Perovskite solar

Weekly Intelligence Report

2026-05-18 | 18 articles | 6 countries

troy-technical.jp

This Week's Keyword

Perovskite Commercialization

Efficiency, stability, and market entry accelerate

18	6	27.6	29.9
articles	countries	%	%
Total Articles Analyzed	Source Countries	Highest Cell Efficiency	Highest Tandem Efficiency

All 18 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	Toyo Seikan & Perovion	Corporate Strategy	●●●○○	●●●●○	●●●●○	●●○○○	●●●●●	Japanese firm partners with Dutch spin-off to commercialize roll-to-roll flexible perovskite cells for Europe.
#02	Additive-Free Interfacial	Research	●●●●●	●●○○○	●●●●○	●●●●●	●●●●○	International team achieves 26.25% efficiency and 24,800-hour lifetime for perovskite cells via additive-free CCI method.
#03	Perovskite/CIGS Tandem	Research	●●●●○	●●○○○	●●●●○	●●●●○	●●●○○	Japanese team sets world record 25.14% efficiency for perovskite/CIGS tandem solar cell.
#04	Fraunhofer ISE Hub	Corporate Strategy	●●○○○	●●●○○	●●●●○	●●○○○	●●●●●	Fraunhofer ISE opens German R&D; hub for mass production of perovskite tandem solar cells.
#05	NTU Ultrathin Transparent	Research	●●●●○	●●○○○	●●●○○	●●●●○	●●●○○	NTU develops ultrathin, transparent perovskite cells with 41% transmittance and 7.6% efficiency for BIPV.
#06	METI Overseas Demos	Corporate Strategy	●○○○○	●●●○○	●●●●○	●●○○○	●●●●●	Japan's METI funds overseas perovskite solar cell demos in Europe, US, and SE Asia to set standards.
#07	Kanazawa Long-Life	Research	●●●●○	●●○○○	●●●●○	●●●●○	●●●○○	Kanazawa University develops long-life perovskite modules stable under ambient conditions by controlling grain boundaries.
#08	Sekisui Commercializes	New Product	●●○○○	●●●●●	●●●●○	●●●○○	●●●●○	Sekisui Chemical commercializes film-type perovskite cells (SOLAFIL), intensifying global competition.
#09	KAIST 25.56% Efficiency	Research	●●●●○	●●○○○	●●●●○	●●●●○	●●●○○	KAIST/KRICT achieve 25.56% efficiency with high stability in perovskite cells, boosting SK commercialization.
#10	GIST Commercialization	Corporate Strategy	●●○○○	●●●○○	●●●●○	●●○○○	●●●○○	GIST launches consortium for world's first perovskite solar cell commercialization, targeting large-area modules.
#11	NYCU Lead-Free Tin	Research	●●●●○	●●○○○	●●●○○	●●●●●	●●●○○	NYCU achieves 9.1% efficiency and 5000hr T80 stability in lead-free tin perovskite cells via HTL optimization.
#12	Korean-Chinese 27.6%	Research	●●●●●	●●○○○	●●●●○	●●●●●	●●●●○	Korean-Chinese team achieves 27.6% certified efficiency and high stability in single-junction perovskite cells.

#	Article Title	Type	Tech Novelty	Market Proximity	Market Impact	Data Reliability	US/EU Relevance	Summary
#13	Sungkyunkwan ALD	Research	●●●●	●●○○	●●●●	●●●●	●●●○	Sungkyunkwan University develops scalable 27.3% efficient inverted perovskite cells using ALD for large-area modules.
#14	Hanwha 29.9% Tandem	Research	●●●●	●●●○	●●●●	●●●●	●●●●	Hanwha Solutions achieves 29.9% efficiency in tandem solar cells with high-reliability encapsulation.
#15	Material Engineering	Trend Article	●●●●	●●○○	●●●●	●●○○	●●●●	Material engineering breakthroughs in 2026 significantly boost perovskite solar cell stability, accelerating commercialization.
#16	Huazhong All-Perovskite	Research	●●●●	●●○○	●●●●	●●●●	●●●○	Huazhong University achieves 29.80% efficiency in all-perovskite tandem cells using laser polishing.
#17	CAS Glutathione Additive	Research	●●●●	●●○○	●●●●	●●●●	●●●○	CAS boosts perovskite cell efficiency to 26.17% (23.14% mini-module) and stability with glutathione additive.
#18	QY Research Forecast	Market Overview	●○○○	●●●●	●●●●	●●●○	●●●●	QY Research forecasts all-perovskite tandem solar cell market to reach $2.279B by 2032 (38.2% CAGR).

