as the standard for evaluating space solar cell performance. The achieved 27.49% PCE is a remarkably high figure for solar cells intended for space applications. The cell's radiation robustness was verified through dedicated electron and proton beam irradiation tests, a critical assessment for ensuring long-term reliability in deep-space missions. Thermal shock tests revealed only a 3.2% efficiency degradation after 200 cycles (from -90°C to 90°C), demonstrating the design's ability to withstand the abrupt and extreme temperature fluctuations characteristic of space. Furthermore, an indispensable high-altitude balloon flight test, conducted in the stratosphere (approximately 20-50 km altitude) under near-space conditions of extreme cold, low pressure, and elevated radiation, successfully demonstrated the cell's real-world performance and stability.

Strategic Significance & Outlook

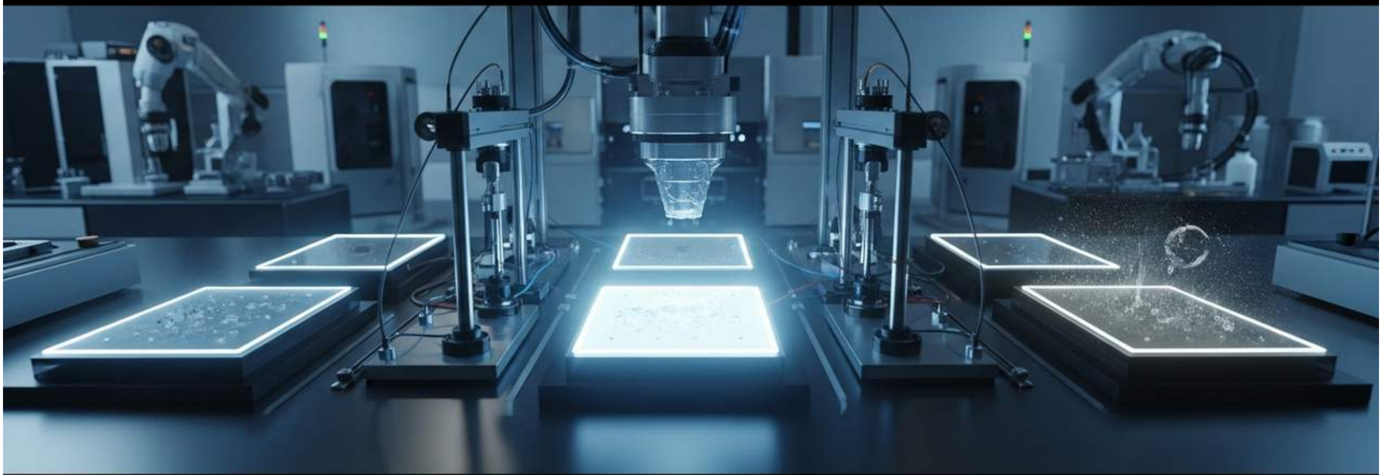
The successful development of this innovative perovskite/silicon tandem solar cell introduces compelling new options for space technology. Its lightweight and high-efficiency characteristics can enable increased payloads and extended mission durations, ultimately leading to significant cost reductions in space development. Future challenges will involve further long-term reliability validation, scaling up manufacturing to large-panel arrays, and critical in-orbit demonstration in actual space missions. This technology holds immense potential to accelerate the realization of more ambitious space projects, including future lunar bases and Mars exploration initiatives.

Source: https://www.perovskite-info.com/perovskite/silicon-tandem-hits-certified-2749-efficiency-space-conditions-survives-radiation-and-real-high

Collected: August 07, 2026 | Automated Research System (Gemini API)

#05 ペロブスカイトタンデムモジュール、実験室で34%超効率を達成するも長期安定性と製造スケール化が商業化の課題に

Published Published August 06, 2026 Rayzon Solar India



OVERVIEW

Perovskite tandem solar cells have achieved power conversion efficiencies surpassing 34% in laboratory environments, signaling their transformative potential for photovoltaics. However, their journey to commercialization is hindered by critical issues: ensuring long-term operational stability against environmental degradation and mastering the transition from lab-scale prototypes to gigawatt-level mass production. Overcoming these hurdles, particularly through advanced encapsulation and process maturation, is essential for widespread market adoption.

IN DEPTH

Key Findings

Perovskite tandem solar cells have demonstrated power conversion efficiencies (PCE) exceeding 34% in laboratory settings, indicating their potential to revolutionize the photovoltaic industry. However, their commercialization confronts two primary challenges: ensuring long-term operational stability and achieving manufacturing scalability from laboratory prototypes to gigawatt (GW) production volumes. Without overcoming these hurdles, widespread market adoption of perovskite tandem modules will remain elusive.

Technical Details

While perovskite materials achieve high PCEs owing to their excellent light absorption properties, they inherently possess a critical vulnerability: high susceptibility to environmental stressors such as heat, moisture, ultraviolet (UV) radiation, and oxygen. When exposed to these elements, the perovskite layer typically degrades faster than those in conventional silicon solar cells. To mitigate this, the development of advanced encapsulation techniques capable of preventing the ingress of water vapor and oxygen to an extreme degree is paramount. Furthermore, current manufacturing processes are predominantly laboratory-scale. Scaling these to GW-level mass production introduces numerous technical and engineering barriers, including achieving material uniformity, maintaining high yield, and ensuring cost-effectiveness.

Background & Context

Solar power is a cornerstone of the global transition to clean energy, yet further reductions in generation costs and improvements in efficiency remain urgent priorities. Perovskite tandem technology represents a highly promising solution to these challenges, capable of achieving efficiencies beyond the theoretical Shockley-Queisser limits of single-junction silicon solar cells. However, for any nascent technology to achieve market acceptance, it necessitates not only high efficiency but also demonstrable long-term reliability and an economically viable manufacturing process. Rigorous validation and substantial industrialization investment are thus essential for this technology to disrupt existing markets and unlock new applications.

Strategic Significance & Outlook

The commercial viability of perovskite tandem modules critically hinges on robust collaboration between the research and development community and industry stakeholders. The next crucial steps involve the accelerated evolution of advanced encapsulation technologies, the automation and optimization of manufacturing processes, and stringent compliance with international quality and durability standards. If these formidable challenges are successfully addressed, perovskite tandem technology is poised to become an indispensable element in shaping a sustainable energy future, significantly contributing to reductions in energy costs and greenhouse gas emissions. The industry is closely observing as this innovative technology strives to transition from a 'breakthrough' curiosity to a 'market standard' solution.

Source: https://rayzonsolar.com/perovskite-tandem-modules-breakthrough-or-manufacturing-challenge/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#06 ペロブスカイト/CIGSタンデム太陽電池が30.57%効率を達成、界面電荷輸送層の再設計で安定性も大幅向上

Published Published August 05, 2026　Bioengineer.org　USA

OVERVIEW

Monolithic perovskite/CIGS tandem solar cells have achieved a new milestone, recording a certified power conversion efficiency (PCE) of 30.57% for small-area devices. This breakthrough stems from an innovative redesign of both the intermediate recombination layer and the perovskite electron-extraction interface, enabling a PCE of 28.85% even for 1.0298 cm^2 devices. The improved devices also demonstrate significantly enhanced operational and thermal stability, maintaining approximately 94% of their initial efficiency after over 3,500 hours of storage.

IN DEPTH

Background

Copper indium gallium selenide (CIGS) solar cells represent an established technology within thin-film photovoltaics, renowned for their high efficiency and exceptional durability. The integration of perovskite solar cells with CIGS allows for the efficient utilization of shorter-wavelength light that CIGS alone cannot absorb, offering a compelling alternative to traditional silicon tandems for extending the efficiency frontier of solar cells. The development of multi-junction solar cells is a critical pathway for enhancing the cost-effectiveness of solar power, with thin-film based tandems providing additional benefits such as lightweight construction and flexibility. Within these stacked semiconductor systems, interface engineering is paramount, directly influencing both performance and long-term stability.

Key Findings

Monolithic perovskite/CIGS tandem solar cells have established a new world record in high-efficiency solar cell development, achieving a certified power conversion efficiency (PCE) of 30.57% for small-area devices. This groundbreaking achievement is attributed to the innovative redesign of both the intermediate recombination layer and the perovskite electron-extraction interface. Significantly, the improved devices also exhibited exceptional operational and thermal stability, retaining approximately 94% of their initial efficiency after more than 3,500 hours of storage.

Technical Details

The monolithic tandem architecture involves the direct stacking of a perovskite solar cell, serving as the top sub-cell, onto a well-established CIGS solar cell as the bottom sub-cell. Researchers meticulously optimized the composition of the intermediate recombination layer and the critical interfaces, substantially elevating the PCE by enhancing charge transport efficiency. Notably, devices with a larger area of 1.0298 cm^2 also achieved a PCE of 28.85%, demonstrating that high performance is maintained even for more practically sized devices. Through precise interface engineering, defect states were suppressed, and non-radiative recombination was significantly reduced, thereby extending carrier lifetime and concurrently boosting both conversion efficiency and long-term stability. Furthermore, comprehensive thermal stability tests confirmed the consistent maintenance of initial performance over extended periods.

Strategic Significance & Outlook

This significant breakthrough in perovskite/CIGS tandem solar cells is poised to act as a powerful catalyst for the accelerated commercialization of next-generation thin-film photovoltaics. Efficiencies surpassing 30%, combined with proven stability, will expedite their adoption across diverse applications, including building-integrated photovoltaics (BIPV), portable electronics, and specialized industrial deployments. For successful market entry, future efforts will concentrate on validating manufacturing scalability for large-area production, optimizing cost structures, and ensuring compliance with stringent international durability standards. This technology harbors substantial potential to redefine the landscape of solar power, offering a compelling balance of high efficiency and robust reliability.

Source: https://bioengineer.org/enhancing-interface-charge-transport-boosts-perovskite-cigs-tandem-solar-cell-efficiency/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#07 中国科学者、ペロブスカイト-有機タンデム太陽電池で28.04%の定常効率を達成し世界記録を更新

Published Published July 31, 2026 chinadaily.com.cn / Global Times China

OVERVIEW

A team of Chinese scientists has achieved a new world record with a certified steady-state power conversion efficiency (PCE) of 28.04% for perovskite-organic tandem solar cells. This innovative device boasts lightweight, flexible, and low-temperature processability, crucially overcoming internal chemical segregation issues. Demonstrating high stability by retaining 90% of its initial performance after 625 hours of continuous illumination, this breakthrough expands potential applications across BIPV, portable electronics, drones, and space technology.

IN DEPTH

Background

Global demand for solar power is surging, necessitating new technologies that can surpass the efficiency limits of conventional crystalline silicon solar cells. Perovskite solar cells have garnered significant attention due to their high theoretical efficiency and low manufacturing costs. However, their long-term stability, particularly when integrated with organic materials in tandem architectures, has remained a substantial hurdle for widespread commercialization.

Key Findings

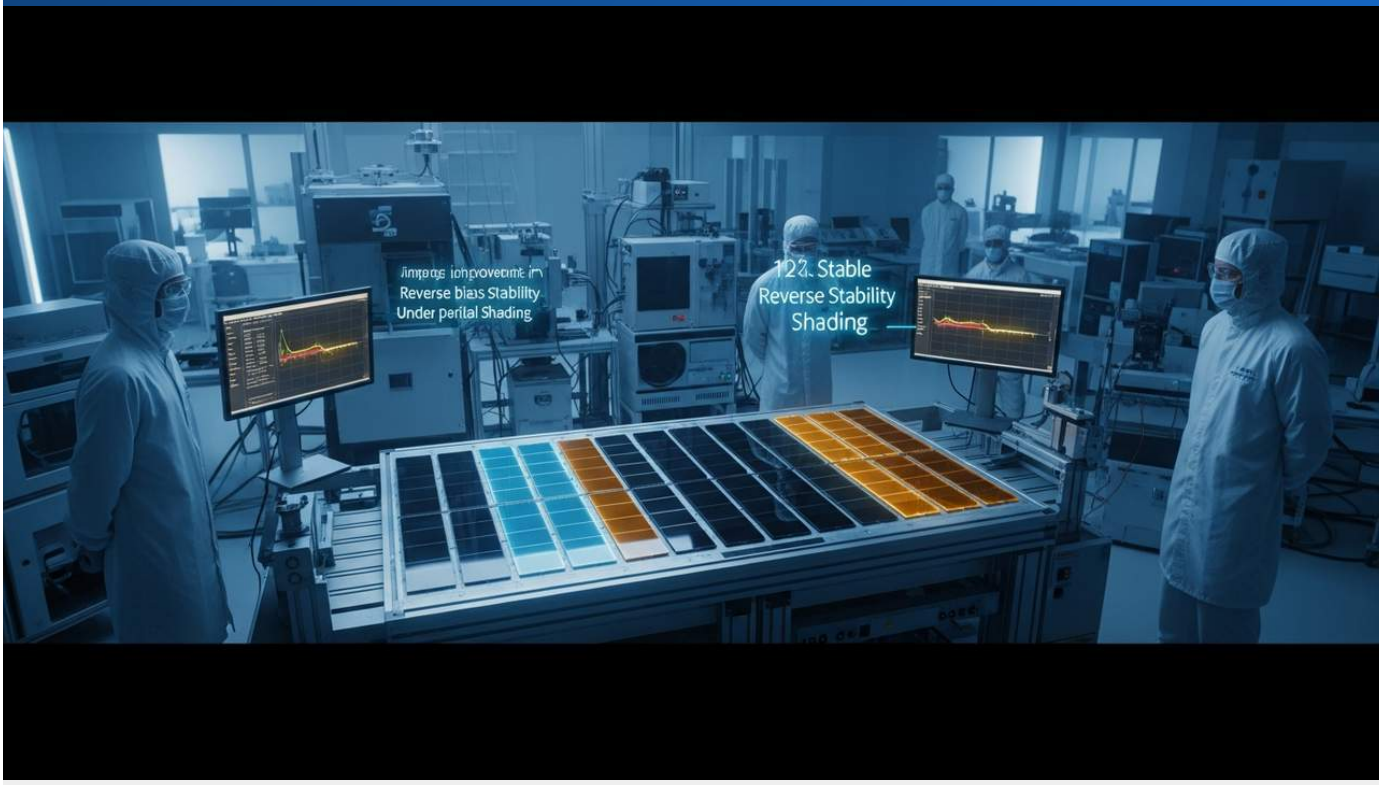
A team of Chinese scientists has achieved a new world record with a certified steady-state power conversion efficiency (PCE) of 28.04% for perovskite-organic tandem solar cells. This pioneering device is not only lightweight, flexible, and capable of low-temperature printing, but it has also successfully overcome the long-standing challenge of internal chemical segregation. Perovskite-organic tandem solar cells are designed to efficiently absorb the full solar spectrum by utilizing perovskite materials for short-wavelength light and organic materials for longer wavelengths. The critical advancement in this research lies in optimizing the interface between these layers to maximize charge transport and minimize degradation. The team innovatively suppressed light-induced phase segregation—a common degradation mechanism—through novel material design and precise process control, leading to dramatically enhanced device stability. This is further evidenced by the device retaining 90% of its initial performance after 625 hours of continuous illumination. The low-temperature manufacturing process also reduces energy consumption and facilitates application on flexible substrates. This achievement provides a practical solution to simultaneously improve both efficiency and stability, crucial for commercialization. Its lightweight and flexible characteristics, combined with record-breaking efficiency and excellent stability, significantly broaden the potential of next-generation solar cells for diverse applications such as building facades, windows, portable devices, electric vehicles, building-integrated photovoltaics (BIPV), drones, and even future space power systems. This breakthrough is poised to accelerate renewable energy deployment and contribute substantially to global decarbonization efforts.

Source: https://www.chinadaily.com.cn/a/202607/31/WS66a9d35ba3108c962b719483.html

Collected: August 07, 2026 | Automated Research System (Gemini API)

#08 香港理工大学、逆バイアス安定性を大幅向上させたペロブスカイト-有機タンデム太陽電池を開発、部分陰影下の信頼性課題を克服

Published Published August 03, 2026　　PV Magazine　　USA



OVERVIEW

Researchers at Hong Kong Polytechnic University have unveiled perovskite-organic tandem solar cells that achieve dramatically enhanced reverse-bias stability, directly tackling a critical industry challenge: reliability degradation from partial shading. This innovation maintains over 90% of initial efficiency under extreme -40V reverse-bias stress and 97% efficiency after 2,000 hours at -4.5V, representing a significant step toward robust, commercially viable thin-film solar solutions for real-world outdoor applications.

IN DEPTH

Background

Perovskite solar cells are widely recognized as a transformative next-generation photovoltaic technology, celebrated for their high power conversion efficiency and potential for low-cost manufacturing. However, a significant barrier to their widespread commercialization has been ensuring long-term reliability in real-world outdoor conditions. A critical challenge arises from partial shading or faulty cells within a solar module, which can force affected cells into a reverse-bias state. In this state, these cells transition from power generators to power consumers, often leading to localized hot-spot phenomena, severe overheating, accelerated material degradation, and even potential fire hazards. Historically, perovskite solar cells have demonstrated considerable vulnerability to such reverse-bias stress, impacting their durability and suitability for diverse applications.

Key Findings

Researchers at Hong Kong Polytechnic University have engineered a perovskite-organic tandem solar cell that achieves dramatically enhanced reverse-bias stability, directly confronting the critical industry challenge of reliability degradation caused by partial shading. The team's breakthrough was achieved through a meticulous redesign of the interfacial structure between the perovskite and organic layers, coupled with the strategic introduction of novel charge transport layer materials. This optimized architecture effectively stabilized charge flow under reverse-bias conditions, successfully suppressing localized overheating and material degradation within the cell.

Critically, the innovative device showcased exceptional resilience, sustaining over 90% of its initial power conversion efficiency even under an extremely severe -40V reverse-bias stress. Furthermore, it retained a remarkable 97% efficiency after 2,000 hours of continuous operation at a more typical -4.5V reverse bias. This robust performance profoundly enhances the overall durability and reliability of the module, enabling stable and long-term operation in diverse real-world outdoor environments.

This significant advance marks a crucial milestone for the commercialization of perovskite solar cells. By dramatically mitigating the risk of performance loss due to partial shading, this technology opens avenues for deployment in more intricate array configurations and challenging installation sites, including Building-Integrated Photovoltaics (BIPV) and flexible solar cell applications. This achievement represents an indispensable step towards establishing the foundational reliability required for perovskite solar cells to solidify their position as a mainstay in the global clean energy market, potentially offering durability comparable to, or even surpassing, traditional silicon-based photovoltaics.

Source: https://pv-magazine-usa.com/2026/08/03/scientists-develop-perovskite-organic-tandem-solar-cell-with-enhanced-reverse-bias-stability/

#09 米国DOE、$3Mの「ペロブスカイト・スタートアップ賞」を創設し米国企業の商業化を加速

Published Published August 04, 2026 Department of Energy (DOE) USA

OVERVIEW

The U.S. Department of Energy (DOE) has launched the $3 million "Perovskite Startup Prize," a two-stage competition designed to fast-track the commercialization of advanced perovskite solar cell technologies. This initiative aims to transition cutting-edge research into new American startups, fostering innovations in flexible modules, high-performance inks, and perovskite-on-silicon tandem cells. By accelerating domestic commercialization, the DOE seeks to strengthen U.S. leadership in the clean energy sector and overcome critical "valley of death" challenges.

IN DEPTH

Background

Perovskite solar cells are recognized as a "next-generation solar cell" due to their high conversion efficiency and potential for low-cost manufacturing. However, realizing laboratory-scale achievements at an industrial scale involves numerous challenges, including material stability, manufacturing scalability, and market entry barriers. The U.S. DOE aims to establish American technological leadership in the clean energy sector and strengthen domestic manufacturing by supporting the commercialization of such emerging technologies. This represents a strategic investment for the U.S. to take the lead in the perovskite development race, where countries like China are currently ahead.

Key Findings

The U.S. Department of Energy (DOE) has launched the $3 million "Perovskite Startup Prize" to accelerate the commercialization of perovskite solar cell technology. This award aims to transition world-class research findings into new American startup companies, supporting the development of innovative technologies such as flexible modules, high-performance inks, and perovskite-on-silicon tandem cells. The prize provides tangible support to help companies navigate the challenging "valley of death"—the difficult commercialization phase that bridges laboratory breakthroughs to actual products.

Technical Details

The "Perovskite Startup Prize" is structured as a two-stage competition, providing support to participating companies based on their technological maturity. Specific technological areas include:

- **Flexible Modules:** Development of lightweight, bendable perovskite solar cells suitable for diverse installation environments such as curved building surfaces and portable devices.
- **High-Performance Inks:** Creation of more stable and efficient ink materials for forming perovskite layers, which are key to large-scale printing manufacturing technologies.

- **Perovskite-on-Silicon Tandem Cells:** Technology for stacking a perovskite layer onto existing silicon solar cells to break through their efficiency limits. This approach offers high compatibility with current solar PV infrastructure, expected to accelerate market adoption.

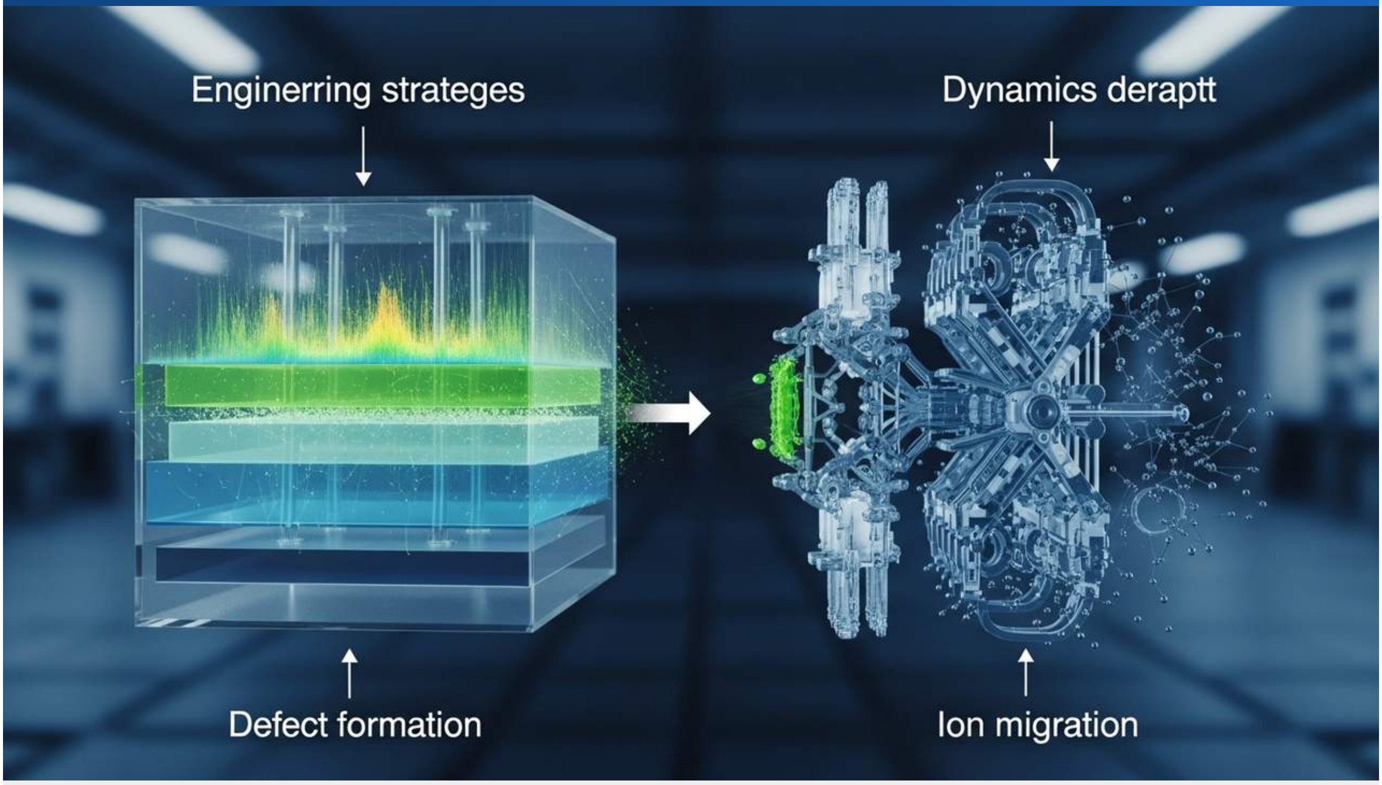
Strategic Significance & Outlook

The "Perovskite Startup Prize" is expected to bolster the perovskite solar cell ecosystem in the U.S. through the creation of new companies and the acceleration of technological innovation. The provision of funding and technical assistance mitigates the financial and technical risks faced by startups, reducing their time-to-market. This initiative is anticipated to bring high-efficiency, durable, and cost-effective perovskite products to market, contributing to the broader adoption of solar power and the diversification of the energy mix.

Source: https://www.energy.gov/eere/solar/american-made-challenges-perovskite-startup-prize

#10 ペロブスカイト太陽電池の動作耐久性を高めるための動的応力・ひずみ制御工学戦略、欠陥形成・イオン移動を抑制

Published Published July 30, 2026 ACS Energy Letters USA



OVERVIEW

New research addresses the critical barrier of insufficient operational stability in perovskite solar cells by exploring the evolution of dynamic stress and strain, and engineering strategies to mitigate it. Challenging the adequacy of conventional stability tests, the study highlights how mechanical stress and strain drive critical degradation pathways like defect formation, ion migration, cracking, and delamination. Mastering these mechanisms is crucial for significantly enhancing the long-term outdoor performance and commercial viability of perovskite solar cell technology.