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

Three Questions That Demand Your Decision This Week

❶ Is your R&D; roadmap competitive against 27%+ perovskite cells?

New breakthroughs from Korea/China (27.6% single-junction, 29.9% tandem) set aggressive benchmarks for efficiency and stability. Does your current perovskite or next-gen PV strategy account for these rapid advances?

❷ How will Asian commercialization impact your supply chain?

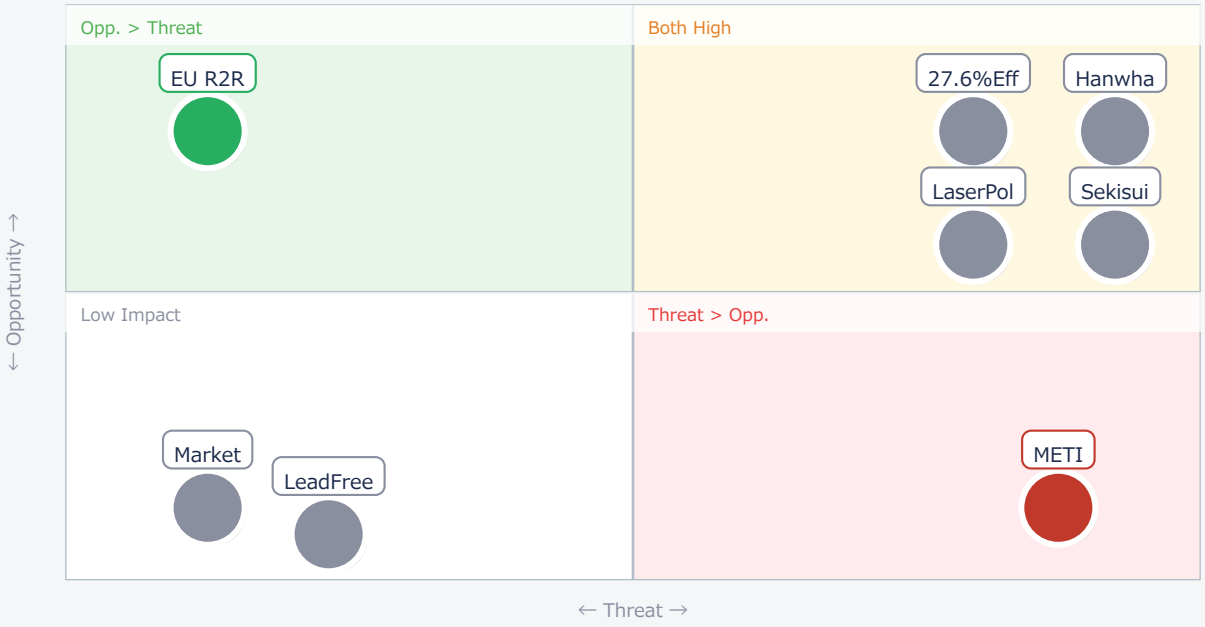
Sekisui Chemical has commercialized film-type perovskites, while Hanwha Solutions nears 30% tandem efficiency. Japan's METI is funding global demos. Are your procurement and supply chain strategies prepared for these new market entrants and technologies?

❸ Are you leveraging EU initiatives for perovskite industrialization?

Fraunhofer ISE established a German R&D; hub for mass production, and a Dutch spin-off (Perovion) is partnering with Toyo Seikan for R2R commercialization in Europe. Are you actively engaging with these European efforts or risk being left behind?

Opportunities vs. Threats for US/European Companies

Opportunity vs. Threat Matrix for US/European Companies



Item	Quadrant	↑ Opportunity	↓ Threat
● 27.6%Eff	Critical	New tech benchmark	Obsoletes current R&D;
● Hanwha	Critical	Tandem tech path	SK market lead
● LaserPol	Critical	Mfg process	China lead
● Sekisui	Critical	New form factor	Japan first-mover
● EU R2R	Opp.	EU market entry	EU competition
● METI	Threat	Demo access	Japan standards
● Market	Ref.	Market insight	Missed trends

LeadFree	Ref.	Green tech	Low efficiency

Deep Dive ① — EU-Japan Partnership for R2R Perovskite

#01 | 2026/05/15 | 東洋製罐グループホールディングス | Tech Novelty●●●○○ Proximity●●●●○ Market Impact●●●●○ Data Reliability●●○○○ US/EU Relevance●●●●●

Japanese Toyo Seikan Group is partnering with Perovion Technologies, a TNO spin-off from the Netherlands, to globally commercialize lightweight, flexible perovskite solar cells using TNO's roll-to-roll (R2R) manufacturing technology.