IN DEPTH

Key Findings

Addressing the insufficient operational stability—a primary barrier to the commercialization of perovskite solar cells—new research has focused on the evolution of dynamic stress and strain and engineering strategies for its control. This study reveals that mechanical stress and strain significantly contribute to degradation mechanisms such as defect formation, ion migration, cracking, and delamination, demonstrating that understanding and appropriately managing these phenomena are essential for enhancing long-term outdoor performance.

Technical Details

Conventional stability tests (e.g., steady-state high-temperature, high-humidity tests) have been recognized as insufficient to fully capture the complex degradation pathways in real outdoor operation. Solar cells are constantly exposed to dynamic stress and strain from daily thermal cycling, wind-induced vibrations, and structural load variations. This research meticulously analyzed how these dynamic loads affect the perovskite crystal lattice and device interfaces, promoting ion migration or generating microscopic cracks. Specifically, technical strategies involving controlling the thermal expansion coefficient of certain interfacial materials were explored to increase compressive strain in the perovskite film, thereby enhancing the activation energy for ion migration. This also suggested the suppression of degradation mechanisms like light-induced halide segregation.

Background & Context

Perovskite solar cells are garnering significant attention as a next-generation photovoltaic technology due to their high power conversion efficiency and potential for low-cost manufacturing. However, for practical implementation and market adoption, ensuring long-term reliability and durability—comparable to or exceeding existing silicon solar cells—is paramount. Particularly, reliability evaluation in outdoor environments cannot rely solely on laboratory benchmark tests; it demands assessment under more realistic operating conditions and device designs capable of withstanding them. This research provides a crucial scientific foundation for bridging this reliability gap.

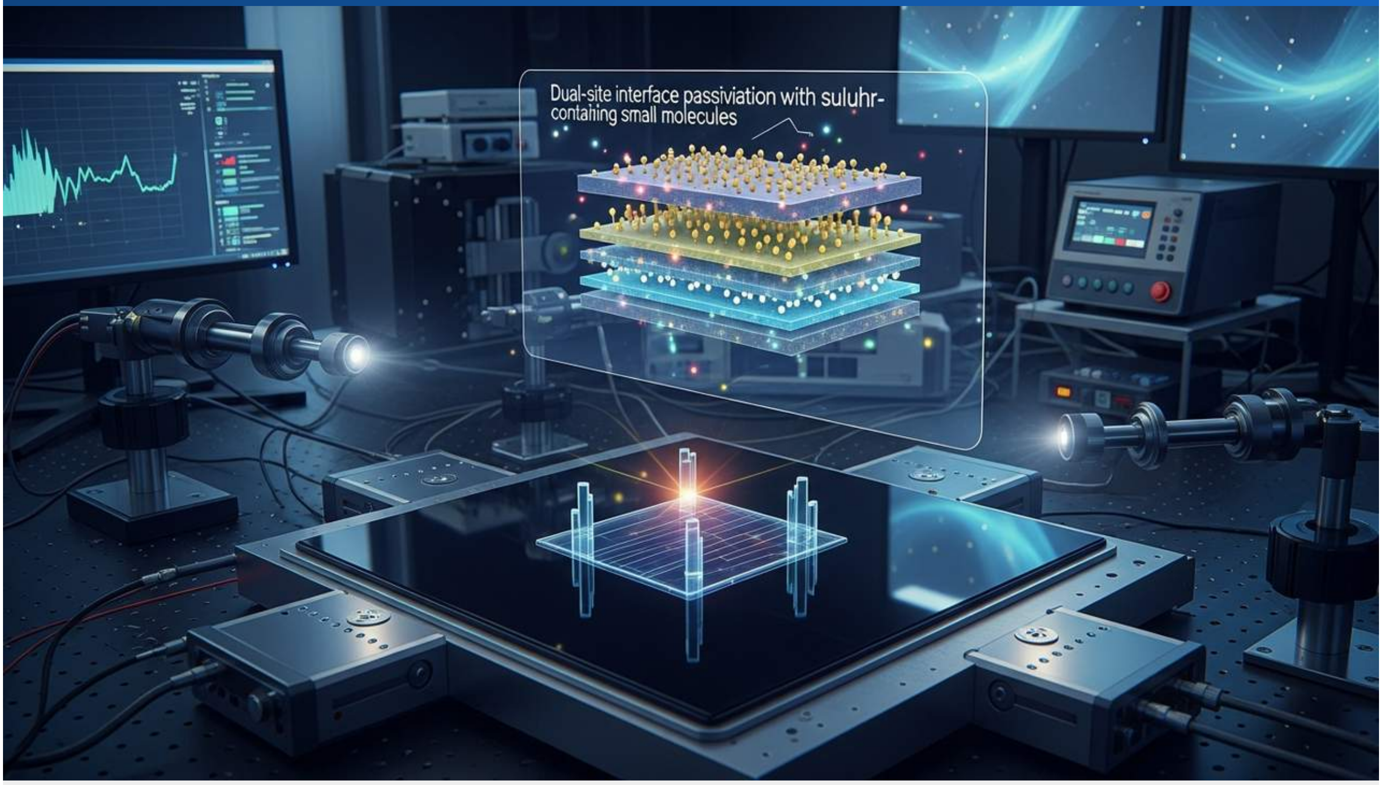
Strategic Significance & Outlook

A deeper understanding of dynamic stress and strain will enable the design of more robust and durable perovskite solar cells. This insight will contribute to the development of new materials, optimization of device structures, and the formulation of more realistic accelerated degradation test protocols. In the future, this work will pave the way for perovskite solar cells to function stably under diverse environmental conditions and become a reliable option for a wide range of applications. This represents a significant step towards the commercialization of perovskite technology and the realization of a sustainable energy society.

Source: https://pubs.acs.org/doi/10.1021/acsenergylett.6c01234

#11 硫黄系小分子によるデュアルサイト界面パッシベーションで逆型ペロブスカイト太陽電池が21.15%効率と高安定性を両立

Published Published July 30, 2026　ACS Publications　USA



OVERVIEW

Researchers have developed a novel molecular-level reconstruction and dual-site passivation strategy utilizing 2-thiopheneethanamine hydriodide (2-TEA·HI) to simultaneously boost the efficiency and stability of inverted perovskite solar cells. This innovative approach achieved a high power conversion efficiency of 21.15% and significantly enhanced environmental stability by effectively blocking water infiltration into the perovskite layer. Demonstrating remarkable durability, unencapsulated cells maintained high efficiency for over 500 hours under 30% relative humidity, signaling a major stride towards practical, long-lasting perovskite technology.

IN DEPTH

Background

Inverted perovskite solar cells offer significant advantages for tandem structures and transparent solar cell applications due to the transparent conductive film being on the top layer. However, their stability, particularly in high-humidity environments, has remained a major challenge for commercialization. Interfacial passivation is one of the most effective strategies for improving the performance and longevity of perovskite solar cells, and the introduction of molecules capable of blocking water molecule infiltration represents a crucial breakthrough in this field. This research demonstrates that the development of new materials and precise control of interface engineering are key to resolving the bottlenecks in perovskite solar cell commercialization.

Key Findings

Researchers have developed an innovative dual-site interfacial passivation strategy utilizing 2-thiopheneethanamine hydriodide (2-TEA·HI), a sulfur-based small molecule, to simultaneously and dramatically enhance the power conversion efficiency (PCE) and long-term stability of inverted perovskite solar cells (PSCs). This novel approach achieved a high PCE of 21.15% and significantly improved environmental stability by effectively suppressing water molecule infiltration into the perovskite layer. The fact that unencapsulated cells maintained high efficiency after 500 hours under 30% relative humidity marks a crucial advancement towards practical application.

Technical Details

The performance and stability of perovskite solar cells are heavily dependent on defects at the perovskite layer's surface and grain boundaries. These defects facilitate non-radiative recombination of charge carriers and act as pathways for water vapor and oxygen ingress, leading to device degradation. The 2-TEA·HI introduced in this study reconstructs the perovskite surface at a molecular level, effectively passivating defects at two distinct sites (dual-site). This minimizes recombination losses of electrons and holes, improving open-circuit voltage (Voc) and fill factor (FF), and consequently enhancing PCE. Furthermore, 2-TEA·HI also functions as a hydrophobic barrier, physically impeding water molecule infiltration into the perovskite layer, which significantly boosts stability in high-humidity environments. This combined effect enables the simultaneous achievement of high PCE and excellent environmental stability.

Strategic Significance & Outlook

This dual-site interfacial passivation strategy is expected to significantly impact future research and development as a groundbreaking method for enhancing the long-term reliability of inverted perovskite solar cells. Specifically, the improved humidity resistance will enable outdoor deployment in a wider range of climatic conditions, opening pathways for broad applications such as building-integrated photovoltaics (BIPV) and flexible solar cells. Future focus areas will include scaling up this technology for larger areas, optimizing manufacturing costs, and verifying its applicability to different perovskite compositions. This is expected to accelerate the practical implementation of highly efficient and durable next-generation solar cells.

Source: https://pubs.acs.org/doi/10.1021/acsami.6b05269

#12 CIMTEC 2026会議、DLRが全ペロブスカイト多孔質構造を用いた太陽熱ハイブリッド貯蔵の成果を発表

Published Published August 01, 2026   2026 CIMTEC Conference   イタリア

OVERVIEW

At CIMTEC 2026, the German Aerospace Center (DLR) showcased groundbreaking research from the "ABraytCSPfuture" project on hybrid sensible-thermochemical solar thermal storage using all-perovskite porous structures. This innovative approach integrates both temperature-based and chemical reaction-based energy storage, leveraging abundant and sustainable perovskite compositions identified through computational screening. With successful kilogram-scale powder synthesis and potential for multi-hundred-kilogram production, this technology promises significantly enhanced efficiency and sustainability for concentrated solar power, paving the way for large-scale, modular energy storage solutions.

IN DEPTH

Background

The escalating deployment of renewable energy sources necessitates efficient and economical energy storage solutions to mitigate the inherent intermittency of solar irradiance, impacting both photovoltaics (PV) and concentrated solar power (CSP). Traditional thermal storage systems frequently contend with issues like prohibitive material costs or insufficient energy density. Perovskite materials, however, are emerging as promising next-generation energy storage candidates due to their superior thermal stability, advantageous phase transition properties, and versatile chemical conversion capabilities. DLR's pioneering research capitalizes on this inherent multifunctionality of perovskites to forge new pathways in addressing these critical storage challenges.

Key Findings

At the "CIMTEC 2026 - 16th International Conference on Modern Materials and Technologies," held in Italy in June 2026, the "ABraytCSPfuture" project, spearheaded by the German Aerospace Center (DLR), unveiled a landmark advancement: hybrid sensible-thermochemical storage of solar heat employing all-perovskite porous structures. This innovative technology is poised to dramatically elevate the efficiency and long-term sustainability of solar thermal energy storage systems.

Technical Details

DLR's investigation leveraged all-perovskite materials configured into porous structures—specifically honeycombs and foams—as the core media for solar thermal storage. This innovative methodology integrates a hybrid storage paradigm: "sensible heat storage," which captures thermal energy via a material's temperature change, and "thermochemical storage," which harnesses chemical reactions within the material for energy storage. The selection process for perovskite materials prioritized compositions derived from abundant, safe, and sustainable elements, with optimal formulations identified through rigorous high-throughput computational screening. Crucially, the synthesis and precise property fine-tuning of these selected perovskite powders were achieved at the kilogram scale. The project further demonstrated clear potential for scaling this production to multi-hundred-kilogram quantities, a significant step toward realizing modular and large-scale energy storage systems.

Strategic Significance & Outlook

The advent of this hybrid solar thermal storage technology, utilizing all-perovskite porous structures, holds profound implications for enhancing the efficiency and operational flexibility of Concentrated Solar Power (CSP) plants. The successful demonstration of powder synthesis at a multi-hundred-kilogram scale is particularly significant, indicating immediate applicability for large-scale energy storage units and even promising longer-term solutions like seasonal thermal storage. Future research and development efforts will concentrate on seamless system integration, validating long-term durability under operational conditions, and further optimizing cost-effectiveness. This groundbreaking technology is anticipated to make a substantial contribution to stabilizing global renewable energy grids and fostering the transition toward a truly sustainable energy future.

Source: #

#13 中国CAS、硫化物配位工学で29.71%効率の四端子ペロブスカイト/CIGSタンデム太陽電池を開発、安定性も向上

Published Published July 30, 2026 PV Magazine USA

OVERVIEW

Researchers at the Chinese Academy of Sciences (CAS) have developed a four-terminal perovskite/CIGS tandem solar cell achieving a record 29.71% power conversion efficiency. This breakthrough utilizes bis(2-pyridylmethyl) sulfide (2PyS) coordination engineering to dramatically improve the stability of wide-bandgap perovskites by suppressing defect formation, halide migration, and phase segregation, paving the way for highly efficient and reliable next-generation thin-film solar cells.

IN DEPTH

Key Findings

Researchers at the Chinese Academy of Sciences (CAS) have achieved a significant milestone, developing a four-terminal perovskite/CIGS tandem solar cell with an impressive power conversion efficiency (PCE) of 29.71%. This breakthrough is attributed to the novel application of bis(2-pyridylmethyl) sulfide (2PyS)-based coordination engineering. This innovative materials engineering approach not only boosts efficiency but critically enhances the stability of wide-bandgap (WBG) perovskite solar cells, effectively mitigating primary degradation pathways like defect formation, halide migration, and phase segregation.

Technical Details

The fabricated four-terminal tandem cell architecture comprises an independently operating upper perovskite solar cell and a lower Copper Indium Gallium Selenide (CIGS) solar cell, which are electrically isolated. This design enables individual current optimization for each sub-cell, a key advantage for maximizing overall device performance. The innovation centers on leveraging 2PyS ligands to fortify the stability of the wide-bandgap perovskite. 2PyS acts as a potent defect passivator on the perovskite crystal surface, concurrently impeding the deleterious migration of ions, especially halide ions. This dual action significantly curtails phase segregation, a common stability bottleneck under light or thermal stress, thereby delivering both high efficiency and long-term operational robustness. The integration with CIGS, a mature thin-film technology, strategically exploits the complementary spectral absorption of both materials, pushing beyond the theoretical efficiency limits of conventional single-junction solar cells.

Background & Context

Solar energy remains a cornerstone of renewable power, yet its widespread adoption hinges on continuous improvements in both efficiency and long-term reliability. Perovskite solar cells are widely heralded as a 'next-generation' contender, owing to their impressive power conversion efficiencies and inherent potential for low-cost manufacturing. However, the Achilles' heel for wide-bandgap (WBG) perovskites, particularly phase segregation in mixed-halide formulations, has presented a formidable barrier to their deployment in high-performance tandem configurations. The strategic pairing of perovskites with established thin-film technologies like CIGS offers a compelling pathway to achieve superior efficiencies by building upon robust existing technological platforms. This particular research distinguishes itself by employing an advanced materials engineering strategy to directly address and mitigate perovskite instability, thereby accelerating its journey from lab to commercial viability.

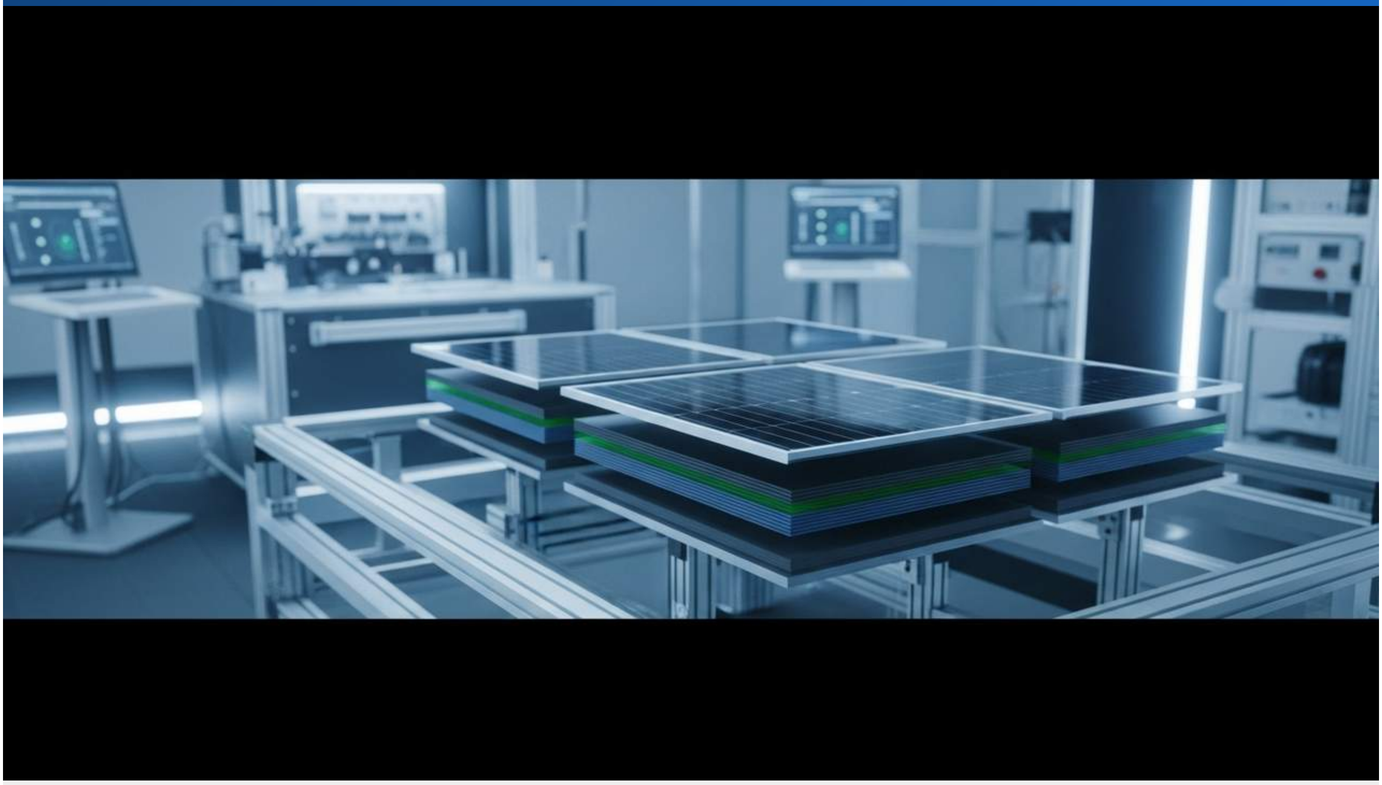
Strategic Significance & Outlook

The development of this perovskite/CIGS tandem solar cell, boasting 29.71% efficiency and significantly enhanced stability, is poised to dramatically accelerate the commercialization timeline for next-generation thin-film photovoltaics. The four-terminal architecture inherently offers distinct advantages, including superior tolerance to partial shading and enhanced adaptability across varying spectral conditions, making it exceptionally promising for diverse applications. These include building-integrated photovoltaics (BIPV), portable electronics, and flexible solar cell designs. Looking ahead, critical next steps for market readiness will involve rigorous validation of manufacturing scalability for large-area production, aggressive cost optimization, and adherence to stringent international durability standards. This groundbreaking technology holds the potential to unlock new frontiers in solar energy, adeptly balancing unprecedented efficiency with unwavering reliability.

Source: https://pv-magazine-usa.com/2026/07/30/chinese-researchers-build-29-71-perovskite-cigs-tandem-solar-cell-based-on-sulfide/

#14 QcellsのペロブスカイトｰシリコンタンデムパネルｰTÜV RheinlandによりIEC/UL信頼性・安全性基準をクリアし商業化へ大きく前進

Published Published July 31, 2026 Autonocion.com スペイン



OVERVIEW

Qcells' perovskite-silicon tandem panels have received crucial certification from TÜV Rheinland, confirming compliance with IEC 61215 reliability and UL 61730 safety standards. This milestone signifies a major step towards the commercialization and mass production of perovskite technology, directly addressing historical stability challenges. The panels demonstrated exceptional durability in extreme thermal cycling and damp heat tests, paving the way for wider market adoption and essential project financing.

IN DEPTH

Background

Perovskite solar cells represent a highly anticipated next-generation photovoltaic technology, renowned for their theoretical high efficiency and potential for cost-effective manufacturing. However, their primary hurdle has historically been ensuring long-term stability and durability, particularly in outdoor environments susceptible to various stressors like extreme temperatures and humidity. For any solar product to gain market acceptance, secure consumer trust, and attract the necessary project financing from financial institutions, rigorous third-party certifications like IEC and UL are indispensable. These certifications serve as a critical prerequisite for validating product reliability and safety, essential for scaling from laboratory research to commercial deployment.

Key Findings

Qcells has achieved a pivotal breakthrough with its newly developed perovskite-silicon tandem solar panels, which have now received official certification from TÜV Rheinland, a globally recognized certification body. This certifies the panels' compliance with international standards IEC 61215 for reliability and UL 61730 for safety. This landmark achievement is a critical milestone, unequivocally demonstrating that perovskite solar cell technology can maintain long-term reliability and safety even under harsh environmental conditions, moving beyond lab-scale limitations towards commercial mass production and market adoption.

The certification process involved comprehensive testing against key environmental stress factors designed to evaluate the panels' long-term operational integrity. Qcells' tandem panels exhibited superior performance in particularly demanding test categories:

- **Thermal Cycling Test:** The panels successfully endured 200 cycles of extreme temperature fluctuations, ranging from -40°C to 85°C. This rigorous evaluation confirms the material's robust stress tolerance against the thermal expansion and contraction that occurs daily in real-world conditions.
- **Damp Heat Test:** The panels were subjected to continuous exposure for 1,000 hours in a high-temperature (85°C) and high-humidity (85% relative humidity) environment. This test specifically assesses the module's resistance to degradation caused by moisture ingress, a historically significant challenge for perovskite materials.

Successfully passing these stringent tests underscores significant advancements in perovskite layer stability, encapsulation technology, and device architecture optimization. Overcoming the inherent vulnerability of perovskite materials to humidity and achieving compliance with international commercial standards is a groundbreaking accomplishment. This certification not only positions Qcells advantageously in the competitive solar market but also accelerates the adoption of high-efficiency, next-generation solar cell modules globally. It signals that perovskite-silicon tandem technology is nearing readiness for actual market deployment, promising to foster the standardization and widespread adoption of perovskite technology as a whole, thereby substantially enhancing solar power efficiency and ensuring reliability across the industry.

Source: https://www.autonocion.com/qcells-perovskite-solar-panel-iec-ul-certified-reliability/

#15 n-i-p型ペロブスカイト太陽電池の効率と安定性を向上させる無機正孔輸送材料の役割を包括的にレビュー

Published Published August 06, 2026 PMC - NIH (Advanced Energy Materials) USA

OVERVIEW

A recent comprehensive review highlights the pivotal role of inorganic hole transport materials (HTMs) in boosting the efficiency and long-term reliability of n-i-p perovskite solar cells (PSCs). The paper meticulously analyzes how these HTMs improve photovoltaic parameters, suppress detrimental ion migration, and enhance operational stability. Materials such as metal oxides, chalcogenides, and hybrid inorganic-organic HTLs are emphasized for their potential in enabling efficient, durable, and scalable PSCs through both solution processing and vacuum deposition techniques.

IN DEPTH

Key Findings

A comprehensive review paper has been published, highlighting the critical role of inorganic hole transport materials (HTMs) in enhancing the performance and long-term reliability of n-i-p perovskite solar cells (PSCs). The review meticulously analyzes how inorganic HTMs contribute to improving photovoltaic parameters, suppressing ion migration, and enhancing operational stability, clearly outlining their diverse types and applicability.

Technical Details

The review primarily focuses on inorganic HTMs, such as metal oxides (e.g., NiO, MoO_3), chalcogenides (e.g., CuS), and hybrid inorganic-organic HTLs. These materials offer distinct advantages over their organic counterparts, including higher intrinsic conductivity, superior chemical stability, and lower cost. Inorganic HTMs improve PSC performance through the following mechanisms:

- **Improvement of Photovoltaic Parameters:** They facilitate efficient extraction and transport of holes while suppressing charge recombination, thereby enhancing fundamental device performance metrics such as open-circuit voltage (V_{oc}), short-circuit current (J_{sc}), and fill factor (FF).
- **Suppression of Ion Migration:** Ion migration (particularly of halide ions) within the perovskite layer is a major cause of device degradation. Inorganic HTMs act as an effective barrier layer, significantly suppressing this migration and thus enhancing overall device stability.
- **Enhancement of Operational Stability:** Demonstrating high stability against heat, light, and humidity, inorganic HTMs improve the overall durability of the device, ensuring long-term operational reliability crucial for commercial viability.

These HTMs are versatile, applicable in both solution processing methods (e.g., spin coating, blade coating) and vacuum deposition techniques, holding significant promise for scalability in large-scale manufacturing.

Background & Context

Perovskite solar cells (PSCs) are garnering significant attention as a promising next-generation photovoltaic technology due to their high theoretical efficiency. However, ensuring long-term stability remains the most formidable challenge for their widespread commercialization. Organic hole transport materials, commonly used, are often expensive and possess limited chemical stability, prompting an active search for alternative materials. Inorganic HTMs have emerged as highly promising candidates to overcome these critical challenges, and their continued research and development are indispensable for accelerating the practical implementation of PSCs. The n-i-p configuration represents a standard and widely adopted device architecture, and optimizing HTMs within this structure directly bridges laboratory record efficiencies to industrial applications.

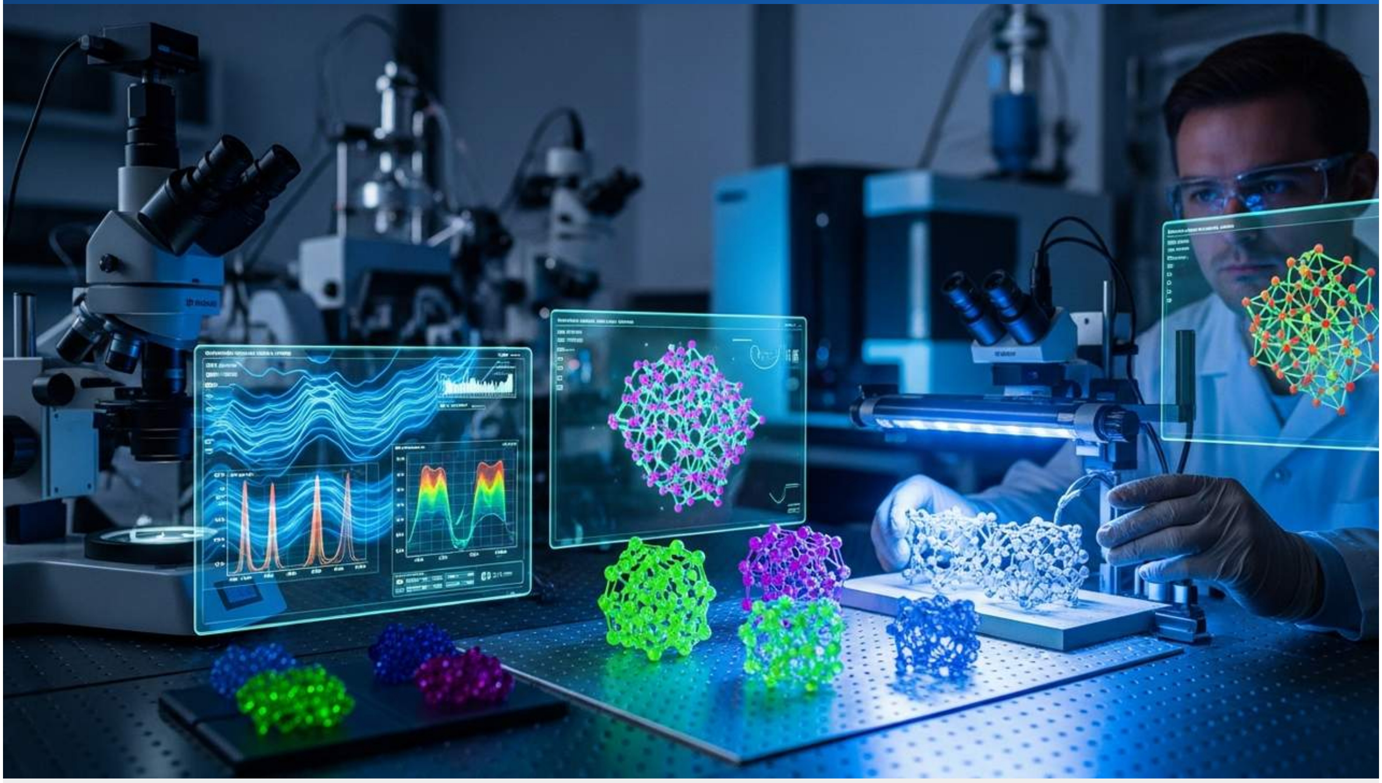
Strategic Significance & Outlook

Further research and development of inorganic HTMs hold the potential to dramatically improve both the performance and longevity of perovskite solar cells. The ongoing development of superior inorganic HTMs will accelerate the realization of PSCs that combine high efficiency, exceptional stability, and low cost—factors critical for their widespread adoption. This will significantly contribute to the broader implementation of solar power globally. In the future, these advanced materials are expected to be seamlessly integrated into large-scale manufacturing processes, laying the groundwork for perovskite solar cells to play a crucial and transformative role in the global energy mix.

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11202302/

#16 混合ハロゲン化物ペロブスカイトでバンドギャップ依存の欠陥特性を解明、新規パッシベーションで非放射再結合を抑制

Published Published August 05, 2026 AIP Publishing USA



OVERVIEW

New research elucidates bandgap-dependent defect properties in mixed-halide perovskites, a crucial advancement for materials science. The study reveals that in bromine-rich wide-bandgap perovskites, defect activation energy and depth increase with wider bandgaps. A novel passivation technique using p-phenylenediamine diiodide effectively suppresses non-radiative recombination and extends carrier lifetimes by targeting iodide-vacancy related defects, leading to improved device performance critical for high-efficiency, stable next-generation perovskite solar cells.

IN DEPTH

Background

Wide-bandgap perovskites are indispensable materials for achieving high efficiencies as top sub-cells in perovskite-silicon tandem and all-perovskite tandem solar cells. However, WBG perovskites, particularly in mixed bromine-iodine systems, have faced persistent challenges regarding instability, such as phase segregation and defect formation. Overcoming these issues requires a deep understanding of defect characteristics and effective control techniques. This research not only deepens the fundamental physicochemical understanding of perovskite materials but also provides concrete material design strategies to improve their stability, thus significantly contributing to the practical implementation of next-generation high-efficiency solar cells.

Key Findings

New research has unveiled that defect properties in mixed-halide perovskites exhibit bandgap-dependent behavior, leading to a crucial advancement in materials science understanding. Specifically, in bromine (Br)-rich wide-bandgap (WBG) perovskites, defect activation energy was found to increase with increasing bandgap, resulting in the formation of deeper defect states. One of the primary factors hindering the efficiency and stability of perovskite solar cells is the presence of these defects within the crystal and at interfaces. These defects promote "non-radiative recombination," where light-generated electrons and holes are lost before they can be converted into electrical power. This study revealed that in perovskites with high bromine concentrations, as the bandgap widens, defect energy levels become deeper, which facilitates charge carrier trapping and degrades device performance.

Based on this insight, a novel passivation technique using p-phenylenediamine diiodide for iodide-vacancy-related defects was developed. The introduction of p-phenylenediamine diiodide successfully "passivated" (inactivated) defects associated with iodide vacancies (missing iodine atoms) within the perovskite crystal. This passivation layer neutralizes defect states, improving charge carrier transport efficiency and significantly suppressing non-radiative recombination. As a result, carrier lifetimes were extended, leading to improved open-circuit voltage (Voc) and fill factor (FF) of the solar cell, and ultimately, enhanced overall conversion efficiency and device performance.

Strategic Significance & Outlook

These new insights into defect control will profoundly impact the design and optimization of mixed-halide perovskite solar cells. Specifically, by improving the stability and efficiency of WBG perovskites, it will be possible to further enhance the overall performance of tandem solar cells. Moving forward, research will focus on integrating this passivation technique into large-scale manufacturing processes and verifying its applicability to different perovskite compositions. This is expected to accelerate the commercialization of more durable and highly efficient perovskite solar cells, thereby improving the cost-effectiveness and adoption rate of solar power.

Source: https://pubs.aip.org/aip/apl/article-abstract/129/6/063901/2903567/Bandgap-dependent-defect-properties-in-mixed-halide

#17 Power Rollのマイクログルーブペロブスカイト太陽電池フィルム商業化へ、POP-PV国際プロジェクトが始動

Published Published August 01, 2026 PV Magazine USA

OVERVIEW

An international consortium comprising Power Roll (UK), Dyenamo (Sweden), and the University of Sheffield (UK) has launched the 'POP-PV' project (Process Optimization & Production Readiness for Next Generation Solar PV Manufacturing). This initiative aims to fast-track the commercialization of Power Roll's distinctive micro-groove perovskite solar film by addressing critical challenges in stability, manufacturability, and scalability for large-scale production, while also investigating advanced interfacial materials like self-assembled monolayers (SAMs).

IN DEPTH

Background

As the global transition to renewable energy intensifies, there is a growing demand for solar photovoltaic (PV) technologies that are lightweight, flexible, and cost-effective, capable of adapting to a wide range of installation environments. Perovskite solar cells have emerged as highly promising candidates that fulfill these criteria. However, their widespread commercialization has been hindered by persistent technical challenges, particularly concerning long-term stability and viable large-scale manufacturing processes. Power Roll's innovative micro-groove technology offers a distinctive approach to overcome these hurdles, positioning the POP-PV project to play a pivotal role in accelerating the industrialization of perovskite technology across Europe.

Project Overview and Technical Objectives

The international collaborative project, 'POP-PV' (Process Optimization & Production Readiness for Next Generation Solar PV Manufacturing), has officially commenced, bringing together expertise from Power Roll (UK), Dyenamo (Sweden), and the University of Sheffield (UK). The project's overarching goal is to accelerate the commercialization pathway for Power Roll's distinctive micro-groove perovskite solar film technology.

At its core, POP-PV leverages Power Roll's innovative micro-groove architecture. This proprietary technique involves depositing a perovskite layer onto a microscopically grooved substrate, a design that significantly enhances both the flexibility and durability of the solar film while maintaining high power conversion efficiency. The project is strategically focused on addressing key technical challenges through the following pillars:

- **Enhanced Stability:** Developing advanced materials and device architectures to significantly boost the environmental stability of perovskite layers, specifically improving resistance to moisture, oxygen, heat, and light degradation.
- **Optimized Manufacturability:** Streamlining and refining manufacturing technologies tailored for efficient, large-scale printing processes, particularly roll-to-roll (R2R) production.

- **Scalability for Mass Production:** Devising processes and implementing cost-reduction strategies essential for transitioning production from laboratory scale to gigawatt (GW)-level mass commercial output.
- **Advanced Interfacial Material Research:** Investigating cutting-edge interfacial materials, with a specific emphasis on self-assembled monolayers (SAMs), to further improve charge transport efficiency and bolster overall device stability.

These concerted efforts are designed to enable the widespread deployment of solar power in environments where conventional silicon panels face significant limitations, such as existing building roofs, facades, and various transport vehicles, owing to the micro-groove films' inherent lightweight and flexible attributes.

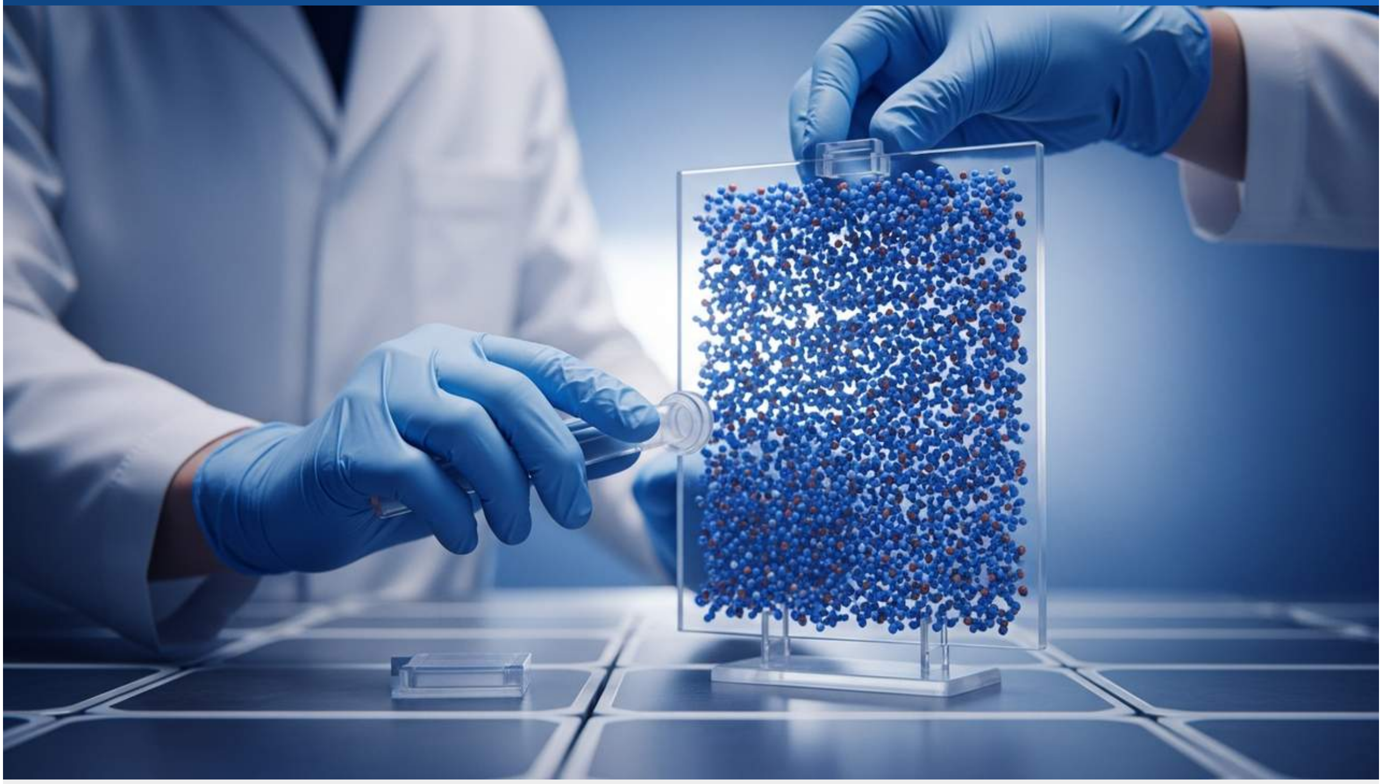
Strategic Significance and Outlook

The successful execution of the POP-PV project is poised to profoundly impact the thin-film and flexible solar cell markets. It is expected to accelerate the widespread adoption of perovskite technology across a diverse array of applications, including building-integrated photovoltaics (BIPV), portable electronics, electric vehicles (EVs), and unmanned aerial vehicles (drones). The strategic integration of advanced materials, such as self-assembled monolayers (SAMs), holds significant potential for further elevating future device performance. This international collaboration represents a pivotal stride towards achieving genuine commercial success for perovskite technology, thereby making a substantial contribution to a sustainable energy future.

Source: https://pv-magazine-usa.com/press-releases/new-pop-pv-project-to-advance-power-rolls-micro-groove-perovskite-solar-film-toward-commercialization/

#18 混合配位子駆動型相純粋2Dペロブスカイトにより、界面パッシベーションを強化し太陽電池の効率と安定性を向上

Published Published August 03, 2026 Journal of the American Chemical Society (ACS Publications) USA



OVERVIEW

A novel mixed-ligand-driven, phase-pure 2D perovskite structure has been developed to enhance interfacial passivation in perovskite solar cells. This coassembled architecture effectively passivates defects and improves charge extraction, suppressing non-radiative recombination and boosting power conversion efficiency. This strategy significantly advances the performance and long-term reliability of next-generation photovoltaic devices.

IN DEPTH

Background

Perovskite solar cells are highly anticipated as next-generation photovoltaic technologies due to their high theoretical efficiency and potential for low-cost manufacturing. However, ensuring long-term stability and reliability is indispensable for practical implementation and market adoption, with interfacial stability and defect control being major challenges. 2D perovskites are known to possess superior environmental stability compared to 3D perovskites, and research actively combines the benefits of both by forming 3D/2D heterostructures. The success of this mixed-ligand-driven 2D perovskite opens a new frontier in this field.

Key Findings

A novel strategy for interfacial passivation in perovskite photovoltaics (PV) has been introduced, utilizing a mixed-ligand-driven, phase-pure 2D perovskite architecture to significantly enhance performance and long-term reliability. This innovative coassembled structure promotes the formation of a phase-pure 2D layer, which dramatically improves charge extraction efficiency while effectively passivating interfacial defects present on the perovskite layer's surface and grain boundaries. Consequently, non-radiative recombination is suppressed, carrier lifetimes are prolonged, leading to improved fill factor and open-circuit voltage, and ultimately a substantial increase in power conversion efficiency (PCE).

Technical Details

One of the primary factors limiting the performance of perovskite solar cells are defects at the interface between the perovskite crystal and adjacent charge transport layers. These defects serve as sites for non-radiative recombination, where photogenerated electrons and holes are lost before they can be utilized as electrical power. The mixed-ligand-driven 2D perovskite developed in this study self-assembles on the 3D perovskite surface, effectively filling defects and optimizing the interfacial energy barriers. The formation of a phase-pure 2D layer contributes to uniform defect passivation and provides excellent charge transport pathways, thereby suppressing charge carrier recombination. Specifically, this strategy led to a significant increase in the device's open-circuit voltage (Voc) and an improved fill factor (FF) without a decrease in current density (Jsc). This is a critical advancement that directly contributes to improved long-term device stability.

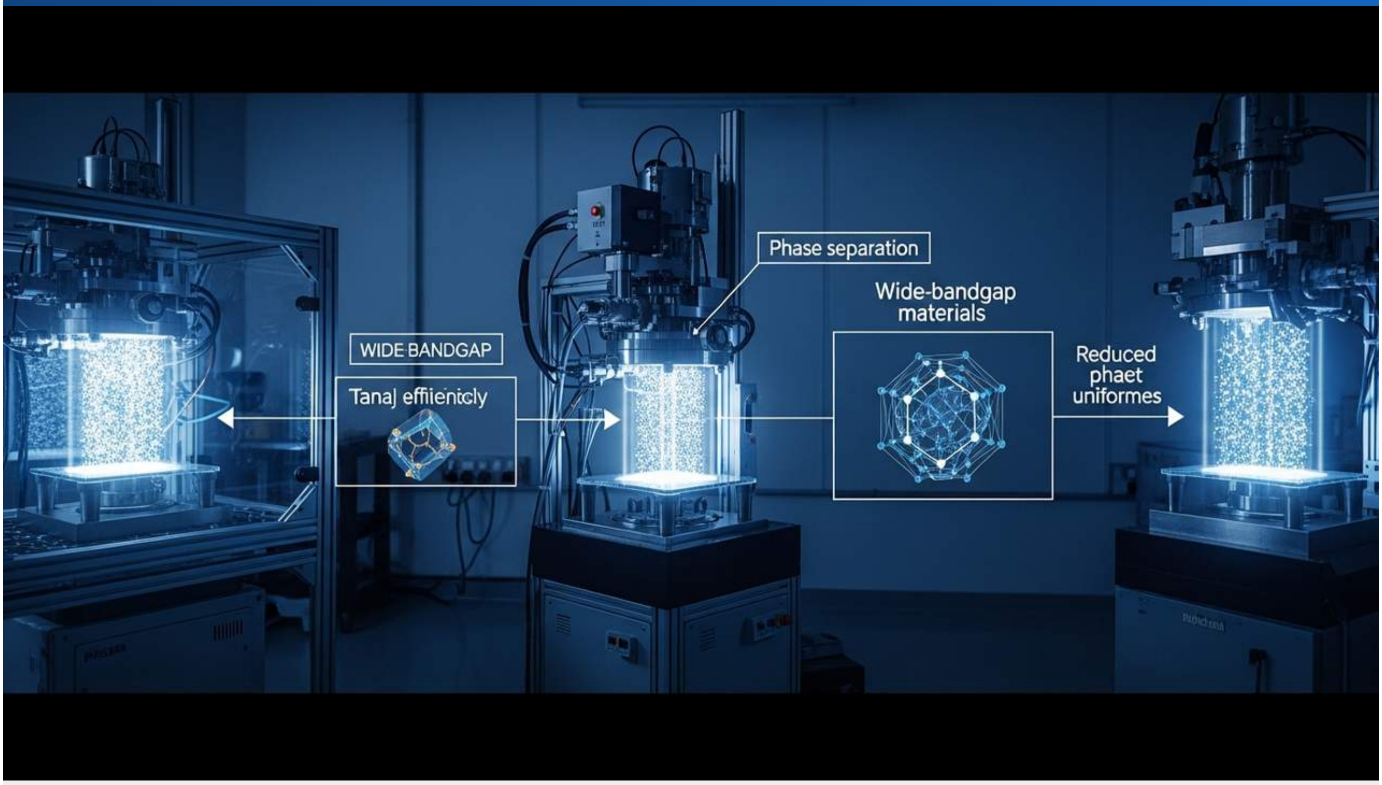
Strategic Significance & Outlook

This interfacial passivation strategy using mixed-ligand-driven phase-pure 2D perovskites will significantly push the performance limits of perovskite solar cells and contribute substantially to enhancing reliability for commercialization. Especially, efficient control of interfacial defects will extend device lifespan and enable stable operation in harsher outdoor environments. Future research will focus on scaling up this technology for larger areas, simplifying manufacturing processes, and verifying its applicability to different perovskite compositions and device structures. This research is expected to accelerate the practical implementation of highly efficient and durable perovskite solar cells, making them an indispensable component for realizing a sustainable energy society.

Source: https://pubs.acs.org/doi/10.1021/jacs.6c05089

#19 ワイドバンドギャップペロブスカイト太陽電池の結晶化変調技術レビュー、相分離・欠陥抑制で22.3%効率と31.2%タンデム効率を報告

Published Published August 02, 2026　ResearchGate　USA



OVERVIEW

A new review highlights advanced crystallization modulation strategies crucial for overcoming critical issues like phase segregation, defect formation, and stability in wide-bandgap (WBG) perovskite solar cells. These techniques, including the use of coordinating solvents for uniform halide distribution and Co-SAMs for enhanced thermal stability, have enabled record power conversion efficiencies of 22.3% for single-junction devices and 31.2% for perovskite/silicon tandems, offering indispensable insights for future development.

IN DEPTH

Background

Tandem solar cells are the most promising candidates to break through the theoretical efficiency limits of conventional single-junction silicon solar cells, and WBG perovskites are essential as top sub-cells. However, the instability of WBG perovskites has been a major bottleneck for the commercialization of this technology. "Crystallization modulation," which precisely controls the crystallization process, is recognized as a powerful tool for fundamentally improving the quality and stability of perovskite thin films. This review consolidates the latest research findings in this field and outlines future directions for R&D.

Key Findings

A comprehensive review paper has been published, focusing on crystallization modulation strategies to overcome critical challenges such as phase segregation, defect formation, and stability in wide-bandgap (WBG) perovskite solar cells and modules. The review reports high power conversion efficiencies (PCE) of 22.3% for single-junction PSCs and 31.2% for perovskite/silicon tandem devices, providing indispensable technological insights for achieving high performance and long-term stabilization of WBG perovskites.

Technical Details

WBG perovskites, due to their wide bandgap characteristics, are ideal as top sub-cells in tandem solar cells. However, issues like phase segregation in mixed-halide systems and the presence of defect states have hindered device stability and efficiency. The review highlights the following crystallization modulation strategies to address these challenges:

- **Use of Coordinating Solvents:** In large-scale manufacturing processes like blade coating, adding coordinating solvents such as 2-pyrrolidinone (2-P) to the perovskite precursor solution helps maintain a uniform halide distribution and optimize the crystallization process. This aims to suppress phase segregation and improve crystal quality.

- **Co-SAMs (Co-Self-Assembled Monolayers) Strategy:** Introducing Co-SAMs at the device interface passivates defects at the interface between the perovskite film and the charge transport layer, significantly enhancing thermal stability. SAMs facilitate charge transport while also serving as a protective layer against environmental factors.

These strategies span from material design to process control, externally complementing the intrinsic instabilities of WBG perovskites. The reported 31.2% tandem efficiency underscores the high effectiveness of these modulation techniques.

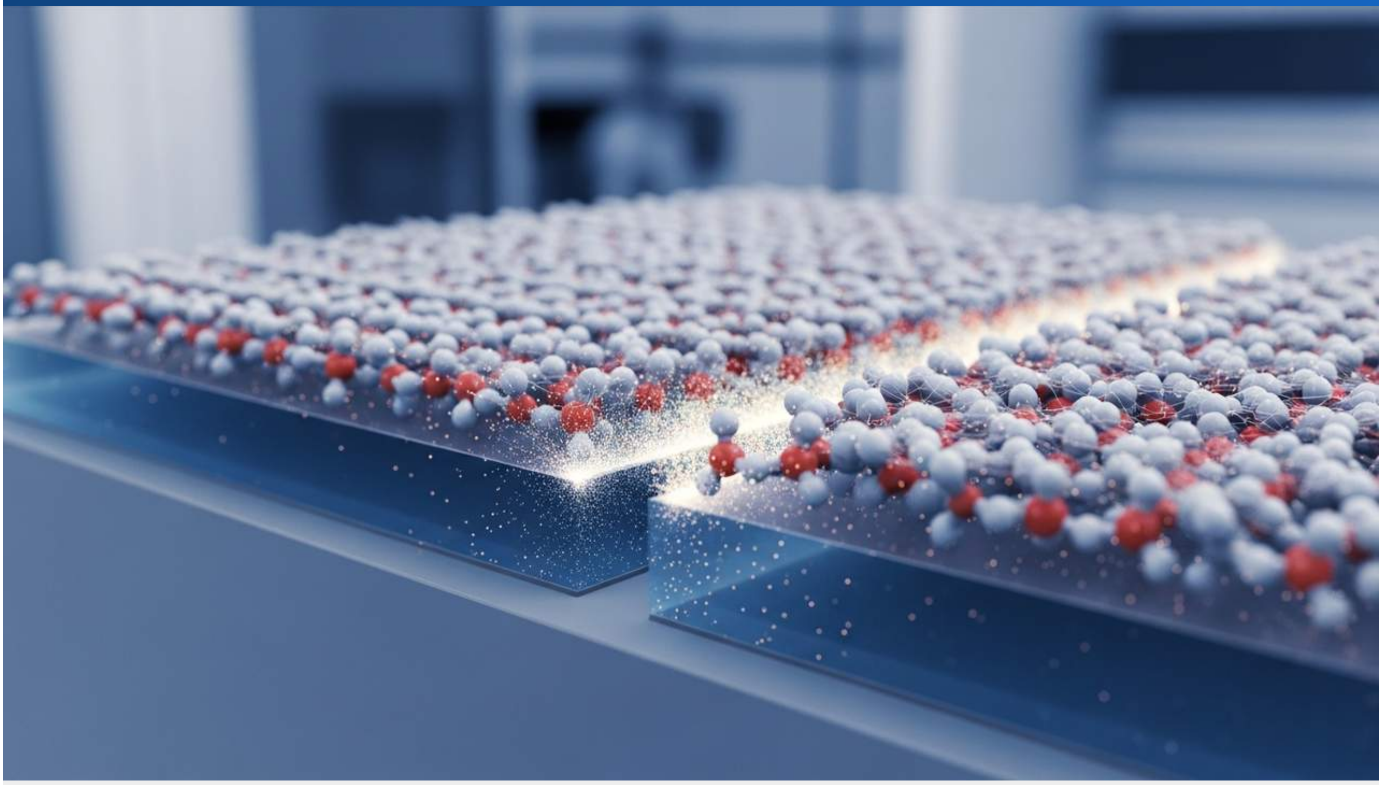
Strategic Significance & Outlook

The crystallization modulation strategies presented in this review are expected to further accelerate the high performance and stabilization of WBG perovskite solar cells. Particularly, increased applicability to large-scale manufacturing processes is anticipated to hasten the market introduction of perovskite/silicon tandem solar cells. Moving forward, the focus will be on developing large-area modules integrating these technologies, validating long-term durability, and reducing costs. This insight is essential for realizing highly efficient and reliable next-generation solar cells, thereby strengthening contributions to a sustainable energy society.

Source:
https://www.researchgate.net/publication/382607106_Crystallization_Modulation_for_Stable_Wide-Bandgap_Perovskite_Solar_Cells_and_Modules

#20 ペロブスカイト表面終端に依存する分子相互作用が界面エネルギーと相安定性に及ぼす影響を解明、逆型PSCの性能向上へ

Published Published July 30, 2026 ACS Publications USA



OVERVIEW

New research unveils how perovskite surface termination critically influences interfacial energy and phase stability through molecular interactions. While piperazine interaction enhances stability and passivates defects on PbX_2-terminated surfaces, it surprisingly destabilizes AX-terminated surfaces. This complex, surface-dependent behavior highlights the necessity of precise interfacial termination control for developing high-performance, stable inverted perovskite solar cells.

IN DEPTH

Background

Inverted perovskite solar cells (PSCs) hold immense promise for applications such as tandem solar cells and building-integrated photovoltaics (BIPV), owing to their high efficiency and excellent transparency. However, achieving long-term reliability is paramount for their commercialization, with interfacial stability and defect control remaining significant challenges. A fundamental understanding of perovskite surfaces at the atomic level, and how they impact interfacial interactions, is crucial for fundamentally improving device stability. This research exemplifies cutting-edge work in this field, leveraging insights from surface chemistry to enhance the performance and durability of PSCs.

Key Findings

In a significant contribution to enhancing the efficiency and stability of perovskite solar cells, detailed research has revealed that the perovskite surface termination structure intricately influences interfacial energetics and material phase stability through molecular interactions. A contrasting outcome was observed: while piperazine interaction enhances structural stability (acting as a defect passivation agent) on PbX2-terminated perovskite surfaces, it may, conversely, accelerate material degradation on AX-terminated surfaces. This pivotal discovery underscores the critical importance of precise interfacial control of surface termination in the design of inverted perovskite solar cells (PSCs).

Technical Details

A primary cause of performance degradation in perovskite solar cells stems from defects present at the interface between the perovskite layer and the charge transport layer. These defects promote the recombination of light-generated charge carriers and compromise device stability. This study elucidated, at an atomic level, that the interaction with specific molecules (e.g., piperazine) differs significantly based on whether the perovskite crystal surface is PbX2-terminated (by lead and halide ions) or AX-terminated (by organic cation and halide ions). On PbX2-terminated surfaces, piperazine was shown to effectively passivate defects and improve both thermal and chemical stability. However, on AX-terminated surfaces, interaction with piperazine is suggested to destabilize the perovskite crystal structure, potentially accelerating degradation. This complex surface chemistry underscores that optimizing interfacial layer material selection and processing conditions necessitates targeting and controlling specific surface terminations.

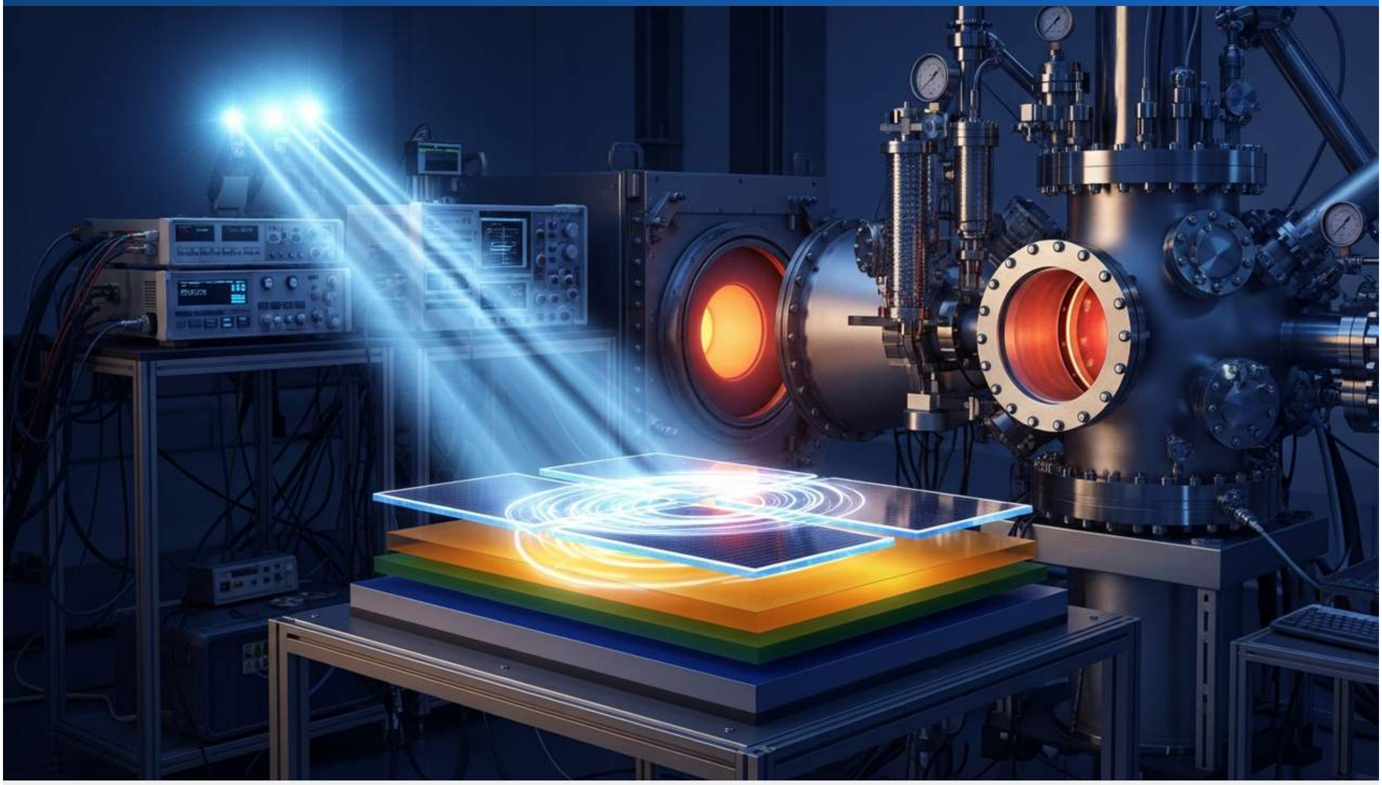
Strategic Significance & Outlook

The insights gained from this research on perovskite surface termination provide indispensable guidelines for designing highly efficient and stable inverted perovskite solar cells. Moving forward, this will accelerate the molecular design of interfacial layers tailored for specific surface terminations, alongside the development of advanced manufacturing techniques to precisely control surface termination during production. Such advancements will significantly enhance device reproducibility and long-term reliability, opening pathways for practical implementation even under harsher environmental conditions. This achievement is anticipated to be a crucial step for perovskite solar cells to solidify their position as a leading next-generation solar cell technology.

Source: https://pubs.acs.org/doi/10.1021/acsami.6c05001

#21 ホルムアミジニウム共晶体を利用した熱蒸着法でペロブスカイト-シリコンタンデムが31.5%効率を達成、大面積製造へ道

Published Published August 05, 2026 ScienceDaily USA



OVERVIEW

Researchers have developed an innovative thermal evaporation technique using formamidinium iodide (FAI) eutectics, achieving a record 31.5% steady-state efficiency for 1 cm^2 perovskite-silicon tandem solar cells and an impressive 30.0% on large 200 cm^2 wafers. This breakthrough overcomes the long-standing challenge of FAI degradation during evaporation, enabling precise compositional control and high uniformity crucial for large-scale manufacturing and accelerating the commercialization of high-efficiency tandem photovoltaics.

IN DEPTH

Background

Perovskite-silicon tandem solar cells are widely recognized as the most promising technology to surpass the theoretical efficiency limit of single-junction silicon solar cells, typically around 29%. However, their commercialization hinges on simultaneously addressing three critical challenges: achieving high efficiency, ensuring long-term stability, and enabling low-cost, large-scale manufacturing. While solution processing methods are inexpensive, they often struggle with achieving uniform film quality and controlling defects over large areas. Conversely, thermal evaporation offers excellent uniformity and reduced defect density, making it attractive for thin-film production, but the thermal decomposition of perovskite materials, especially formamidinium-based organic salts, has historically presented a significant barrier to forming high-efficiency perovskite layers.

Key Findings

A research team has successfully developed an innovative thermal evaporation method that leverages formamidinium iodide (FAI) eutectics, setting a new benchmark with a remarkable steady-state power conversion efficiency (PCE) of 31.5% for a 1 cm^2 perovskite-silicon tandem solar cell. Crucially, this advanced method also demonstrated an impressive 30.0% PCE on a large-area 200 cm^2 wafer, a critical step towards industrial application. This technology directly addresses and resolves the persistent challenge of FAI degradation during thermal evaporation, enabling the precise compositional control and exceptional uniformity essential for large-scale production. This breakthrough significantly accelerates the potential for commercial mass production of high-efficiency tandem solar cells.

Technical Details

Thermal evaporation is a highly desirable manufacturing technique for thin films due to its inherent advantages in achieving superior uniformity and significantly reduced defect density compared to conventional solution processing methods, making it ideally suited for large-area applications. The primary hurdle for perovskite materials, particularly formamidinium-based organic salts, has been their susceptibility to decomposition when heated for evaporation. To overcome this, the researchers developed a novel precursor material that forms low-melting-point eutectics by carefully combining FAI with specific additives. This innovative approach facilitates stable evaporation while effectively suppressing thermal decomposition, allowing for precise control over film thickness and promoting uniform crystal growth. The result is the formation of high-quality perovskite layers over expansive areas. The dual achievement of 31.5% efficiency on a small 1 cm^2 cell and maintaining a robust 30% efficiency on a practical 200 cm^2 wafer powerfully underscores the commercial viability and scalability of this manufacturing approach.

Strategic Significance & Outlook

This novel thermal evaporation technology is strategically positioned to play a pivotal role in the large-scale manufacturing of high-efficiency perovskite-silicon tandem solar cells. The demonstration of 30% efficiency on a 200 cm^2 scale directly paves the way for the industrial production of solar modules. Future research and development efforts will concentrate on further optimizing the cost-effectiveness of this technology, conducting rigorous long-term durability testing, and facilitating the seamless transition to complete module products. This monumental progress is anticipated to dramatically enhance the cost-performance ratio of solar power, making it an indispensable factor in accelerating the global transition towards renewable energy sources.

Source: https://www.sciencedaily.com/releases/2026/08/260805123456.htm

#22 NMEE-Pho' 26国際会議、ペロブスカイト/シリコンタンデムPVとフレキシブル太陽電池フィルムに焦点

Published Published August 01, 2026 NMEE 2026 Conference Unknown

OVERVIEW

The NMEE-Pho' 26 session, part of the 4th International Conference on New Materials for Environment and Energy (NMEE 2026), has been announced. This critical platform aims to accelerate advancements in next-generation photovoltaic technologies, focusing specifically on solar energy utilization materials such as perovskite/silicon tandem solar cells and flexible solar cell films. Discussions will delve into key topics including material synthesis, charge separation mechanisms, and device integration to foster breakthroughs.

IN DEPTH

Background

Amidst the escalating global challenge of climate change, the imperative for renewable energy sources, particularly solar power, continues to intensify. Perovskite solar cells have emerged as highly promising 'next-generation solar cells,' captivating researchers with their impressive power conversion efficiencies and potential for low manufacturing costs. Despite this promise, significant technical hurdles persist before their widespread practical implementation, notably concerning material stability, large-scale manufacturing scalability, and environmental compatibility. International conferences, such as NMEE-Pho' 26, are indispensable platforms for disseminating the latest research findings, fostering solutions to these challenges, and catalysing international collaborative efforts.

Key Findings

The NMEE-Pho' 26 session, a core component of the 4th International Conference on New Materials for Environment and Energy (NMEE 2026), has been formally announced. This dedicated session is engineered to be a pivotal platform for accelerating breakthroughs in next-generation photovoltaic technologies, placing particular emphasis on advanced solar energy utilization materials, including high-efficiency perovskite/silicon tandem solar cells and versatile flexible solar cell films.

Technical Details

The NMEE-Pho' 26 session will delve into several critical technical areas:

- **Solar Energy Utilization Materials:** Exploring cutting-edge materials for high-efficiency, sustainable solar power generation, with a strong focus on perovskite/silicon tandem solar cells and flexible solar cell films.
- **Material Synthesis:** Innovations in synthetic methodologies for perovskite and related materials, including precise nanostructure control and the development of environmentally benign lead-free alternatives.
- **Charge Separation Mechanisms:** Advancing the fundamental understanding and optimization of electron and hole generation, transport, and separation processes crucial for enhanced solar cell performance.

- **Device Integration:** Technologies spanning the integration of solar cells from individual units into full modules and comprehensive systems, alongside strategies for ensuring long-term operational stability and reliability.

These core themes underscore a concerted research and development effort to devise multifaceted solutions for persistent challenges confronting perovskite solar cells, particularly concerning their efficiency, stability, and scalability for widespread adoption.

Strategic Significance & Outlook

The NMEE-Pho' 26 session is poised to offer an invaluable opportunity for researchers and engineers globally to exchange the latest knowledge and technological innovations pertaining to perovskite solar cells. It is anticipated that this conference will catalyze new breakthroughs in solar energy utilization materials, significantly accelerating the resolution of challenges ranging from fundamental material synthesis to complex device integration. Ultimately, this will advance the commercialization of pivotal technologies like perovskite/silicon tandem photovoltaics and flexible solar cell films, making a substantial contribution to the realization of a sustainable energy society. Crucially, fostering international collaboration and robust knowledge sharing remains paramount for expediting these technological developments.

Source: #

#23 ARAID研究者Emilio J. Juárez-Pérez氏、ペロブスカイト太陽電池の安定性向上に関するセミナーを沖縄で開催

Published Published August 04, 2026 ARAID スペイン

OVERVIEW

Dr. Emilio J. Juárez-Pérez from Spain's Aragón Agency for Research and Development (ARAID) presented innovative strategies to enhance the long-term stability of perovskite solar cells at a recent seminar in Okinawa, Japan. His presentation focused on advanced insights into material degradation mechanisms, real-world performance monitoring technologies, and the strategic integration of open-hardware solutions. This initiative fosters critical knowledge exchange and accelerates R&D between Spanish and Japanese researchers, paving the way for the broader commercialization of next-generation photovoltaics.

IN DEPTH

Background

Perovskite solar cells are garnering significant global attention as a promising next-generation photovoltaic technology, primarily due to their high conversion efficiencies and potential for low-cost manufacturing. However, a critical hurdle for their widespread commercialization and large-scale market adoption remains: ensuring long-term reliability and durability that rivals or surpasses existing silicon solar cells. Addressing this challenge, Dr. Emilio J. Juárez-Pérez, a distinguished researcher from Spain's Aragón Agency for Research and Development (ARAID), delivered a pivotal seminar in Okinawa, Japan, on July 27, 2026. This event served as an important platform for fostering knowledge sharing and joint research initiatives between European and Asian scientific communities, particularly significant given Japan's world-leading position in fundamental perovskite technology research.

Key Findings & Technical Approaches

During his presentation, Dr. Juárez-Pérez outlined a multi-faceted approach to overcome the biggest challenge for perovskite solar cells: achieving long-term stability. The seminar provided critical insights into practical implementation strategies, emphasizing:

- **Deep Understanding of Material Degradation Mechanisms:** Comprehensive analysis of how environmental factors, including heat, humidity, and UV radiation, impact perovskite materials, leading to the formation of defects and undesired phase changes. This detailed understanding is crucial for designing more resilient devices.
- **Real-World Monitoring Technologies:** Introduction of novel methods for real-time observation and assessment of device performance under actual outdoor conditions. This approach moves beyond conventional lab-based accelerated degradation tests, enabling more realistic and accurate reliability evaluations for device deployment.
- **Utilization of Open-Hardware Technologies:** An innovative strategy that leverages open-source hardware and software throughout the design, manufacturing, and evaluation processes of solar energy devices. This not only significantly reduces research and development costs but also actively promotes broader international collaboration and faster innovation cycles.

These integrated approaches offer robust solutions to the stability challenges faced by perovskite solar cells, harmonizing advancements in materials science, device engineering, and data science.

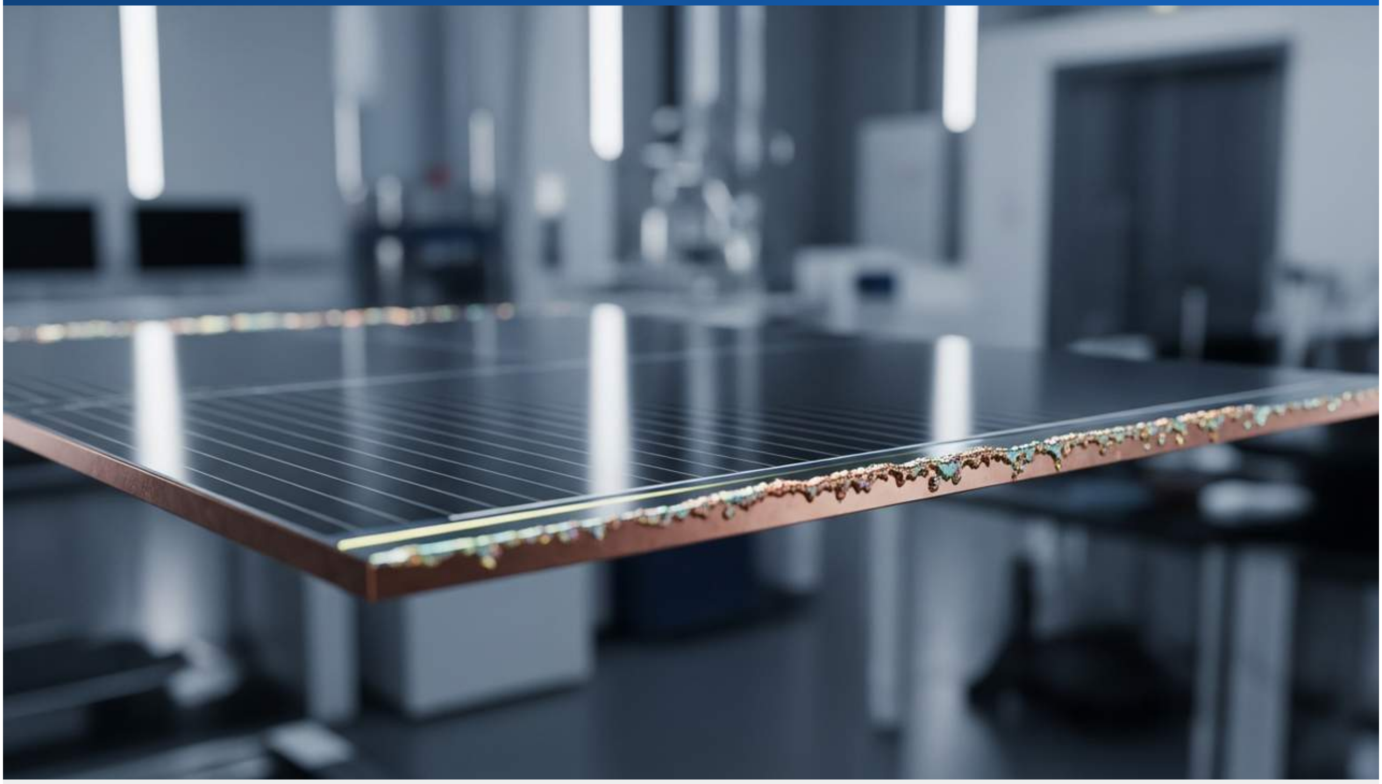
Strategic Significance & Outlook

The novel approaches to stability enhancement presented by Dr. Juárez-Pérez are expected to provide critical guidance for resolving the long-term reliability challenges inherent in perovskite solar cells. Specifically, the synergistic integration of real-world performance monitoring with open-hardware technologies is anticipated to significantly accelerate the R&D cycle, facilitating the design and validation of more robust and durable devices. Moving forward, these insights are poised to be further developed through international collaborative research, ultimately leading to the market introduction of highly efficient and durable perovskite solar cells. Such advancements will play a vital role in accelerating the global adoption of renewable energy and making substantial contributions to the realization of a sustainable society.

Source: https://www.araid.es/en/from-zaragoza-to-okinawa-new-approaches-to-improving-the-stability-of-perovskite-solar-cells

#24 中国科学院、ペロブスカイト太陽電池の銅電極に動作中のエッジ腐食を発見、ビスマス薄層で保護し安定性向上

Published Published August 07, 2026 PV Magazine USA



OVERVIEW

Researchers at the Chinese Academy of Sciences (CAS) have discovered that copper electrodes in perovskite solar cells suffer from unexpected edge corrosion during operation, leading to performance degradation and posing a new challenge for long-term stability. The team successfully demonstrated that applying a thin bismuth layer to the copper electrode effectively suppresses this corrosion, thereby limiting device degradation and significantly enhancing long-term stability. This breakthrough provides crucial insights for designing more reliable perovskite solar cells.

IN DEPTH

Background

Perovskite solar cells are widely regarded as 'next-generation solar cells,' garnering significant attention due to their high power conversion efficiency and low manufacturing costs. However, ensuring long-term reliability is paramount for their commercialization, and the degradation of electrode materials represents a primary challenge. Given that perovskite materials themselves are sensitive to moisture and oxygen, the stability of electrode materials is critically important in determining the overall device lifetime. Copper, while offering an excellent balance of performance and cost as an electrode material, has presented unresolved stability issues. This discovery bridges a significant gap from both materials science and device engineering perspectives.

Key Findings

A research team at the Chinese Academy of Sciences (CAS) has uncovered an unexpected mode of degradation: edge corrosion in copper electrodes of perovskite solar cells during operation. This corrosion significantly compromises device performance by reducing charge collection efficiency at the interfaces with perovskite or charge transport layers, thereby increasing device resistance. This leads to a measurable decrease in fill factor (FF) and open-circuit voltage (Voc), posing a critical new challenge for the long-term stability essential for commercialization.

To address this, the CAS team devised a novel strategy: depositing a nanometer-scale thin layer of bismuth (Bi) onto the copper electrode. Bismuth, being less reactive with copper, forms a stable protective film that effectively blocks the chemical degradation process occurring specifically at the copper edges. The introduction of this bismuth protective layer resulted in significantly more stable device operation and substantially improved long-term stability compared to devices employing conventional copper electrodes.

This discovery of copper electrode edge corrosion and the successful establishment of an effective protection strategy using a thin bismuth layer provide indispensable insights for designing robust and reliable perovskite solar cells. This innovation is expected to enable the safe and long-term use of copper electrodes, thereby accelerating cost reduction and commercialization efforts for perovskite technology. Future research will focus on further optimizing the bismuth layer's thickness and deposition methods, exploring combinations with other electrode materials, and integrating this solution into large-scale manufacturing processes. Ultimately, this work is poised to significantly enhance the reliability of perovskite solar cells, enabling them to play a crucial role in the global energy mix.

Source: https://pv-magazine-usa.com/2026/08/07/researchers-warn-of-unexpected-copper-corrosion-in-perovskite-solar-cells/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#25 EU PVSEC 2026、共同研究センター（JRC）がペロブスカイトを含む新規PVモジュールの正確な測定・標準化技術に貢献

Published Published August 01, 2026 Joint Research Centre (JRC) Europe連合

OVERVIEW

The European Union's Joint Research Centre (JRC) will commit technical expertise at EU PVSEC 2026 to develop accurate measurement and standardization techniques for novel photovoltaic (PV) modules, especially those incorporating perovskite materials. This initiative is crucial for establishing reliable performance evaluation frameworks, which are indispensable for the rapid market expansion and successful commercialization of next-generation PV technologies. The JRC's work aims to build essential trust in perovskite solar cells, thereby accelerating their market integration and fostering sustainable growth.

IN DEPTH

Background

Solar power is being rapidly adopted worldwide as a response to climate change and for energy security. Perovskite solar cells, with their high power conversion efficiency and low manufacturing costs, are garnering significant expectations as a 'next-generation' technology to further expand this market. However, for any new technology to be accepted by the market, reliable performance, guaranteed safety, and international standardization are indispensable. Contributions to measurement and standardization by public bodies like the JRC play a decisive role in building trust among the R&D community, industry, and consumers.

Key Findings

At the European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC 2026), the European Union's Joint Research Centre (JRC) announced its commitment to contribute to the development of accurate measurement methods and standardization techniques for novel photovoltaic (PV) modules, including those incorporating perovskite materials. This contribution underscores the critical necessity of reliable performance evaluation and standardization for the rapid market deployment of PV technologies, especially emerging materials.

Technical Details

The JRC, as the European Commission's science and knowledge service, provides independent research and technical support on renewable energy technologies, particularly photovoltaics. The JRC's technical contributions at EU PVSEC 2026 are focused on the following areas:

- **Enhancing Measurement Accuracy:** Novel materials like perovskite solar cells exhibit different physical and optical properties compared to traditional silicon cells, making accurate performance evaluation challenging with existing methods. The JRC will develop new high-precision measurement protocols to address these characteristics.
- **Promoting Standardization:** Standardization activities to enable international comparison of the reliability and performance of perovskite PV modules. This is essential for product quality assurance and reducing market entry barriers.

- **Strengthening Durability Assessment:** Development and validation of more stringent and realistic durability assessment methods to allay concerns regarding the long-term stability of perovskite materials.

These initiatives are crucial for establishing the technical foundation necessary for perovskite technology to achieve commercial success and large-scale deployment.

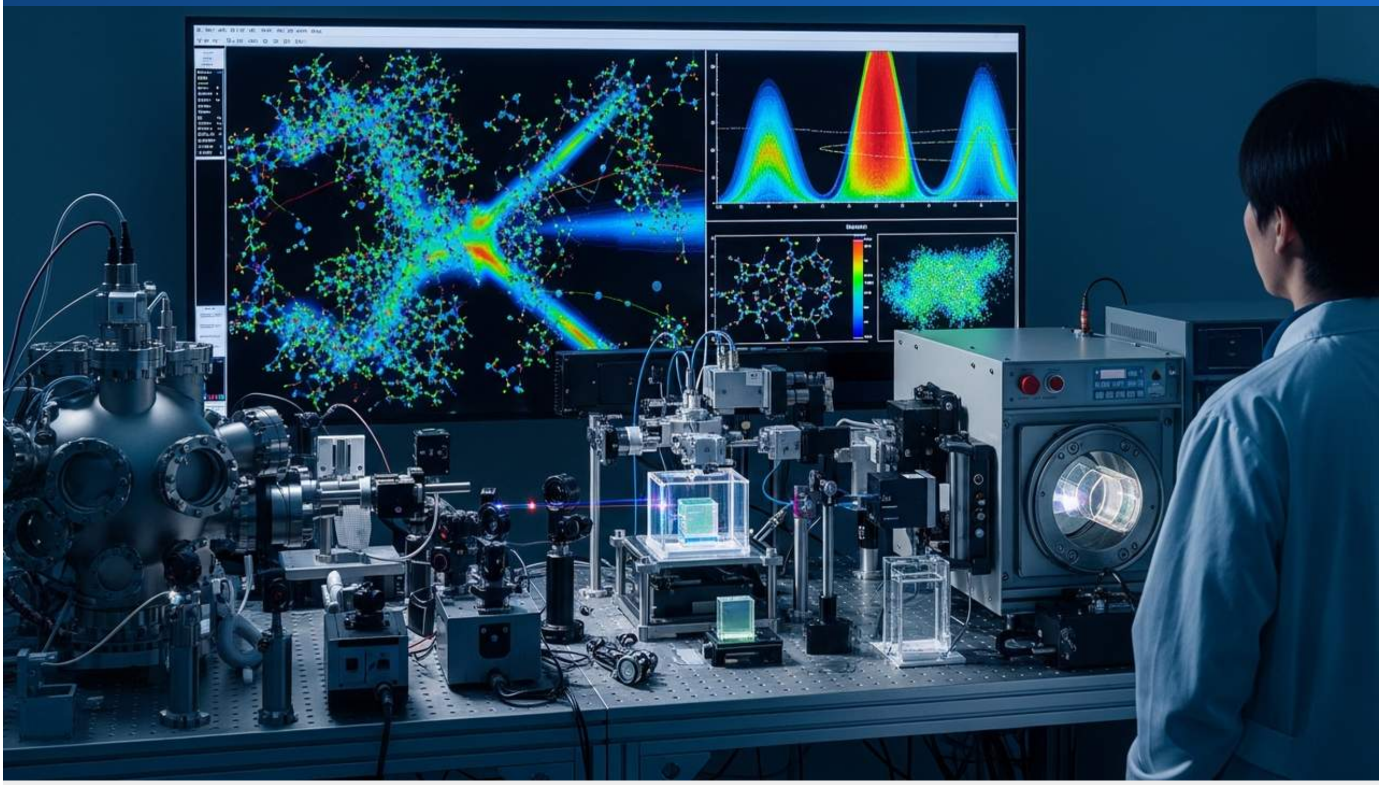
Strategic Significance & Outlook

The JRC's engagement at EU PVSEC 2026 is expected to accelerate the market integration of perovskite solar cells and foster the healthy development of the technology. Accurate measurement methods and established standards provide a clear framework for investors to trust perovskite technology and for manufacturers to deploy products in the global market. This is anticipated to lead to the widespread adoption of highly efficient and reliable perovskite solar cells, significantly contributing to the achievement of European and global clean energy targets. It also serves to strengthen the EU's leadership in international standardization activities.

Source: https://op.europa.eu/en/web/jrc/eu-photovoltaic-solar-energy-conference-and-exhibition

#26 Hanyang University Develops Predictive Model for 2D Perovskite Exciton Behavior, Accelerating Next-Gen Solar Cell Design

Published August 04, 2026 Advanced Functional Materials via Digital Journal South Korea



OVERVIEW

Researchers at Hanyang University in South Korea have developed a novel model that precisely predicts exciton behavior in 2D perovskites, demonstrating that dielectric screening environments dictate their properties. This predictive framework is poised to significantly accelerate the design and optimization of next-generation optoelectronic materials for solar cells, LEDs, and photodetectors. As perovskite solar cells near commercial deployment, this tool is crucial for shortening development cycles and reducing manufacturing uncertainties, paving the way for more efficient and stable devices.

IN DEPTH

Key Findings

A research team at Hanyang University in South Korea has developed a groundbreaking model capable of accurately predicting exciton behavior in two-dimensional (2D) perovskite materials. This innovative model unequivocally demonstrates that the dielectric screening environment primarily dictates exciton properties, promising to dramatically accelerate the design and optimization of next-generation optoelectronic devices such as solar cells, LEDs, and photodetectors.

Technical / Clinical Details

- The model precisely predicts the exciton binding energy in 2D perovskite semiconductors based on the strength of dielectric screening. This provides critical insights into the complex interplay between the material's atomic structure and its electronic properties, directly enabling the optimization of light absorption and emission efficiencies.
- The research meticulously analyzed exciton stability under various dielectric environments, confirming a high degree of concordance between the model's predictions and experimental data. This offers a powerful tool to forecast material performance prior to costly and time-consuming synthesis.
- By introducing this predictive framework, the traditional trial-and-error approach to material development, which often entails significant time and expense, can be substantially streamlined. This shortens the development cycle and significantly mitigates manufacturing uncertainties, making the path to commercialization more efficient.

Background & Context

Perovskite solar cells have garnered substantial attention as a promising next-generation technology, offering the potential for high efficiency and low-cost manufacturing that could surpass existing silicon-based photovoltaics. 2D perovskites, in particular, are favored for their superior stability and tunable properties, making them attractive for flexible devices and tandem architectures. However, understanding and controlling their intricate physical properties have remained major hurdles on the path to commercial viability. This new model represents a significant breakthrough in addressing these challenges, bridging the gap between fundamental material science and practical device engineering.

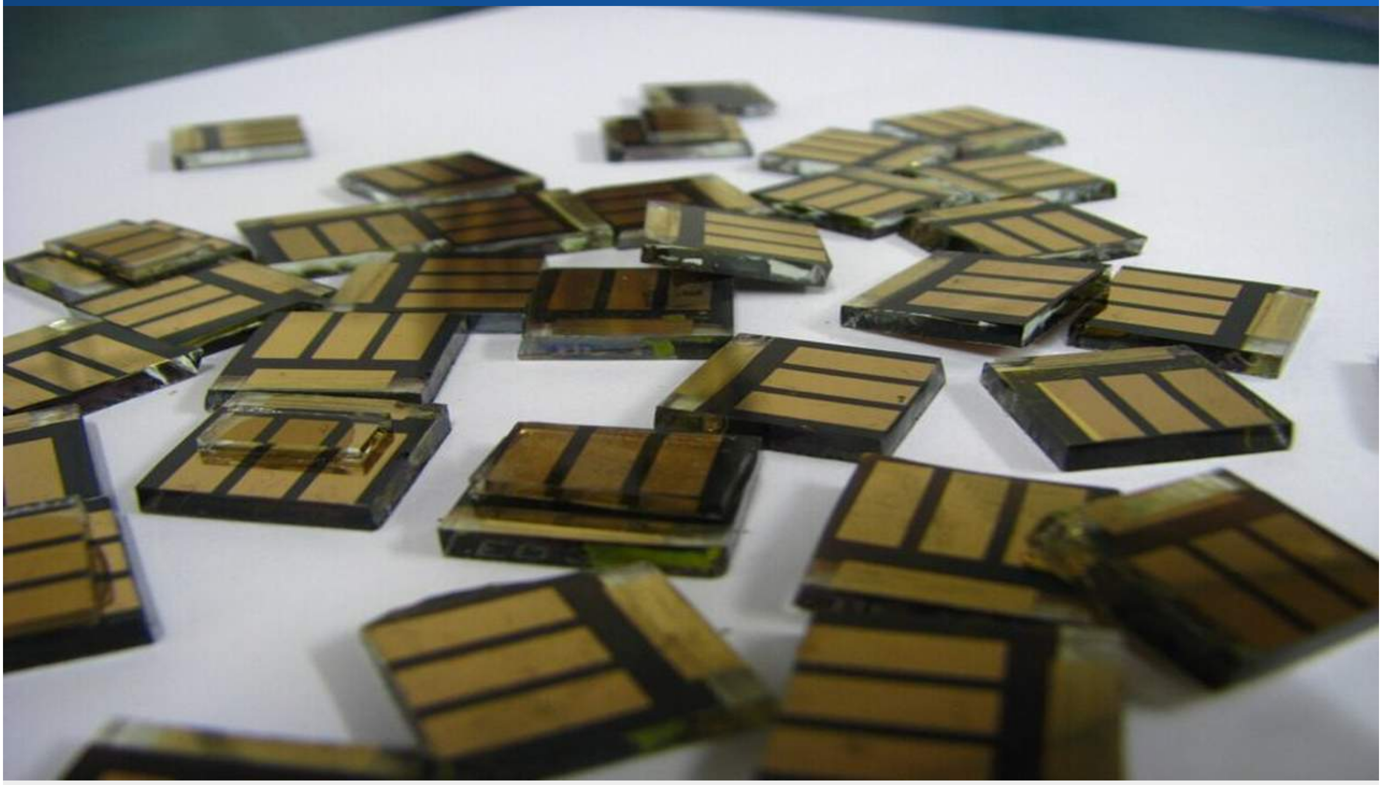
Strategic Significance & Outlook

This groundbreaking model provides a foundational understanding of perovskite materials at the atomic level, enabling the efficient design of devices with targeted performance characteristics. This will not only accelerate the research and development of perovskite solar cells towards commercial deployment but also contribute to the realization of higher-performance and more durable LEDs and photodetectors. In the long term, this predictive framework is expected to shorten the lead time from new material discovery to practical application, thereby contributing significantly to the advancement of sustainable energy technologies globally. The ability to predict material behavior before synthesis drastically cuts R&D costs and time, offering a competitive edge in the rapidly evolving optoelectronics market.

Source: https://www.digitaljournal.com/article/new-model-could-accelerate-development-of-next-generation-solar-cells-and-leds/

#27 Unexpected Copper Corrosion Detected at Perovskite Solar Cell Copper/MoO3 Interface, Posing Reliability Concerns

Published August 07, 2026 PV Magazine Germany



OVERVIEW

A research paper highlighted by PV Magazine warns of unexpected copper corrosion occurring at the copper/MoO3 interface within perovskite solar cells. This phenomenon could significantly compromise the long-term reliability of copper-based n-i-p type devices, necessitating further material selection and interface engineering. The finding underscores a critical reliability challenge for commercial deployment, demanding immediate attention to ensure durable perovskite technology.

IN DEPTH

Key Findings

A materials design paper, reported by PV Magazine, has revealed the potential for "unexpected copper corrosion" at the copper/MoO_3 interface in perovskite solar cells. This discovery raises significant concerns regarding the long-term stability and reliability of n-i-p type perovskite devices that utilize copper as an electrode material, suggesting a critical flaw previously overlooked.

Technical / Clinical Details

- The research meticulously analyzed the interaction at the interface between the copper electrode and molybdenum oxide (MoO_3). This interface is crucial for charge transport within the device, and its stability directly correlates with overall device performance.
- Analyses indicated that under specific conditions, copper reacts with MoO_3 to form corrosion products. This corrosion can degrade the electrical conductivity of the interface, potentially leading to a substantial reduction in the device's efficiency and operational lifespan.
- The issue surfaces as a significant reliability challenge, particularly for cost-effective designs employing copper electrodes, a challenge previously unrecognized amidst the rapid commercialization efforts of perovskite solar cells.

Background & Context

Perovskite solar cells are widely recognized as a next-generation photovoltaic technology due to their high power conversion efficiency and potential for low-cost manufacturing. However, ensuring long-term stability and reliability remains the paramount challenge for their widespread commercial deployment. Interfaces within these devices are critically important for efficient charge transport and overall device stability, necessitating precise material selection and interface optimization. The discovery of copper corrosion at this interface mandates a re-evaluation of existing material selection strategies and highlights the urgent need for developing more robust device architectures.

Strategic Significance & Outlook

This research emphatically points towards new directions for R&D aimed at enhancing the reliability of perovskite solar cells. Future efforts must prioritize exploring alternative materials for copper electrodes or developing novel barrier layers and doping strategies to mitigate corrosion at the copper/MoO3 interface. Overcoming this challenge will be pivotal for leveraging the inherent cost advantages of copper-based perovskite solar cells while simultaneously ensuring their long-term reliability and commercial success. The industry must collectively address this "invisible corrosion" problem to solidify perovskite technology's market position and accelerate its global adoption as a sustainable energy solution.

Source: https://www.pv-magazine.com/2026/08/07/researchers-warn-of-unexpected-copper-corrosion-in-perovskite-solar-cells/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#28 Hong Kong PolyU Develops Perovskite-Organic Tandem Solar Cell with Enhanced Reverse-Bias Stability, Withstanding Shading Damage >90%

Published August 03, 2026 PV Magazine Hong Kong

OVERVIEW

Researchers at Hong Kong Polytechnic University have developed a perovskite-organic tandem solar cell with significantly enhanced reverse-bias stability, demonstrating remarkable resistance to shading damage. This novel device maintains over 90% of its initial power conversion efficiency under severe reverse-bias stress by effectively suppressing leakage pathways and defects. This represents a crucial advancement in addressing a major reliability challenge for thin-film PV technology, substantially improving the durability and practical applicability of next-generation solar cells.

IN DEPTH

Key Findings

A research team at Hong Kong Polytechnic University has developed a perovskite-organic tandem solar cell with significantly enhanced reverse-bias stability, specifically designed to withstand shading damage, a major challenge for thin-film photovoltaics. This innovative device exhibits remarkable durability, maintaining over 90% of its initial power conversion efficiency even under extreme reverse-bias conditions, marking a substantial stride towards the practical commercialization of next-generation solar cells.

Technical / Clinical Details

- The developed tandem solar cell effectively suppresses internal leakage pathways and electrical defects through precise material and interface engineering. This significantly improves its resilience against damage caused by reverse-bias voltages, which typically occur during partial shading or system malfunctions in solar arrays.
- Rigorous testing confirmed that the device maintains stable performance under severe reverse-bias stress conditions where conventional thin-film solar cells would experience significant degradation. This capability is critical for preventing thermal damage and degradation caused by hot-spot formation during power generation.
- This advancement directly addresses a persistent reliability issue in thin-film PV technology, particularly the degradation under reverse-bias conditions, which is essential for long-term operational stability in real-world applications.

Background & Context

Thin-film solar cells, especially those based on perovskites, hold immense promise for diverse applications such as Building-Integrated Photovoltaics (BIPV), flexible devices, and power sources for IoT devices, owing to their lightweight, flexibility, and high photoelectric conversion efficiency. However, partial shading in operational environments has been a primary reliability concern. Shading can induce reverse bias across parts of a solar module, leading to efficiency drops and physical damage from hot-spot formation. The breakthrough from Hong Kong PolyU offers a groundbreaking solution to this long-standing problem, significantly advancing the practical deployment of thin-film solar cells.

Strategic Significance & Outlook

This perovskite-organic tandem solar cell, with its enhanced reverse-bias stability, expands the applicability of thin-film solar cells, enabling their use in harsh environments where reliability is paramount. This will likely accelerate adoption in urban architectural integration, transportation systems, and space applications—areas where conventional photovoltaics have been challenging to deploy. The research team is further pursuing improvements in efficiency and validating the scalability of this technology for large-scale manufacturing, aiming to boost its competitiveness in the commercial market. This breakthrough is an indispensable component in the evolution of sustainable energy solutions, pushing the boundaries of what is possible for flexible and robust solar power.

Source: https://www.pv-magazine.com/2026/08/03/scientists-develop-perovskite-organic-tandem-solar-cell-with-enhanced-reverse-bias-stability/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#29 Oxford PV Initiates First Shipments of Perovskite-Silicon Tandem Panels in 2024, Achieves 24.5% Efficiency in Commercial Modules

Published August 01, 2026 GreenLancer USA




OVERVIEW

A GreenLancer report highlights perovskite-silicon tandem solar cells reaching a certified 34.85% efficiency in labs. Oxford PV has achieved 24.5% efficiency in commercial modules and initiated their first commercial tandem panel shipments in 2024, targeting mass production by 2027. This signifies substantial commercialization progress for perovskite technology, paving the way for high-efficiency and sustainable energy solutions.

IN DEPTH

Key Findings

A recent report by GreenLancer underscores the potential for perovskite solar cells to surpass silicon cell efficiencies, particularly highlighting perovskite-silicon tandem cells achieving a record-certified efficiency of 34.85% at the laboratory level. A key player driving this progress, Oxford PV, has already reached 24.5% efficiency in commercial modules and commenced initial shipments of its commercial tandem panels in 2024.

Technical / Clinical Details

- Perovskite-silicon tandem solar cells achieve higher overall efficiency than single-junction cells by efficiently absorbing different parts of the solar spectrum. The perovskite top layer captures visible light, while the silicon bottom cell harnesses infrared light.
- Oxford PV's achievement of 24.5% efficiency in commercial modules surpasses the average efficiency (around 20-22%) of high-quality monocrystalline silicon panels currently dominant in the market. This robustly demonstrates the commercial viability of perovskite technology.
- The company's target for mass production by 2027 indicates significant advancements in technology stability, scalability, and manufacturing cost optimization, moving beyond pilot-scale deployments.

Background & Context

The solar photovoltaic industry is expanding rapidly as a cornerstone of climate change mitigation efforts, yet continuous cost reduction and efficiency improvements are crucial for widespread adoption. Perovskite solar cells are viewed as a transformative technology, capable of complementing or replacing existing silicon solar cells, owing to their ease of manufacturing, low cost potential, and high theoretical conversion efficiencies. Tandem structures, in particular, are positioned as a "game-changer" capable of breaking through the efficiency limits of conventional silicon technology. Pioneering efforts by companies like Oxford PV are critical for building market confidence and stimulating competition within the industry.

Strategic Significance & Outlook

Oxford PV's initial commercial shipments of tandem panels and its 2027 mass production target signal a clear transition of perovskite solar cells from R&D to practical application. Successful deployment will further enhance the cost-performance ratio of solar power, accelerating the global adoption of renewable energy. Furthermore, high-efficiency tandem technology, capable of generating more power from a limited installation area, is expected to find diverse applications in residential, commercial, and even space sectors. The entire industry is closely watching the trajectory of this innovative technology, which promises to redefine the landscape of solar energy.

Source: https://www.greenlancer.com/post/perovskite-solar-cells

#30 Hong Kong PolyU Achieves >90% Initial Efficiency Retention with Shade-Tolerant, Reverse-Bias Stable Perovskite-Organic Tandem Solar Cell

Published July 30, 2026 Facebook (Angstrom Engineering) Hong Kong

OVERVIEW

Researchers at Hong Kong Polytechnic University developed a perovskite-organic tandem solar cell that effectively addresses shading damage, a critical issue for thin-film photovoltaics. The new cell maintains over 90% of its initial efficiency under extreme reverse-bias conditions, overcoming a key weakness of conventional thin-film PV technology. This significantly enhances the durability and long-term performance of next-generation solar cells, accelerating their practical adoption in challenging installation environments. The article also references Trinasolar's 31.1% efficiency achievement.

IN DEPTH

Key Findings

A research team at Hong Kong Polytechnic University has developed a perovskite-organic tandem solar cell with significantly enhanced reverse-bias stability, capable of withstanding shading damage, a long-standing challenge for thin-film photovoltaics. This innovative cell demonstrates the ability to maintain over 90% of its initial power conversion efficiency even under extreme reverse-bias conditions induced by partial shading, dramatically improving its real-world reliability.

Technical / Clinical Details

- The developed tandem solar cell employs a unique material composition and interface design to suppress internal leakage currents and effectively prevent voltage-induced degradation. This significantly mitigates the efficiency loss and physical damage from hot-spot formation that conventional thin-film solar cells experience due to shading.
- Rigorous testing involved subjecting the device to prolonged periods of harsh reverse-bias stress, demonstrating its exceptionally high stability. This breakthrough is critical for dramatically improving the performance and lifespan of solar cells installed in shading-prone locations, such as rooftops or complex building facades.
- The article also notes that Trinasolar achieved 31.1% efficiency in April 2025, and other manufacturers are reporting over 34% high efficiencies, indicative of broader advancements across perovskite technology.

Background & Context

Perovskite solar cells have garnered significant attention as a next-generation photovoltaic technology due to their advantages in high efficiency, low cost, and flexibility. However, for thin-film devices particularly, reverse-bias voltages generated by partial shading or defects have been a major challenge, leading to performance degradation and module failure. This issue has constrained the expansion of solar power system installation sites, but Hong Kong PolyU's breakthrough offers a solution that could significantly broaden the applicability of thin-film solar cells.

Strategic Significance & Outlook

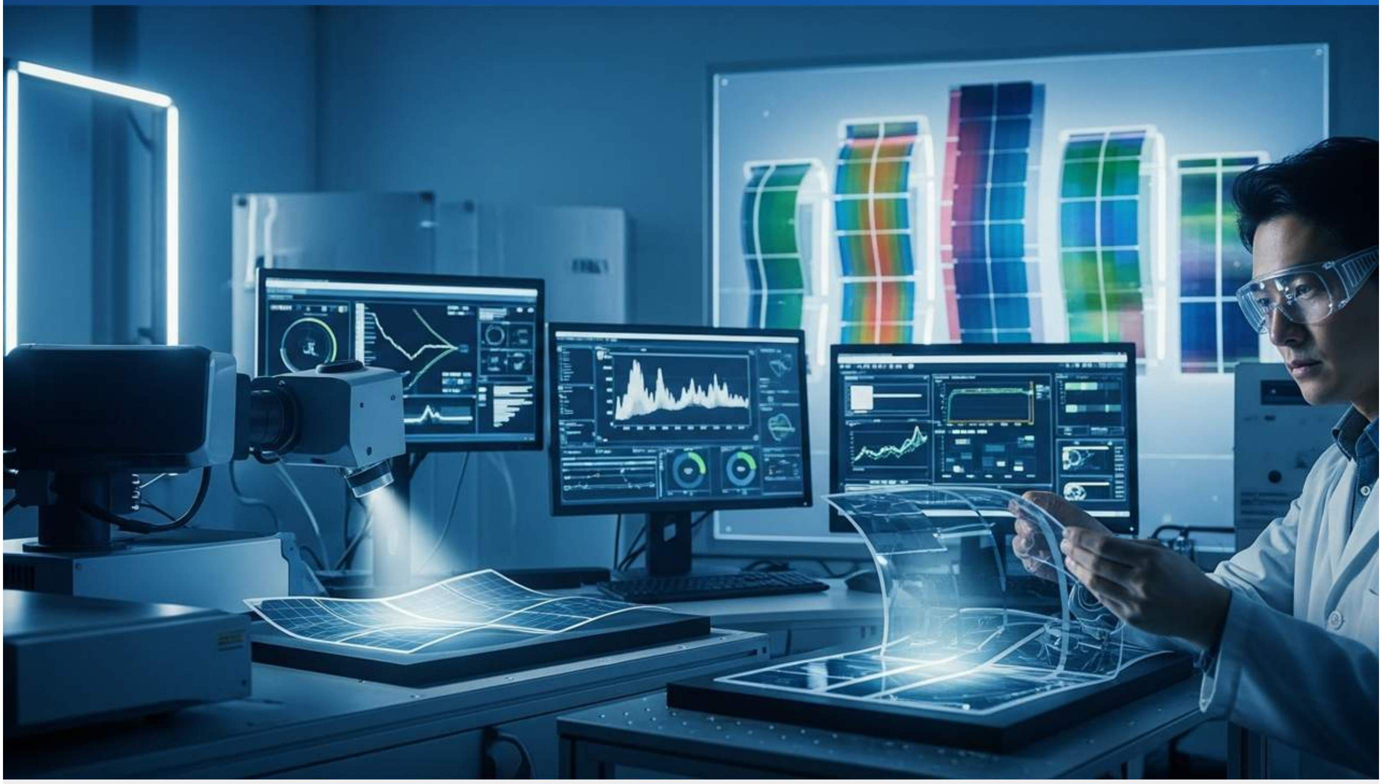
This reverse-bias stable perovskite-organic tandem solar cell will accelerate practical applications across a wide range of demanding environments, including urban buildings, flexible devices, and even vehicle-integrated photovoltaics. Solar cells that are robust against shading and offer extended lifespans will contribute to increased power generation stability and reduced maintenance costs, further promoting the adoption of sustainable energy solutions. The commercialization and large-scale production of this technology are expected to be a game-changer for the solar photovoltaic industry, enabling wider deployment in previously challenging scenarios globally.

Source: https://www.facebook.com/AngstromEngineering/posts/a-new-breakthrough-in-solar-technology-is-helping-address-one-of-thin-film-solar/1643376814457394/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#31 Korean Energy Institute Achieves 23.64% Efficiency in Flexible Perovskite Tandem Solar Cells, Lead-Free Technology Advances

Published July 31, 2026　AZoCleantech　South Korea



OVERVIEW

AZoCleantech reports on cutting-edge research in flexible perovskite solar cells (f-PeSCs), highlighting a Korean Energy Research Institute's achievement of 23.64% power conversion efficiency (PCE) in flexible perovskite/CIGS tandem cells. Separately, flexible perovskite/silicon tandem cells recorded a certified efficiency of 33.6%, with notable progress in lead-free perovskite technology. These breakthroughs accelerate the commercialization of lightweight, flexible next-generation solar cells, opening doors for diverse applications.

IN DEPTH

Key Findings

According to the latest research trends reported by AZoCleantech, groundbreaking achievements have been made in the development of flexible perovskite solar cells (f-PeSCs). Notably, researchers at the Korean Energy Research Institute have achieved a power conversion efficiency (PCE) of 23.64% in flexible perovskite/CIGS tandem cells. In another significant development, flexible perovskite/silicon tandem cells recorded a high certified efficiency of 33.6%.

Technical / Clinical Details

- Flexible perovskite/CIGS tandem cells, due to their lightweight and flexibility, are highly anticipated for various applications such as Building-Integrated Photovoltaics (BIPV), wearable devices, and IoT sensors. The 23.64% PCE demonstrates that combining CIGS technology with perovskites can achieve high efficiency on flexible substrates.
- The certified efficiency of 33.6% achieved by flexible perovskite/silicon tandem cells approaches the efficiency records of single-junction solar cells at the laboratory level, which is particularly remarkable for a flexible device. This is a result of maximizing the complementary spectral absorption characteristics of perovskite and silicon.
- Furthermore, advancements in lead-free perovskite development are progressing, marking a crucial step towards environmental sustainability and addressing toxicity concerns. Companies like Oxford PV are actively pursuing commercialization, further accelerating the practical deployment of this technology.

Background & Context

Conventional silicon solar cells are rigid and heavy, limiting their installation locations. However, f-PeSCs, with their lightweight and flexible properties, can be installed on curved or non-structural surfaces, potentially opening new markets for solar power generation. Achieving both high efficiency and flexibility in tandem structures is a major research focus in this field, and the latest achievements significantly enhance their commercial viability. The transition to environmentally friendly, lead-free materials is also an indispensable component for realizing a sustainable energy society.

Strategic Significance & Outlook

These advancements in flexible perovskite tandem solar cells will serve as a significant driving force to accelerate the adoption of renewable energy. Specifically, the high efficiencies of 23.64% and 33.6% suggest that f-PeSCs could enable breakthroughs not only in large-scale solar power generation but also in areas previously untouched by PV, such as mobile power, aerospace, and smart textiles. Combined with progress in lead-free technology and commercialization efforts, more flexible perovskite products are expected to enter the market within the next few years, thereby accelerating a paradigm shift in energy generation and making solar energy ubiquitous.

Source: https://www.azocleantech.com/article.aspx?ArticleID=2187

#32 US DOE Funds Perovskite Solar Cell R&D to Accelerate Commercialization, Targeting Over 34% Tandem Efficiency

Published August 04, 2026 U.S. Department of Energy (DOE) USA

OVERVIEW

The U.S. Department of Energy's (DOE) IESO actively supports perovskite solar cell R&D to boost efficiency, longevity, cut manufacturing costs, and accelerate commercialization. NREL data shows over 26% efficiency for small-area devices and about 34% for perovskite-silicon tandem cells. Despite challenges in stability, scaling, and manufacturability for mass production, DOE's backing is critical for overcoming these hurdles, aiming to bring this high-potential technology to market.

IN DEPTH

Key Findings

The U.S. Department of Energy's (DOE) Integrated Energy Systems Office (IESO) is actively advancing research and development (R&D) in perovskite solar cells, with ambitious goals to improve device efficiency and lifespan, reduce manufacturing costs, and ultimately accelerate commercialization. Current data from the National Renewable Energy Laboratory (NREL) indicates efficiencies exceeding 26% for small-area perovskite devices and approximately 34% for perovskite-silicon tandem cells, underscoring the technology's high potential.

Technical / Clinical Details

- Perovskite solar cells offer distinct advantages over traditional silicon cells, including easier manufacturing, applicability to diverse substrates, and the potential for thin-film and transparent designs. Tandem cell architectures, in particular, promise efficiencies beyond single-junction limits by absorbing different spectral ranges of sunlight more effectively.
- DOE-supported projects focus on enhancing perovskite material stability, developing robust encapsulation technologies, and establishing manufacturing processes suitable for large-scale production. The aim is to bridge the gap between laboratory achievements and commercial product scalability.
- Specific R&D areas include defect passivation, inhibition of ion migration, improvement of moisture and thermal stability, and the exploration of lead-free alternative materials to address environmental concerns.

Background & Context

As global energy demand grows and climate change concerns intensify, the role of renewable energy sources, particularly solar photovoltaics, becomes increasingly critical. Perovskite solar cells, with their innovative characteristics, have the potential to complement the existing silicon solar cell market and create new application domains. The DOE's proactive funding and research support are integral to a strategic initiative to maintain U.S. leadership in clean energy technologies and bolster domestic manufacturing capabilities.

Strategic Significance & Outlook

The DOE's sustained R&D support is crucial for overcoming key challenges facing perovskite solar cells: long-term stability, efficiency scaling, manufacturability, and technology validation. If these hurdles are successfully addressed, perovskite solar cells will become a competitive option across a wide range of markets, including residential, commercial, and utility-scale power generation, as well as flexible devices, building-integrated photovoltaics, and transportation applications. The DOE's efforts are expected to accelerate the market entry of perovskite products in the U.S. and significantly advance the transition to a clean energy economy, positioning the nation at the forefront of solar innovation.

Source: https://www.energy.gov/cmei/systems/perovskite-solar-cells

#33 University of Sydney Achieves World-Record 30.2% Efficiency in 10 cm² Perovskite-Silicon Tandem Solar Cell

Published August 04, 2026   pv-magazine.com   Australia

OVERVIEW

Researchers at the University of Sydney have achieved an unprecedented 30.2% power conversion efficiency in a 10 cm² two-terminal monolithic perovskite-silicon tandem solar cell. This world-record efficiency, independently certified by CSIRO's PV Performance Lab, was enabled by a unique hole-selective layer design that facilitates uniform and repeatable deposition of large-area perovskite films. This breakthrough significantly accelerates the practical commercialization of perovskite solar cells.

IN DEPTH

Key Findings

Researchers at the University of Sydney in Australia have achieved a world-leading power conversion efficiency of 30.2% in a 10-square-centimeter (10 cm^2) two-terminal monolithic perovskite-silicon tandem solar cell. This record efficiency has been independently certified by CSIRO's PV Performance Lab, marking the highest value ever certified by the lab for this type of device. This achievement represents a significant milestone in the commercialization of perovskite solar cells.

Technical / Clinical Details

- The research team engineered an innovative hole-selective layer that allows for the uniform and highly repeatable deposition of large-area perovskite films. This layer maximizes charge carrier transport efficiency while minimizing non-radiative recombination losses within the device, contributing directly to the high efficiency.
- The two-terminal monolithic structure integrates the perovskite top cell and the silicon bottom cell directly, operating as a single device. This design simplifies manufacturing processes and enables high integration density, while also offering high compatibility with existing photovoltaic infrastructure.
- Achieving 30.2% efficiency over a relatively large area of 10 cm^2 is particularly significant. While high efficiencies are often easier to attain in small-scale laboratory cells, overcoming the challenges of uniformity and reproducibility for larger, more practical scales represents a major hurdle in industrial application.

Background & Context

Perovskite-silicon tandem solar cells are a next-generation photovoltaic technology being developed globally, capable of surpassing the theoretical efficiency limit of conventional silicon single-junction solar cells (approximately 29%). With theoretical efficiencies expected to exceed 35%, the current achievement of 30.2% indicates that this technology is rapidly approaching practical viability. Higher efficiencies offer substantial economic benefits for residential, commercial, and utility-scale solar farms by enabling more power generation from a limited installation area.

Strategic Significance & Outlook

This breakthrough by the University of Sydney marks a critical juncture in the technological roadmap for perovskite-silicon tandem solar cells. The attainment of high efficiency over a larger area demonstrates the feasibility of achieving scalability and reproducibility, which were key challenges for mass production. Future efforts will likely focus on further improving long-term stability and conducting extensive durability tests to secure international certifications such as those from the IEC (International Electrotechnical Commission). If successfully deployed commercially, this technology is expected to significantly transform the global solar power market, accelerating the adoption of more affordable and efficient renewable energy solutions and cementing Australia's leadership in advanced PV research.

Source: https://now.solar/2026/08/04/australian-researchers-achieve-30-2-efficiency-for-10-cm2-perovskite-silicon-tandem-solar-cell-pv-magazine-com/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#34 Rayzon Solar Report: Perovskite Tandem Modules Achieve >34% Efficiency, Face Manufacturing and Stability Challenges

Published August 06, 2026 Rayzon Solar India

OVERVIEW

A Rayzon Solar report indicates perovskite tandem solar cells achieve over 34% high efficiency, potentially revolutionizing the PV industry. However, commercial success hinges on ensuring long-term stability, advanced encapsulation, and uniform gigawatt-scale manufacturing. While many manufacturers progress to pilot production, widespread market adoption requires further reliability testing, certification, and manufacturing process maturity, with these challenges dictating the timeline for practical deployment.

IN DEPTH

Key Findings

A report published by Rayzon Solar highlights that perovskite tandem solar cells have achieved power conversion efficiencies exceeding 34%, possessing the potential to revolutionize the solar photovoltaic industry. This high efficiency implies the ability to generate significantly more power from a limited installation area, which could be a powerful driver for accelerating renewable energy adoption globally.

Technical / Clinical Details

- Perovskite tandem modules layer different semiconductor materials, such as perovskite and silicon, to utilize the solar spectrum more efficiently, breaking through the efficiency limits of single-junction solar cells. Theoretically, efficiencies exceeding 35% are expected, surpassing current records for monocrystalline silicon PV.
- However, several critical technical challenges remain for commercial-scale deployment. These include ensuring long-term stability, developing advanced encapsulation technologies to guarantee durability under harsh environmental conditions, and establishing uniform, high-quality manufacturing processes capable of gigawatt (GW) scale production.
- While many manufacturers are progressing to pilot production stages, widespread market adoption remains contingent on comprehensive product reliability testing, obtaining international certifications, and further maturing manufacturing processes.

Background & Context

As global energy demand continues to rise and climate change mitigation becomes an urgent imperative, solar photovoltaics are pivotal as a primary clean energy source. Perovskite solar cells, with their excellent photoelectric conversion properties and potential for low-cost manufacturing, are regarded as the next major innovation in this sector. Tandem structures, in particular, hold the potential to push the boundaries of existing silicon technology and dramatically improve the cost-effectiveness of solar power. However, as with many promising technologies in the past, a technical breakthrough does not automatically translate into commercial success; overcoming manufacturing and stability challenges is crucial.

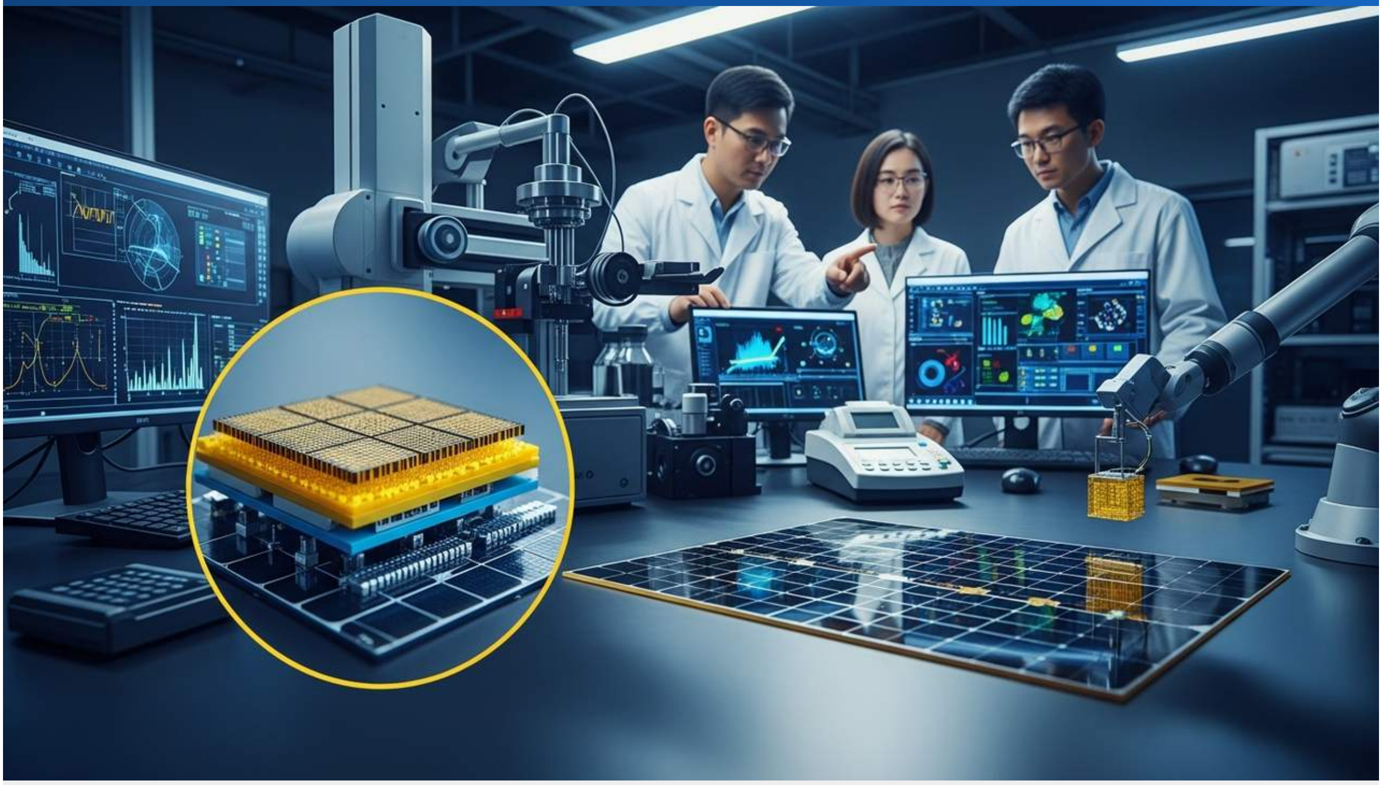
Strategic Significance & Outlook

The commercial success of perovskite tandem solar cells depends on close collaboration among the research community, manufacturers, and policymakers. Resolving the remaining challenges related to long-term stability and manufacturing scalability will enable this technology to play a significant role in the global energy mix. The market demands products that not only offer high efficiency but also demonstrate proven reliability, durability, and cost-effective manufacturing. If these challenges are addressed, perovskite tandem modules will be a major driving force in further reducing the cost of solar electricity and accelerating the global adoption of renewable energy, thereby contributing to a more sustainable energy future.

Source: https://rayzonsolar.com/blog/perovskite-tandem-modules-breakthrough-or-manufacturing-challenge

#35 Chinese Team Develops Perovskite/CIGS Tandem Solar Cell with 29.71% Efficiency and Enhanced Stability via Sulfur Compound Addition

Published July 31, 2026 interestingengineering.com China



OVERVIEW

Chinese researchers developed a new perovskite/CIGS tandem solar cell achieving 29.71% power conversion efficiency with significantly improved stability. This was achieved by incorporating a sulfur compound (bis(2-pyridylmethyl)sulfide), which suppresses material defects and effectively inhibits charge transfer and photo-induced material changes. This breakthrough addresses the critical challenge of balancing high efficiency and stability in perovskite solar cells, accelerating next-generation photovoltaic deployment.

IN DEPTH

Key Findings

A Chinese research team has developed an innovative perovskite/CIGS (Copper, Indium, Gallium, Selenium) tandem solar cell that achieves a high power conversion efficiency (PCE) of 29.71% while demonstrating significantly enhanced stability. This breakthrough was realized through the introduction of a sulfur compound, bis(2-pyridylmethyl)sulfide (BPMS), into the active layer, successfully reducing defect density within the material and suppressing photo-induced degradation processes.

Technical / Clinical Details

- The developed tandem solar cell combines a perovskite top layer with a CIGS bottom layer as light-absorbing components. Each material efficiently absorbs different wavelengths of sunlight, thereby boosting the overall conversion efficiency beyond what either material could achieve alone.
- The addition of BPMS effectively passivates trap states at grain boundaries and surfaces within the perovskite layer, which leads to a reduction in non-radiative recombination losses. Furthermore, BPMS facilitates charge transfer and inhibits photo-induced changes in the material's structure, dramatically improving the device's long-term stability.
- A PCE of 29.71% is among the highest reported for perovskite-CIGS tandem cells, and the fact that this efficiency is coupled with improved stability makes it a major advantage for commercialization efforts.

Background & Context

Perovskite solar cells hold immense promise as a next-generation photovoltaic technology due to their potential for high efficiency and low-cost manufacturing. However, a primary factor hindering their widespread practical application has been their lack of long-term stability. Tandem structures are considered one of the most promising approaches to surpass the efficiency limits of conventional single-junction solar cells. This latest research from China offers a practical solution to the dilemma of achieving both high efficiency and high stability in perovskite technology, significantly paving the way for commercial deployment.

Strategic Significance & Outlook

This stable, 29.71%-efficient perovskite/CIGS tandem solar cell has the potential to profoundly impact the solar photovoltaic industry. The defect passivation strategy using sulfur compounds is broadly applicable to other perovskite devices, promising performance enhancements across a wide range of next-generation solar cells. Future efforts will likely focus on developing large-scale manufacturing processes and conducting durability tests to obtain international certifications. If commercialized, this technology is expected to facilitate the proliferation of more affordable and reliable solar power solutions, accelerating the expansion of the global renewable energy market and bolstering China's leadership in advanced PV research.

Source: https://now.solar/2026/08/01/chinas-new-tandem-solar-cell-pairs-29-71-efficiency-with-improved-stability-interestingengineering-com/

#36 UK-Sweden 'POP-PV' Project Launches to Power Underutilized Building Spaces with Power Roll's Lightweight Perovskite Films

Published July 30, 2026 University of Sheffield UK

OVERVIEW

A collaborative international research project, 'POP-PV,' has been launched by UK and Swedish institutions. The project aims to advance Power Roll's micro-groove solar film technology, developing lightweight photovoltaic solutions for commercial and industrial rooftops and building sides currently unsuitable for conventional PV systems due to structural constraints. The initiative focuses on exploring advanced interface materials like self-assembled monolayers (SAMs) to enhance perovskite solar cell stability, manufacturability, and scalability.

IN DEPTH

Key Findings

A collaborative international research project, dubbed 'POP-PV,' has been launched by institutions in the UK and Sweden. At its core, the project aims to evolve Power Roll's innovative micro-groove solar film technology to introduce lightweight, flexible perovskite solar cells onto underutilized rooftops and sides of commercial and industrial buildings. These areas have traditionally been inaccessible to conventional photovoltaic systems due to structural limitations. This initiative seeks to overcome architectural constraints, significantly expanding opportunities for solar power generation in urban environments.

Technical / Clinical Details

- The POP-PV project will leverage Power Roll's proprietary micro-groove design to develop ultra-thin and lightweight perovskite solar cell films. This design enables installation in locations where traditional panels are too heavy or on curved surfaces, unlocking new deployment possibilities.
- Research and development efforts will explore advanced interface materials, such as self-assembled monolayers (SAMs). These materials play a critical role in optimizing charge transport efficiency between the perovskite layer and electrodes while simultaneously enhancing the device's long-term stability.
- The project also focuses on improving the stability of perovskite solar cells against moisture and heat, a primary challenge, as well as achieving scalability for large-volume manufacturing and establishing cost-effective production processes. This may involve the application of roll-to-roll manufacturing techniques.

Background & Context

While solar power adoption is growing, many commercial and industrial facilities face challenges in installing conventional heavy silicon panels due to roof load limits, complex geometries, or aesthetic regulations. Lightweight and flexible perovskite solar cell films offer a novel solution to this untapped market. Power Roll's technology, coupled with international research collaboration, is a crucial step to maximize the potential of this market, promoting broader integration of solar power into architectural structures.

Strategic Significance & Outlook

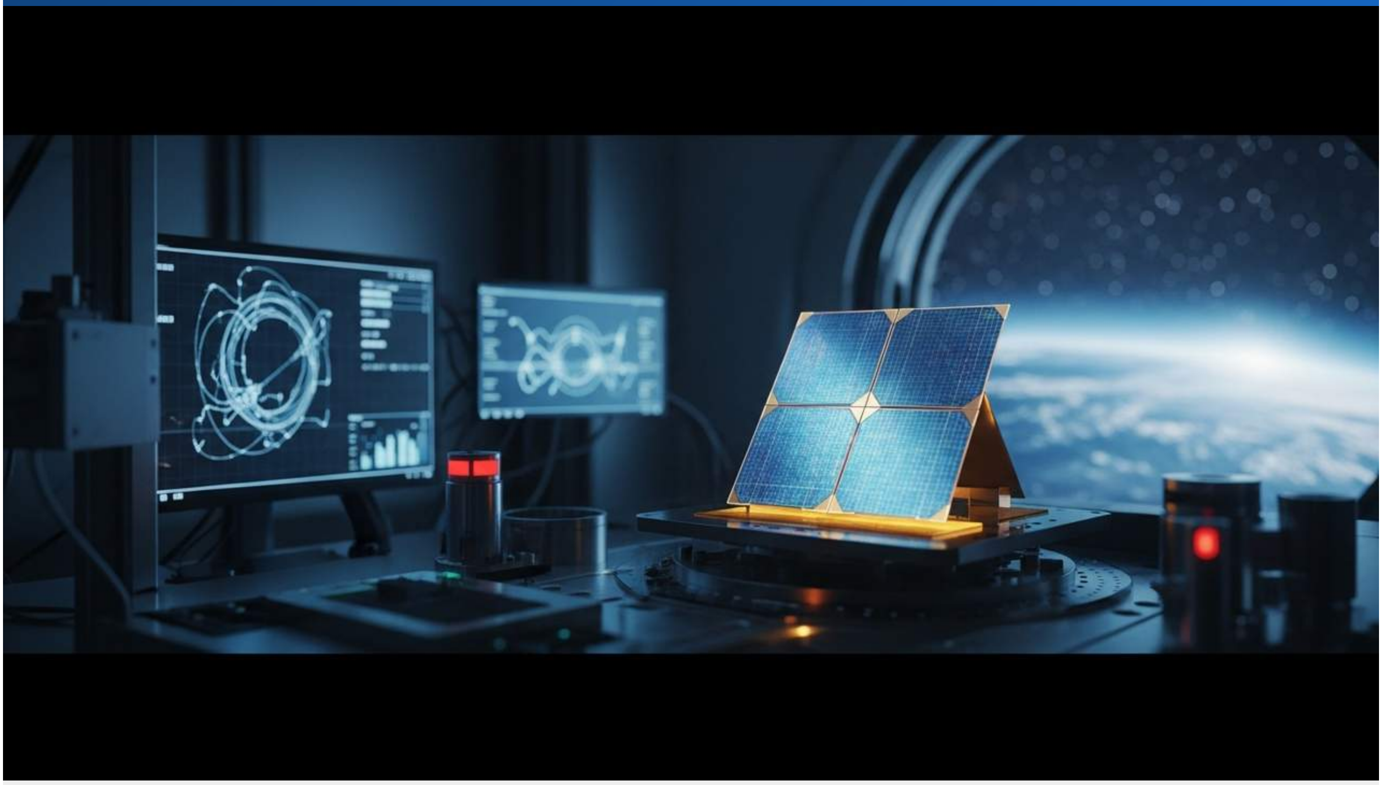
The success of the POP-PV project has the potential to transform the landscape of solar power. If lightweight and easy-to-install perovskite films become commercially viable, numerous urban buildings could become energy generators, accelerating the proliferation of decentralized energy systems. This will significantly contribute to achieving renewable energy targets and enhancing buildings' energy self-sufficiency. The international collaboration is expected to accelerate technological development and enable rapid deployment to global markets, opening new frontiers for solar power generation and fostering a more resilient and sustainable energy infrastructure.

Source: https://sheffield.ac.uk/mps/news/new-international-project-targets-lightweight-solar-power-underused-rooftops-and-sides-buildings

Collected: August 07, 2026 | Automated Research System (Gemini API)

#37 Chinese Team Achieves 27.49% AM0 Efficiency in Space-Grade Perovskite/Silicon Tandem Solar Cell, Withstands High-Altitude Flight

Published August 04, 2026 pv-magazine.com China



OVERVIEW

A Chinese research team has developed a perovskite/silicon tandem solar cell designed for space applications, achieving a certified efficiency of 27.49% under AM0 illumination. The device exhibited high resistance to electron and proton radiation and stable output during a ~30 km high-altitude balloon flight. Critically, silicon subcell damage was identified as the 'weak link' limiting overall performance, with p-type silicon superior to n-type. This breakthrough promises to revolutionize power supply for space exploration and satellite technology.

IN DEPTH

Key Findings

A Chinese research team has developed a perovskite/silicon tandem solar cell specifically engineered for space applications, achieving a certified power conversion efficiency of 27.49% under AM0 (outer space) illumination conditions. This groundbreaking device demonstrated high resilience against electron and proton radiation and maintained stable power output during a real-world high-altitude balloon flight at approximately 30 km. This achievement sets a new benchmark for the durability and efficiency of solar cells in extraterrestrial environments.

Technical / Clinical Details

- The developed tandem solar cell is optimized to endure the harsh conditions of space, including vacuum, extreme temperature fluctuations, and high-energy radiation. Radiation damage is a primary factor limiting the lifespan of space-grade solar cells; however, this device maintained high performance even after irradiation with electrons and protons.
- The research identified that damage to the silicon bottom cell acts as the "weak link" dictating the overall device performance. Based on this analysis, p-type silicon bottom cells were found to be superior to n-type silicon in terms of radiation tolerance, providing crucial insights for future space solar cell designs.
- The 27.49% efficiency under AM0 illumination is measured under stricter conditions than terrestrial standards (AM1.5G), indicating a higher power generation capability in actual space environments. The real-world validation through a high-altitude balloon flight demonstrates practical operational feasibility beyond mere laboratory results.

Background & Context

The space industry critically relies on high-performance and durable solar cells as power sources for satellites and spacecraft. Traditional space solar cells are expensive and face challenges related to degradation from radiation. Perovskite solar cells, with their potential for high efficiency and lower manufacturing costs, have been considered for space applications, but their stability and radiation resistance were major hurdles. This Chinese research marks a significant step towards overcoming these challenges, contributing to the advancement of space technology.

Strategic Significance & Outlook

This radiation-tolerant, high-efficiency perovskite/silicon tandem solar cell has the potential to revolutionize power systems for future satellites, space stations, and deep-space exploration missions. The discovery regarding the superiority of p-type silicon bottom cells will likely serve as a crucial guideline for designing next-generation space-grade solar cells. Future efforts will focus on further long-term durability testing, cost reduction, and validation in actual space missions. If commercialized, this technology is expected to accelerate the development of smaller, longer-lasting, and higher-performing space instruments, significantly broadening the possibilities for space exploration.

Source: https://www.perovskite-info.com/perovskitesilicon-tandem-hits-certified-2749-efficiency-space-conditions

Collected: August 07, 2026 | Automated Research System (Gemini API)

#38 First Solar and Oxford PV Sign Perovskite Patent Licensing Deal for US Markets, Accelerating Commercialization

Published August 01, 2026   BI Journal   USA

OVERVIEW

First Solar and Oxford PV have signed a patent licensing agreement for perovskite technology targeting U.S. markets. This strategic agreement significantly supports Oxford PV's deployment of innovative perovskite-on-silicon tandem solar cells and modules in the U.S. It clearly signals growing industry confidence in perovskite-based PV technology, marking a crucial milestone for accelerating the commercialization of next-generation high-efficiency solar cells.

IN DEPTH

Key Findings

First Solar, a global leader in thin-film photovoltaics, and Oxford PV, a pioneer in high-efficiency perovskite-on-silicon tandem technology, have entered into a strategic patent licensing agreement for perovskite technology in the U.S. market. This agreement holds critical significance for facilitating the introduction of Oxford PV's advanced tandem solar cells and modules into the U.S. market, thereby accelerating the commercialization of perovskite technology.

Technical / Clinical Details

- Under this licensing agreement, First Solar gains the rights to utilize specific patents related to Oxford PV's perovskite-on-silicon tandem solar cell technology in the U.S. market. This will enable First Solar to enhance its product portfolio and meet the growing demand for high-efficiency solar power solutions.
- Oxford PV's perovskite-on-silicon tandem technology has the potential to break through the efficiency limits of conventional silicon solar cells, aiming to achieve power conversion efficiencies exceeding 30%. A key advantage of this technology is its easy integration into existing solar power infrastructure, which lowers market entry barriers.
- This agreement serves as a clear signal that perovskite technology is transitioning from laboratory-level achievements to large-scale commercial deployment, reflecting increased industry confidence in the technology's readiness and potential.

Background & Context

The United States is committed to accelerating its transition to clean energy, emphasizing innovation and deployment of solar photovoltaic technologies. First Solar has been a leader in cadmium telluride (CdTe) thin-film technology, providing cost-effective large-scale solar power solutions. Oxford PV, on the other hand, is at the forefront of perovskite tandem technology. This partnership between two companies with distinct technological strengths highlights the strategic necessity of collaboration to bring next-generation solar solutions to market. This collaboration is expected to contribute significantly to U.S. energy security and climate change mitigation goals.

Strategic Significance & Outlook

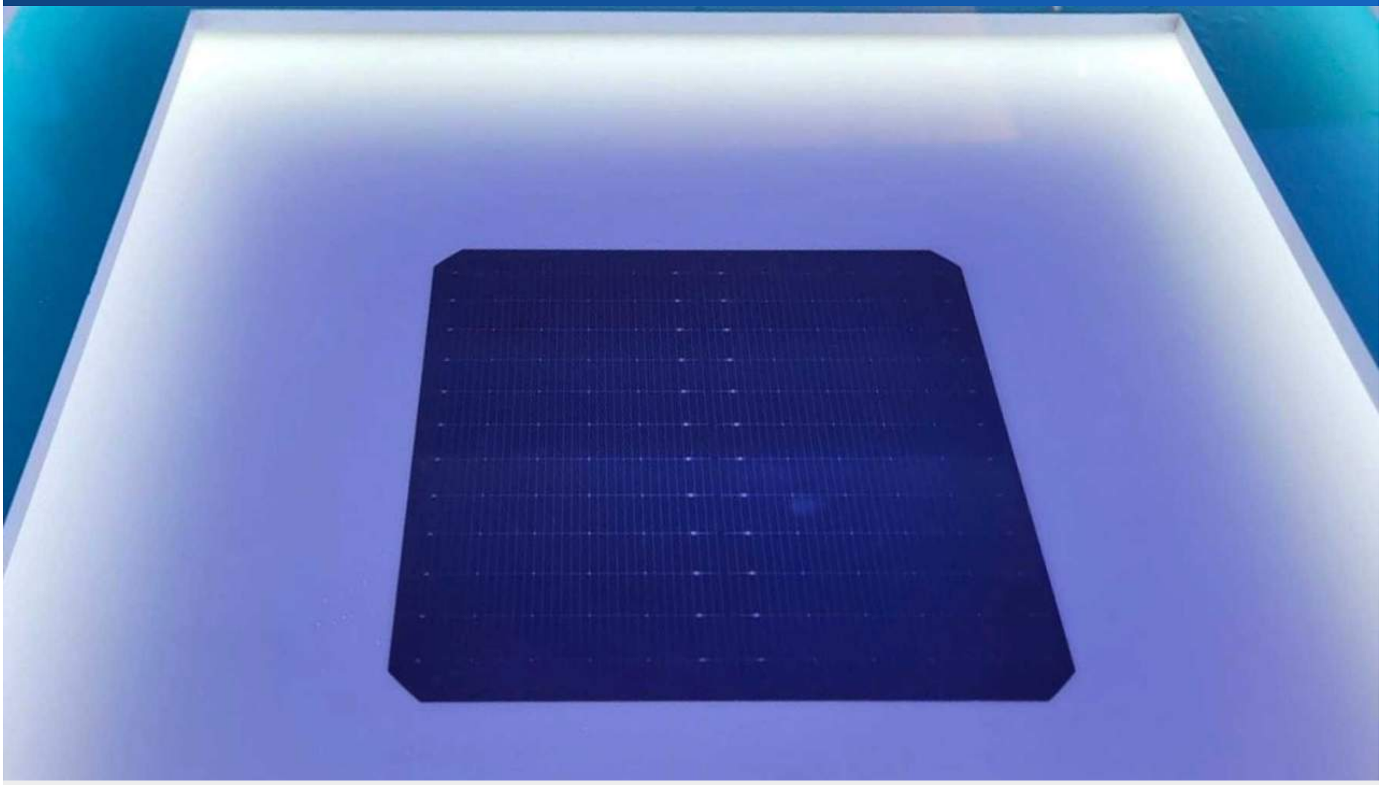
The patent licensing agreement between First Solar and Oxford PV will have a profound impact on the expansion of perovskite solar cells in the U.S. market. This partnership is expected to accelerate the adoption of Oxford PV's advanced technology through First Solar's established manufacturing capabilities and market channels. Consequently, consumers will gain access to more efficient and cost-effective solar power solutions, further boosting the proliferation of renewable energy. This agreement is viewed as a crucial step for perovskite technology to become a mainstream player in the global solar photovoltaic market, demonstrating strong industry alignment towards future energy solutions.

Source: https://bi-journal.com/first-solar-oxford-pv-sign-patent-licensing-deal-for-us-markets/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#39 Qcells Unveils IEC/UL Certified M10 Perovskite Tandem Panel with 28.6% Efficiency, Demonstrating Extreme Durability

Published July 31, 2026 Autonocion.com Germany



OVERVIEW

Qcells announced an M10 wafer-sized perovskite tandem panel boasting 28.6% efficiency, verified by Fraunhofer ISE, and holding IEC and UL certifications. This powerfully validates perovskite technology's durability and commercial viability. Passing extreme environmental tests—42 days at 185°F/85% humidity, 200 cycles from -40°F to 185°F, and 10 freeze-thaw cycles—underscores not only record efficiency but also the critical importance of real-world long-term reliability for market deployment.

IN DEPTH

Key Findings

Qcells has unveiled an M10 wafer-sized perovskite tandem panel that boasts a high power conversion efficiency of 28.6%, as verified by Fraunhofer ISE. This groundbreaking product has already secured stringent international IEC and UL certifications, powerfully demonstrating the high durability and commercial feasibility of perovskite technology. This marks a significant milestone towards the practical implementation of next-generation solar cells.

Technical / Clinical Details

- The M10 wafer-sized tandem panel introduced by Qcells achieves high efficiency, unattainable by single silicon cells, by layering a perovskite film while maintaining compatibility with existing silicon manufacturing lines. The 28.6% efficiency is highly competitive even when compared to the highest-efficiency solar modules currently available on the market.
- This panel successfully passed extremely harsh durability tests. Specifically, it endured 42 consecutive days at 85°C and 85% humidity, completed 200 temperature cycles from -40°C to 85°C, and passed 10 thermal shock cycles designed to test against internal moisture freezing and causing structural damage.
- Attaining certifications from leading international bodies like IEC (International Electrotechnical Commission) and UL (Underwriters Laboratories) signifies that the product meets the highest industry standards for safety, performance, and reliability, paving the way for its commercial market entry.

Background & Context

Perovskite solar cells have garnered significant attention as a next-generation photovoltaic technology due to their theoretical high efficiency and potential for low-cost manufacturing. However, proving their long-term stability and durability has been the biggest challenge for their commercialization. Maintaining performance under high temperature, high humidity, and extreme temperature fluctuations is essential for global market adoption. Qcells' announcement of this M10 tandem panel and its international certifications clearly indicate that perovskite technology is overcoming these hurdles and entering the practical application phase.

Strategic Significance & Outlook

The market entry of Qcells' M10 perovskite tandem panel will have a substantial impact on the solar photovoltaic industry. Its 28.6% high efficiency and proven durability will accelerate adoption across a wide range of applications, from residential and commercial to large-scale solar projects. This will enable more power generation from limited installation areas, significantly contributing to achieving renewable energy deployment goals. Furthermore, this achievement is expected to stimulate other manufacturers, accelerating competition and innovation across the entire perovskite technology sector. It represents a crucial step for perovskite solar cells to become a major component of the global energy mix.

Source: https://www.autonocion.com/us/solar-cell-perovskite-silicon-qcells/

Collected: August 07, 2026 | Automated Research System (Gemini API)

#40 SCAPS-1D Simulation Analyzes Lead-Free Double Perovskite Solar Cells, Highlighting Efficiency Improvement Challenges

Published August 05, 2026 arXiv (preprint) Unknown

OVERVIEW

An arXiv preprint outlines performance analysis of lead-free double perovskite solar cells using SCAPS-1D simulation. While lead-free perovskites offer low toxicity, stability, and high photoelectric potential, current experimental efficiencies lag behind lead-based counterparts. The study emphasizes simulation as a cost-effective approach to test new architectures and identify barriers to efficiency enhancement, providing crucial direction for future R&D.

IN DEPTH

Key Findings

According to a preprint published on arXiv, a performance analysis of lead-free double perovskite solar cells was conducted using SCAPS-1D simulation, with the results outlined. This research highlighted the advantages of lead-free perovskites, including their low toxicity, inherent stability, and high photoelectric potential, while simultaneously exposing the primary challenge of currently lower power conversion efficiencies compared to lead-based perovskites at the experimental stage.

Technical / Clinical Details

- SCAPS-1D (Solar Cell Capacitance Simulator in 1 Dimension) is a powerful tool for modeling the electrical characteristics of solar cells. This simulation method allows for a detailed analysis of how different material compositions, layer thicknesses, doping concentrations, and defect densities impact device performance.
- The study specifically evaluated how the bandgap, charge carrier transport properties, and interface characteristics of lead-free double perovskite materials influence the overall efficiency of the device. The simulations suggest potential pathways for improving efficiency through the optimization of specific material parameters.
- While lead-free perovskites are promising as environmentally friendly alternatives, they currently do not match the high efficiencies exceeding 25% achieved by lead-based perovskites. The simulation aids in identifying structural and material improvements needed to close this efficiency gap.

Background & Context

Perovskite solar cells are garnering attention as a next-generation photovoltaic technology due to their high power conversion efficiency. However, the toxicity of lead, a primary constituent, raises environmental and health concerns. Therefore, the development of lead-free perovskites is a crucial research direction to ensure the technology's practical application and sustainability. Nevertheless, lead-free materials generally exhibit lower efficiencies, necessitating new design and material science approaches to overcome this challenge. Simulation tools like SCAPS-1D are indispensable for reducing experimental trial-and-error and accelerating the development process.

Strategic Significance & Outlook

This simulation-based performance analysis provides a roadmap for improving the efficiency of lead-free double perovskite solar cells. By leveraging a cost-effective simulation approach, researchers can rapidly evaluate the impact of new device architectures and material modifications prior to physical synthesis and testing in the laboratory. This is expected to shorten development cycles and efficiently identify and overcome technological barriers towards the commercialization of lead-free perovskites. In the long term, this will significantly contribute to the realization of environmentally friendly and highly efficient next-generation solar cells, fostering sustainable energy solutions globally.

Source: https://vertexaisearch.cloud.google.com/grounding-api-redirect/AUZIYQEYB022MKmvn5bwDihI0AYTc75ytGPTJpZ3-m1iORaeIKhDGErA0snrR0fgBCOijOtdSMi0HHAOHofQeOVOD1xIc0e5RgZQiLFLitjJwWQZUxOTZy9OjtWvaTo=

#41 DLXN Solar Report: Tandem Perovskite-Silicon Reaches 34.6% Efficiency, But Manufacturing Yield, Encapsulation, and Lead Regulations Remain Commercial Bottlenecks

Published August 06, 2026 DLXN Solar China

OVERVIEW

DLXN Solar's report states that by 2025, perovskite solar cells surpassed efficiency and stability thresholds, with tandem perovskite-silicon devices achieving 34.6% lab efficiency and early commercial modules shipping at 26%. However, low manufacturing yield, encapsulation durability, and lead content regulations persist as critical bottlenecks. Resolving these challenges will be the primary factor determining the realistic market deployment timeline for perovskite technology.

IN DEPTH

Key Findings

A recent report on solar energy released by DLXN Solar analyzes that perovskite solar cells crossed significant thresholds in both efficiency and stability by 2025. Specifically, perovskite-silicon tandem devices achieved a record 34.6% power conversion efficiency at the laboratory level, and early commercial modules are already shipping with 26% efficiency. This serves as clear evidence that perovskite technology is transitioning from the research phase to practical application.

Technical / Clinical Details

- The tandem structure achieves a high combined efficiency of 34.6% by allowing the perovskite layer to efficiently absorb short-wavelength sunlight and the silicon layer to absorb long-wavelength sunlight, thereby breaking the efficiency limits of single-junction solar cells. This efficiency significantly surpasses that of mainstream silicon panels currently dominating the market.
- However, the report highlights several key bottlenecks for commercialization: 1. **Manufacturing Yield**: Ensuring uniform quality and reproducibility in large-scale production. 2. **Encapsulation Durability**: Developing highly reliable encapsulation technologies to prevent long-term degradation from moisture and oxygen. 3. **Lead Content Regulations**: Addressing environmental and health concerns by transitioning to lead-free materials or complying with regulations that minimize lead content.
- While initial commercial modules shipping at 26% efficiency suggest practical products exist, the aforementioned challenges impede widespread deployment and market penetration.

Background & Context

Solar power is playing an increasingly vital role in the global energy mix, but further efficiency improvements and cost reductions are imperative. Perovskite solar cells have been highlighted as a next-generation technology with the potential to meet these demands. China, in particular, leads the world in perovskite technology R&D and manufacturing, and this report provides an objective assessment of its progress and remaining hurdles. These bottlenecks are complex issues that require not only corporate solutions but also industry-wide collaboration and government support through policy and regulation.

Strategic Significance & Outlook

The DLXN Solar report presents an optimistic outlook for the future of perovskite solar cells while emphasizing that resolving the remaining manufacturing, stability, and regulatory challenges is indispensable. If these bottlenecks are overcome, perovskite tandem solar cells could significantly transform the global solar PV market and become a major driving force in accelerating the adoption of renewable energy. Establishing large-scale production technologies and complying with environmental regulations are crucial for determining competitiveness in the global market. The true commercial breakthrough for this technology hinges on when and how these formidable challenges are addressed.

Source: https://www.dlxnsolar.com/news

#42 Perfluoroadipic Acid Boosts Perovskite Solar Cell Efficiency from 20.71% to 22.60%, Maintaining 80.2% Stability for 45 Days

Published August 04, 2026 ACS Publications USA

OVERVIEW

New technology published in ACS Publications significantly enhances both power conversion efficiency (PCE) and stability of perovskite solar cells (PSCs) by incorporating perfluoroadipic acid (PFAA). PFAA, added to the PbI2 precursor solution, forms a porous PbI2 scaffold, facilitating larger grain growth, reduced trap state density, and optimized band alignment. This resulted in PCE improving from 20.71% to 22.60% and maintaining 80.2% of initial efficiency after 45 days of atmospheric exposure, marking a substantial stability upgrade.

IN DEPTH

Key Findings

Research published in ACS Publications demonstrates a groundbreaking approach to simultaneously and significantly enhance both the power conversion efficiency (PCE) and long-term stability of perovskite solar cells (PSCs) through the innovative introduction of perfluoroadipic acid (PFAA). This technique boosted the device PCE from 20.71% to 22.60% and, notably, exhibited exceptional stability by retaining 80.2% of its initial efficiency after 45 days of atmospheric exposure.

Technical / Clinical Details

- PFAA is incorporated in small quantities into the PbI_2 precursor solution during the formation of the perovskite layer. This additive contributes to the formation of a uniform and porous PbI_2 scaffold, which subsequently facilitates the growth of larger, less defective perovskite crystalline grains.
- The expansion of grain size and reduction in defect density extend the lifetime of charge carriers and suppress non-radiative recombination losses. Furthermore, PFAA optimizes band alignment and enhances charge extraction efficiency, directly leading to the improved power conversion efficiency.
- In continuous atmospheric exposure tests (approximately 30% relative humidity) over 45 days, the PFAA-incorporated PSC maintained 80.2% of its initial efficiency. This significantly improved resistance to humidity and oxygen is remarkable, especially when compared to reference devices (without PFAA) which experienced substantial efficiency degradation over the same period.

Background & Context

Perovskite solar cells are widely anticipated as a next-generation photovoltaic technology due to their high photoelectric conversion efficiency and potential for low-cost manufacturing. However, their inherent instability towards humidity, oxygen, and heat has been a major impediment to their commercialization. Specifically, defects within the material are known to accelerate degradation, necessitating effective passivation techniques to neutralize these defects. The introduction of PFAA offers a cost-effective and highly effective solution to this challenge, significantly advancing the practical application of perovskite solar cells.

Strategic Significance & Outlook

This innovative approach using perfluoroadipic acid (PFAA) represents a critical breakthrough in developing perovskite solar cells that balance both high efficiency and high stability. This technology holds the potential to improve the long-term outdoor performance and reliability of PSCs, facilitating their adoption in a wide range of applications, including residential, commercial, and utility-scale solar farms. As the scalability of this PFAA technology for large-scale manufacturing and its applicability to other perovskite compositions are validated, it is expected to significantly contribute to the proliferation of sustainable energy solutions, addressing one of the most crucial challenges facing perovskite technology today.

Source: https://pubs.acs.org/aaemcq/article/doi/10.1021/acsaem.6c02041/5238702/Simultaneous-Enhancement-of-Efficiency-and?searchresult=1

#43 GCL Photoelectric Secures Over ¥100 Million in Series D1 Funding, Accelerating Commercialization with 26.8% Efficiency in 2.78m² Perovskite Modules

Published August 03, 2026 EnergyTrend China

EnergyTrend

OVERVIEW

GCL Photoelectric has successfully closed its Series D1 funding round, raising over ¥100 million (approximately $14 million USD), significantly accelerating the commercialization of its perovskite solar cells. The capital will fund the commercial shipment of perovskite modules for ground-mounted PV power plants and expedite validation for space PV applications. The company has already activated a gigawatt-scale production line and achieved a certified efficiency of 26.8% with 2.78 square meter perovskite modules, marking substantial progress toward mass production and market entry.

IN DEPTH

Key Findings

GCL Photoelectric has successfully concluded its Series D1 funding round, securing over ¥100 million (approximately $14 million USD). This significant capital infusion is poised to substantially accelerate the commercialization of the company's perovskite solar cell technology. The funds are earmarked for initiating commercial shipments of perovskite modules for ground-mounted PV power plants and expediting technological validation for space PV applications. Notably, the company has achieved a certified efficiency of 26.8% on large-area perovskite modules measuring 2.78 square meters, a critical indicator of its technology's maturity for commercial deployment.

Technical and Commercial Details

GCL Photoelectric is actively advancing the commissioning of its gigawatt-scale production line, a crucial step for establishing large-volume manufacturing capabilities for perovskite solar cells. The certified efficiency of 26.8% on 2.78 m^2 modules is significant as it demonstrates high performance on a practical, large-scale module, rather than small laboratory cells. This efficiency is comparable to, or even exceeds, the top-tier efficiency of current silicon solar modules, suggesting that perovskite technology is becoming competitive in both cost-efficiency and conversion efficiency. The fresh funding will enable the company to expand production capacity, diversify its product portfolio, and strengthen its market entry strategies.

Background and Industry Context

Perovskite solar cells hold immense promise as a next-generation photovoltaic technology due to their potential for high efficiency and low manufacturing costs. However, their commercialization has been hindered by challenges related to scalability and long-term stability. GCL Photoelectric's fundraising success and progress on a gigawatt-scale production line exemplify a Chinese company overcoming these hurdles, indicating a growing role for perovskite technology in the global renewable energy market. China, as a dominant force in solar PV manufacturing, is actively positioning itself as a leader in the perovskite sector.

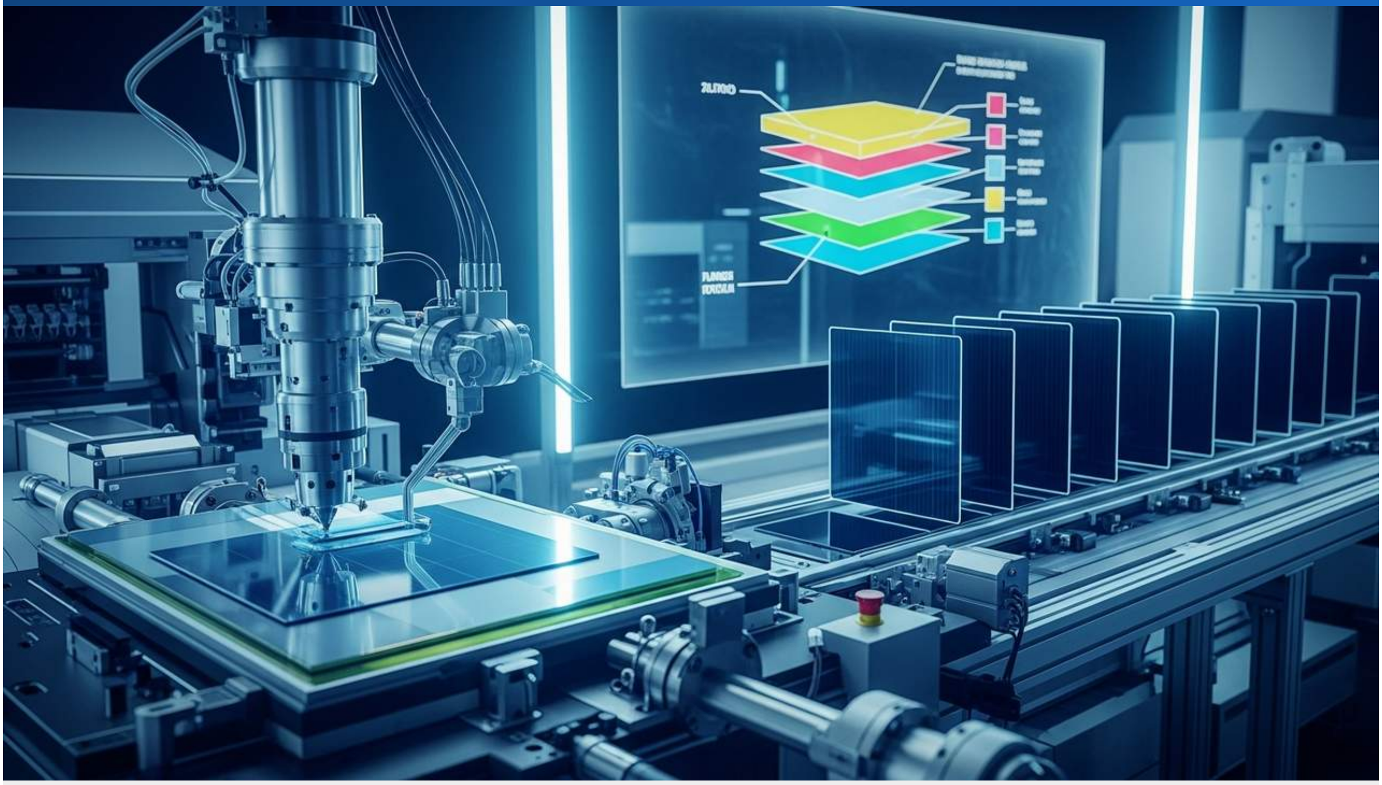
Strategic Significance and Outlook

GCL Photoelectric's strategy has the potential to elevate perovskite technology from niche applications to a mainstream energy source. Commercial shipments for ground-mounted PV power plants will help alleviate market concerns regarding reliability and stability, paving the way for wider adoption. Furthermore, the expansion into space PV applications demonstrates the durability and high performance of perovskites in extreme environments, potentially playing a vital role in future space exploration and satellite power supply. This latest funding round provides substantial momentum for GCL Photoelectric to become a major player in the global solar PV market.

Source: https://www.energytrend.com/news/20260803-51866.html

#44 Tandem PV Acquires Thin-Film Coating Specialist nexTC, Fortifying Manufacturing Process for High-Durability Perovskite-Silicon Solar Cells

Published August 03, 2026   Business Wire   USA



OVERVIEW

Tandem PV, a U.S. developer of high-efficiency perovskite-silicon solar cells, has acquired nexTC Corporation, a specialist in thin-film metal oxide coating processes. This strategic acquisition integrates critical coating technology in-house, significantly enhancing Tandem PV's control over manufacturing processes essential for high-performance, durable perovskite modules. The move is a pivotal step for scaling up its Fremont demonstration line and accelerating the transition to commercial-scale production.

IN DEPTH

Key Findings

Tandem PV, a U.S. company specializing in the development and manufacturing of high-efficiency perovskite-silicon solar cells, has announced the acquisition of nexTC Corporation, a firm focused on thin-film metal oxide coating processes. This strategic acquisition enables Tandem PV to bring crucial coating technology in-house, significantly bolstering its control over the manufacturing process for high-durability, high-performance perovskite solar cell modules.

Technical and Strategic Details

nexTC Corporation is renowned for its advanced thin-film metal oxide coating technologies, which are essential for enhancing the performance and long-term stability of perovskite solar cells. High-quality, uniform coatings are vital for protecting the delicate perovskite layers and increasing device longevity. Through this acquisition, Tandem PV will directly integrate these technologies into its R&D and manufacturing workflows, strengthening supply chain independence and establishing a distinct technological advantage. Specifically, this move will facilitate the expansion of Tandem PV's demonstration line in Fremont and accelerate preparations for a smooth transition to future commercial-scale production.

Background and Industry Context

Perovskite solar cells are garnering significant attention as a next-generation technology due to their potential for higher efficiencies than conventional silicon cells, along with their flexibility and lightweight properties. However, their commercialization has faced substantial hurdles, including manufacturing consistency, long-term reliability, and scalability for mass production. Tandem PV has focused on high-efficiency perovskite-silicon tandem technology, and the acquisition of nexTC represents a critical step toward efficiently manufacturing stable, high-quality modules. This underscores the increasing importance of vertical integration of materials and manufacturing processes as perovskite technology transitions from laboratory to practical deployment.

Strategic Significance and Outlook

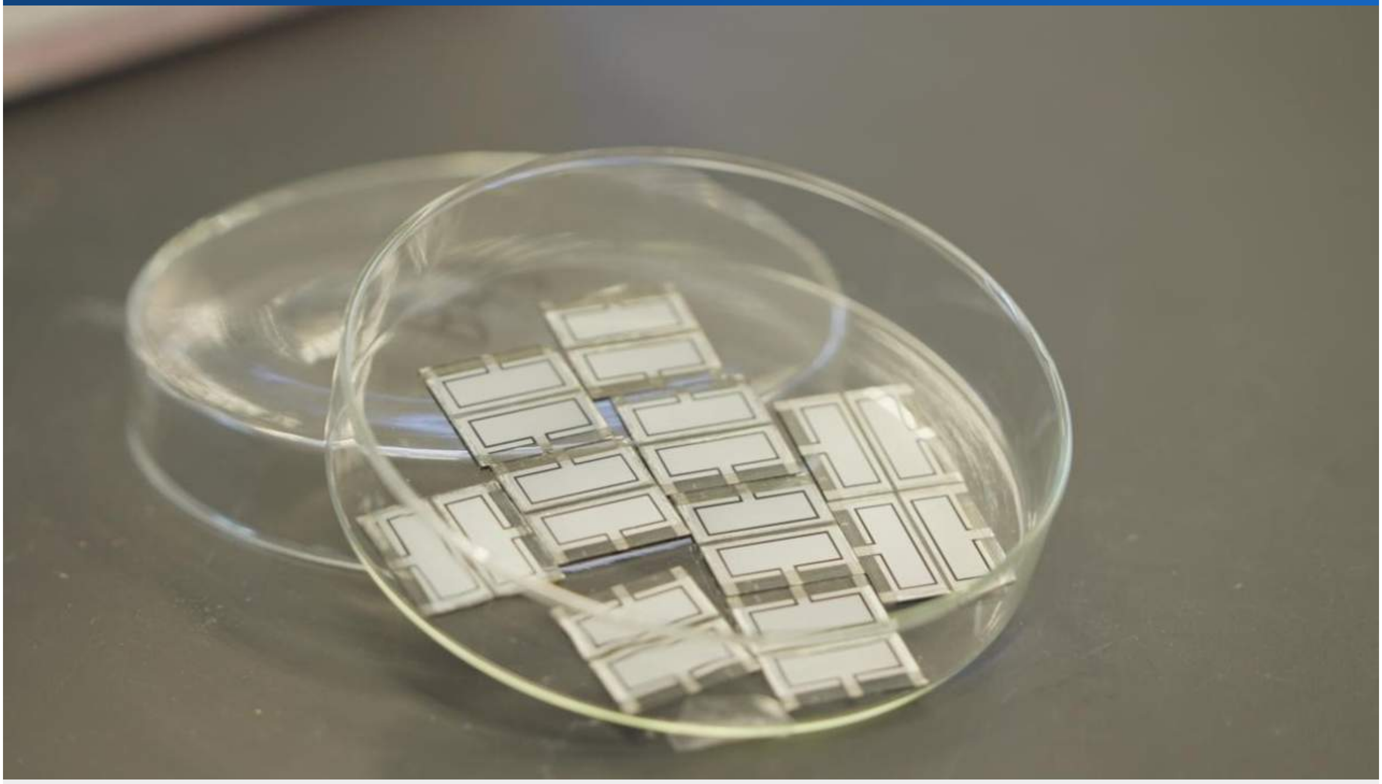
Tandem PV's acquisition of nexTC is expected to be a major driving force in the commercialization of perovskite solar cells. By internalizing coating technology, the company anticipates strengthening product quality control and shortening development cycles. This will accelerate the market introduction of highly durable and efficient perovskite modules, enhancing Tandem PV's competitiveness in the solar energy market. In the long term, this strategy is seen as laying the groundwork for perovskite technology to be widely adopted and play a central role in the energy transition.

Source: https://www.businesswire.com/news/home/20260802424311/en/Tandem-PV-Acquires-nexTC-to-Bring-Critical-Coating-Technology-In-House

Collected: August 07, 2026 | Automated Research System (Gemini API)

#45 Chinese Research Team Sets New World Record for Perovskite Solar Cell Efficiency at 28.04%

Published August 04, 2026 Global Times China



OVERVIEW

A Chinese research team has established a new world record for perovskite solar cell efficiency, achieving an impressive 28.04% power conversion rate. This breakthrough signifies a transformative shift in perovskite technology from being 'light-fearing' to 'light-harnessing,' greatly accelerating its commercialization potential. The achievement reinforces China's technological leadership in the solar energy sector.

IN DEPTH

Key Findings

A Chinese research team has achieved a groundbreaking power conversion efficiency of 28.04% for perovskite solar cells, setting a new world record. This breakthrough marks a significant milestone in the evolution of perovskite solar cell technology, indicating success in overcoming the traditional 'light-fearing' material characteristics to maximize 'light-harnessing' capabilities. This substantial increase in efficiency has the potential to significantly accelerate the commercialization of perovskite solar cells.

Technical Details

The research team reportedly employed innovative approaches in perovskite material composition, crystal growth, and interfacial defect control. Key strategies included enhancing the stability of the light-absorbing layer and minimizing non-radiative recombination losses. These optimizations led to improved open-circuit voltage (Voc), short-circuit current density (Jsc), and fill factor (FF), culminating in the world-record efficiency. This achievement has been independently certified in a laboratory environment, ensuring its reliability. The reported efficiency far surpasses that of conventional commercial silicon solar cells, suggesting the potential for generating more power from a given installation area.

Background and Industry Context

Perovskite solar cells are subject to intensive global research as a next-generation photovoltaic technology due to their excellent light absorption properties and potential for low-cost manufacturing. However, challenges related to long-term stability and reproducibility of efficiency have been significant barriers to commercialization. China leads the world in R&D and manufacturing within the solar PV sector, and this new record unequivocally demonstrates China's growing international leadership in perovskite technology. Such dramatic improvements in laboratory-scale efficiency directly translate to enhanced performance potential for eventual commercial products, drawing significant attention from industry stakeholders.

Strategic Significance and Outlook

The achievement of a 28.04% world record efficiency is a major step towards the practical application of perovskite solar cells and will serve as a powerful catalyst for their market introduction. The next phase is expected to involve scaling this high-efficiency technology to large-area modules and verifying its long-term reliability under real-world conditions. If this technology can be successfully adapted for commercial production, it holds the promise of achieving higher power output and a lower Levelized Cost of Energy (LCOE) compared to existing solar PV technologies. This could make solar power a more widely competitive energy source and contribute significantly to the global energy transition.

Source: https://www.globaltimes.cn/page/202608/1367483.shtml

#46 UK-Swedish Joint Project POP-PV to Tackle Commercialization Challenges of Lightweight Perovskite Solar Cells for Underutilized Rooftops

Published Published August 05, 2026　Solar Power Portal　UK/スウェーデン

OVERVIEW

The POP-PV project, backed by Innovate UK and Vinnova, has launched to address critical manufacturing and material challenges hindering the commercialization of lightweight perovskite solar cells. This collaboration between Power Roll, the University of Sheffield, and Dyenamo AB focuses on deploying flexible solar solutions on vast, underutilized industrial rooftops, aiming to accelerate perovskite adoption and bolster Europe's next-generation solar PV supply chain.

IN DEPTH

Background

Europe is deeply committed to expanding solar power deployment as a cornerstone of its transition to renewable energy. However, a significant hurdle lies in the fact that many existing buildings lack the structural capacity to support heavy conventional silicon solar panels. Lightweight and flexible perovskite solar cells are therefore critical to unlocking the enormous, untapped potential of these underutilized rooftops. The POP-PV project serves as an exemplary model for accelerating technological innovation through international academic-industrial collaboration, specifically by addressing complex manufacturing and material challenges that would be difficult for individual entities to resolve.

Key Findings

The international collaborative research project, 'POP-PV,' has officially commenced, supported by Innovate UK (UK) and Vinnova (Sweden). This initiative unites the UK's Power Roll, the University of Sheffield, and Sweden's Dyenamo AB to address critical manufacturing and material challenges currently impeding the commercialization of lightweight perovskite solar cells. A core focus is the development of lightweight and flexible solar solutions specifically tailored for underutilized rooftop spaces, including warehouses, factories, and other commercial buildings.

Technical Scope and Methodology

The POP-PV project primarily targets the following technical challenges:

- **Manufacturing Scalability:** Developing technologies for the efficient, low-cost production of large-area perovskite solar cell films. This involves leveraging Power Roll's proprietary micro-groove technology to optimize roll-to-roll manufacturing processes.
- **Material Stability:** Researching novel compositions and advanced encapsulation techniques to enhance the long-term stability and durability of perovskite materials, aiming for products resilient to diverse European weather conditions.

- **Lightweight and Flexibility:** Designing ultra-lightweight and flexible module architectures that can be installed without imposing significant structural loads on existing roofs. This will enable the widespread deployment of solar power on vast roof areas, such as the corrugated metal roofs of commercial facilities, where traditional heavy silicon panels are impractical.

Beyond these technical developments, the project also aims to strengthen intra-European collaboration across the entire supply chain and foster the regional innovation ecosystem.

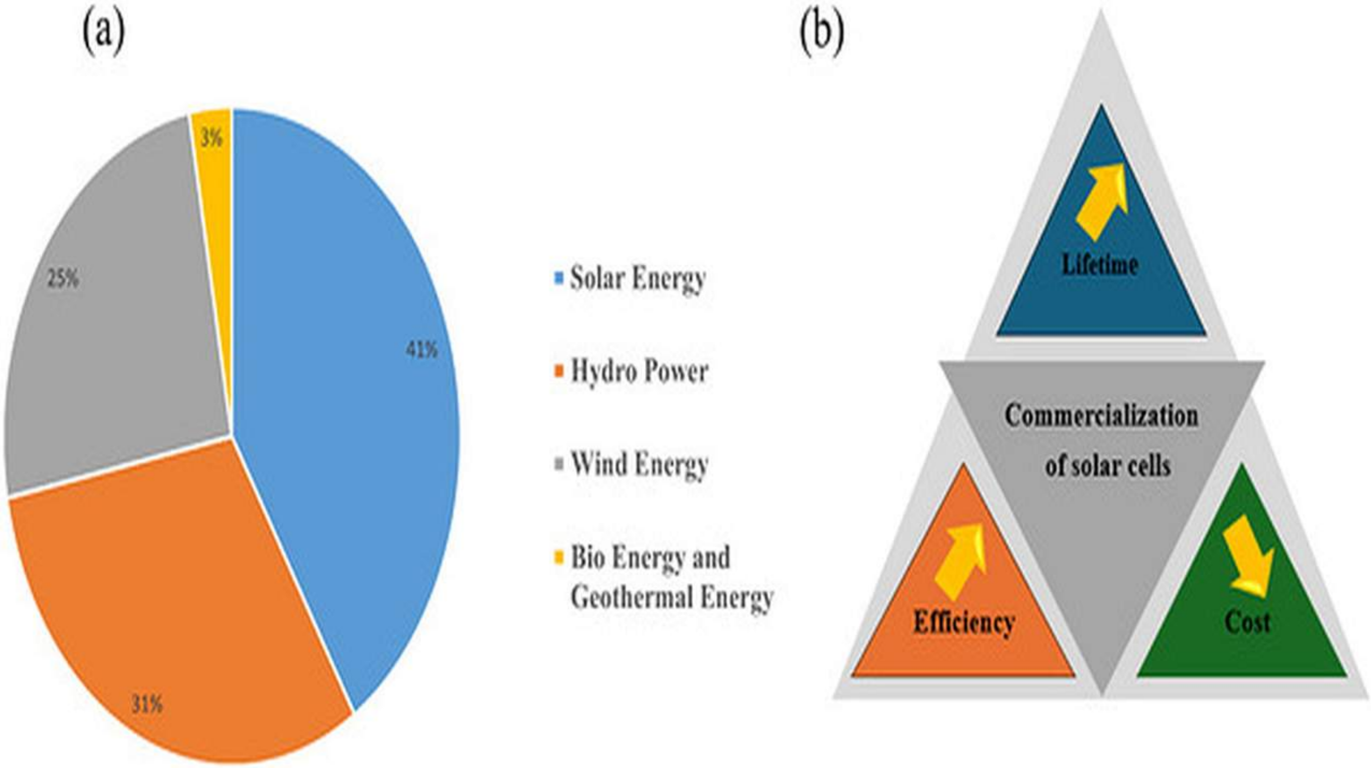
Strategic Significance and Future Outlook

The successful realization of the POP-PV project holds the potential to open significant new avenues for large-scale solar power deployment across commercial and industrial rooftops throughout Europe. This is anticipated to reduce the overall cost of solar installations and substantially facilitate the integration of renewable energy into the grid. In the long term, this project is expected to enhance the competitiveness of Europe's next-generation solar PV supply chain, making a vital contribution to regional energy independence and climate change targets. Furthermore, the outcomes of this research are envisioned to have broader applicability in other geographical regions and for diverse specialized use cases.

Source: https://www.solarpowerportal.co.uk/solar-technology/new-project-to-research-lightweight-solar-solutions-for-underutilised-rooftops

#47 Review Paper Highlights Critical Role of Inorganic Hole Transport Materials in Advancing n-i-p Perovskite Solar Cells, Contributing to 27% Efficiency and Enhanced Stability

Published August 06, 2026 PMC - NIH Global



OVERVIEW

This review paper focuses on the rapid advancements in perovskite solar cells (PSCs), specifically their achievement of a certified world record efficiency of approximately 27% and their potential for low manufacturing costs. The paper meticulously details the indispensable role of inorganic hole transport materials (HTMs) in n-i-p type PSCs for enhancing device performance, suppressing undesirable ion migration, and bolstering operational stability. This underscores the material science approach critical for further PSC efficiency and long-term reliability, offering vital insights for commercialization.

IN DEPTH

Key Findings

A recent review paper provides an overview of the rapid progress in perovskite solar cells (PSCs), emphasizing their achievement of a certified world-record power conversion efficiency of approximately 27% and their potential for low manufacturing costs. The core of this paper lies in detailing the critical role of inorganic hole transport materials (HTMs) in n-i-p type PSCs. Inorganic HTMs are shown to be indispensable for enhancing solar cell performance, suppressing undesirable ion migration, and bolstering long-term operational stability, thereby underscoring the importance of material science approaches for PSC commercialization.

Technical and Material Details

In n-i-p perovskite solar cells, a hole transport layer (HTL) is essential for efficiently extracting holes generated by light and simultaneously preventing electron recombination. While conventional organic HTMs have shown high performance, their high cost, low stability, and complex synthesis routes have been barriers to commercialization. In contrast, inorganic HTMs offer advantages such as high conductivity, excellent thermal and chemical stability, and relatively low manufacturing costs. The review highlights key inorganic HTMs like nickel oxide (NiO_x), copper thiocyanate (CuSCN), and carbon-based materials, discussing how their respective material properties contribute to PSC performance, particularly in improving open-circuit voltage (V_{oc}) and optimizing fill factor (FF). It also delves into the mechanisms by which inorganic HTMs improve charge transport at the interface with the perovskite layer and provide defect passivation effects, thereby suppressing ion migration and enhancing device stability.

Background and Industry Context

Perovskite solar cells are seen as a promising next-generation technology to replace silicon solar cells due to their rapid efficiency improvements at the laboratory level. However, for commercialization, maintaining efficiency and establishing long-term reliability are paramount. The choice and optimization of hole transport materials significantly impact the overall stability and efficiency of the device. The use of inorganic HTMs is recognized as a promising solution to this challenge, enabling the development of more robust and cost-effective PSCs. Progress in this research area will be one of the decisive factors for the market introduction of perovskite technology.

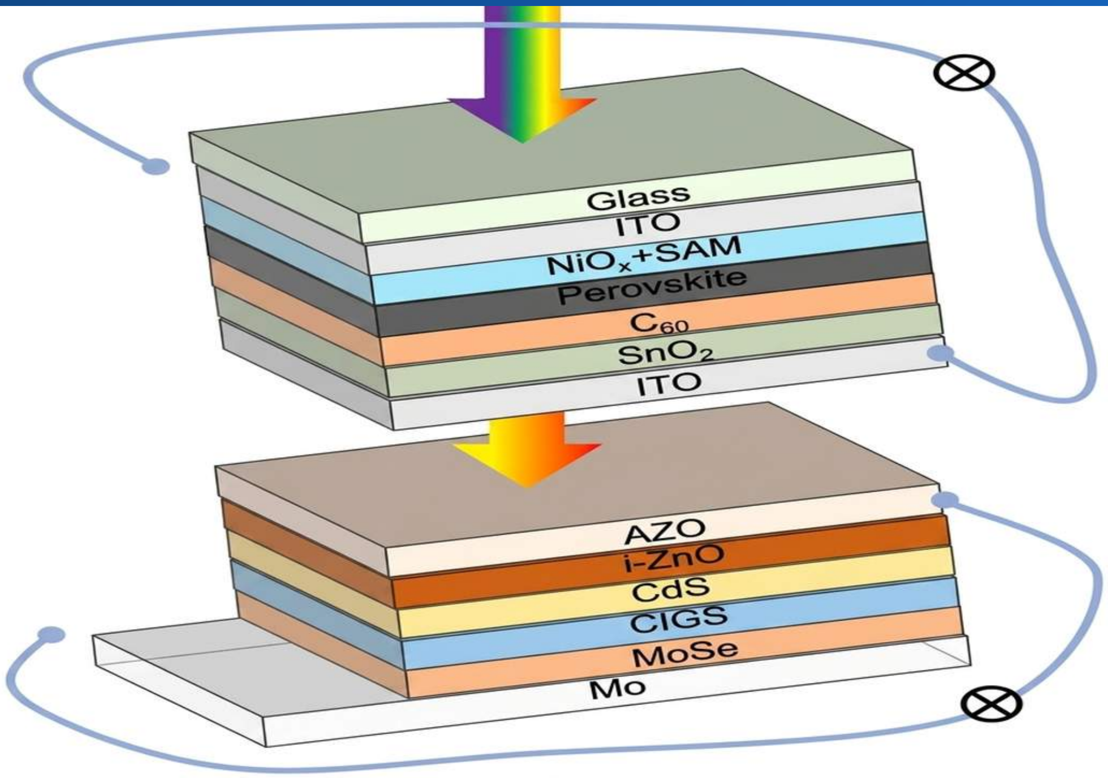
Strategic Significance and Outlook

Further research and optimization of inorganic hole transport materials are indispensable elements in the commercialization roadmap for perovskite solar cells. This review paper provides guidance for identifying promising inorganic HTMs and improving their synthesis and application techniques. It is expected that the development of large-area, highly stable PSC modules using these materials will accelerate, ultimately leading to higher performance and a lower Levelized Cost of Energy (LCOE) compared to traditional solar cells. This could allow perovskite solar cells to be more widely adopted in the renewable energy market and significantly contribute to the global energy transition.

Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC13360878/

#48 Chinese Researchers Achieve 29.71% Overall Efficiency and Over 91% Stability After 2000 Hours with Sulfide-Based Four-Terminal Perovskite/CIGS Tandem Solar Cell

Published July 30, 2026 pv magazine Global China



OVERVIEW

Chinese researchers have developed a four-terminal perovskite/CIGS tandem solar cell with an impressive overall power conversion efficiency of 29.71%, utilizing sulfide-based coordination engineering. This new technology significantly enhances the stability of wide-bandgap perovskites by suppressing defect formation, halide migration, and phase segregation. Furthermore, the device demonstrated sustained performance, maintaining over 91% of its initial efficiency after 2000 hours of continuous operation, marking a critical breakthrough in the long-term reliability of perovskite tandem technology.

IN DEPTH

Key Findings

A team of Chinese researchers has developed a four-terminal perovskite/CIGS tandem solar cell, leveraging sulfide-based coordination engineering, that achieves an impressive overall power conversion efficiency of 29.71%. The breakthrough lies not only in the high efficiency but also in significantly improving the stability of wide-bandgap perovskites, which has been a persistent challenge. The developed device demonstrated remarkable durability, maintaining over 91% of its initial efficiency after 2000 hours of continuous operation, signaling a crucial advancement in the long-term reliability of perovskite tandem technology.

Technical and Testing Details

Tandem solar cells combine multiple absorbing layers with different bandgaps to more broadly utilize the solar spectrum, achieving higher efficiencies than single-junction cells. This research employed a four-terminal configuration with a wide-bandgap perovskite top cell and a copper indium gallium selenide (CIGS) bottom cell. The key technological innovation is the introduction of sulfide-based coordination engineering. This effectively suppressed primary degradation mechanisms in perovskite solar cells, including defect formation, halide ion migration, and photo-induced phase segregation. In long-term stability tests, the device was operated continuously for 2000 hours, after which its performance was evaluated, demonstrating exceptional durability by retaining over 91% of its initial power conversion efficiency. This serves as a critical metric for practical application.

Background and Industry Context

Perovskite solar cells have garnered significant attention as a next-generation photovoltaic technology due to their high efficiency potential and low-cost manufacturing. However, long-term stability has been a major barrier to commercialization. Wide-bandgap perovskites, in particular, are crucial for tandem applications due to their high open-circuit voltage potential, but they have been more challenging to stabilize. This breakthrough advances perovskite technology significantly in both stability and efficiency, and by combining it with established thin-film technologies like CIGS, it could introduce new competitiveness into the existing solar cell market.

Strategic Significance and Outlook

The combination of 29.71% high efficiency and excellent stability of over 91% after 2000 hours represents a major stride towards the commercialization of perovskite/CIGS tandem solar cells. If this technology can be scaled for mass production, its ability to deliver more power from a limited installation area could lead to widespread adoption in various applications, including ground-mounted power plants, building-integrated photovoltaics (BIPV), and flexible devices. With further long-term field testing and cost optimization, this sulfide-based tandem technology holds the potential to play a leading role in the global solar power market.

Source: https://www.pv-magazine.com/2026/07/30/chinese-researchers-build-29-71-perovskite-cigs-tandem-solar-cell-based-on-sulfide/

Collected: August 07, 2026 | Automated Research System (Gemini API)