Toyo Seikan will optimize its MiraNeo® functional materials (front/back sheets, sealants) for TNO's R2R line, establishing a stable supply system through phased demonstrations, initially targeting European markets.

▶ Strategic Analyst's Perspective

Published numbers are realistic as this is a commercialization partnership, not a research breakthrough with efficiency claims. Technical barriers involve scaling R2R for perovskites, ensuring material compatibility, and achieving long-term durability under real-world conditions. [Opportunity] for US/EU materials suppliers to integrate into this emerging R2R supply chain and for BIPV/flexible electronics OEMs to access new form factors. [Threat] for US/EU PV manufacturers if Japanese/Dutch collaboration gains first-mover advantage in flexible perovskites. Next actions: [Procurement] Identify MiraNeo® material specs and potential alternatives by end of month. [R&D;] Evaluate R2R perovskite integration with existing flexible PV lines by next quarter. [Business Dev] Explore partnership opportunities with Perovion or similar European R2R initiatives.

Deep Dive ② — 27.6% Certified Perovskite Efficiency

#12 | 2026/05/15 | Daum (DBR) | Tech Novelty●●●●● Proximity●●○○○ Market Impact●●●●○ Data Reliability●●●●● US/EU Relevance●●●●○

A Korean-Chinese team, led by Sungkyunkwan University, achieved a world-leading 27.6% certified power conversion efficiency for a single-junction perovskite solar cell using a molecular design strategy.

This breakthrough stabilizes both the internal crystal and surface with a 3-PMPCl additive and utilizes bismuth (Bi) electrodes, maintaining over 93% efficiency after 1011 hours under high temperature and solar illumination, published in 'Science'.

▶ Strategic Analyst's Perspective

The 27.6% certified efficiency is highly credible given the 'Science' publication and specific stability data. Technical barriers include scaling this molecular design strategy to large-area modules and ensuring the long-term cost-effectiveness and environmental impact of Bi electrodes. [Opportunity] for US/EU materials science firms to license or develop similar molecular stabilization additives and for PV R&D; to benchmark against this new efficiency and stability standard. [Threat] for US/EU perovskite developers whose current R&D; platforms may be rendered less competitive by this significant leap in performance and durability. Next actions: [R&D;] Immediately analyze the 3-PMPCl mechanism and Bi electrode integration for competitive benchmarking. [Legal/IP] Investigate patent landscape around molecular stabilization and alternative electrodes by next month.

Deep Dive ③ — Hanwha's 29.9% Tandem with Encapsulation

#14 | 2026/05/11 | Daum (毎日経済新聞) | Tech Novelty●●●●○ Proximity●●●○○ Market Impact●●●●● Data Reliability●●●●○ US/EU Relevance●●●●○

South Korean firm Hanwha Solutions achieved 29.9% conversion efficiency in tandem solar cells, nearing the 30% commercialization threshold, by combining perovskite and silicon layers.

A key innovation is their proprietary "high-reliability encapsulation" technology, designed to overcome perovskite's vulnerability to moisture and heat, crucial for extending practical lifespan and commercial viability.

▶ Strategic Analyst's Perspective

The 29.9% efficiency for a tandem cell is highly impressive and realistic for a major industrial player like Hanwha. The critical technical barrier is proving the long-term reliability of the encapsulation under diverse real-world conditions (e.g., IEC standards) and scaling it cost-effectively. [Opportunity] for US/EU materials suppliers specializing in advanced encapsulation films, sealants, and moisture barriers to partner with Hanwha or other tandem developers. [Threat] for US/EU PV manufacturers, particularly those focused on conventional silicon, as Hanwha's near-commercial tandem technology could rapidly capture market share in high-efficiency segments. Next actions: [Procurement] Research Hanwha's encapsulation material requirements and identify potential supply chain gaps by end of month. [Strategy] Assess competitive impact of near-30% tandem cells on existing product roadmaps by next quarter.

Other Notable Articles

#02 Additive-Free Interfacial Strategy Boosts Perovskite Cell Efficiency to 26.25% and Extends Lifetime to 24,800 Hours (XenoSpectrum)
Tech Novelty●●●●● Proximity●●○○○ Market Impact●●●●○ Data Reliability●●●●● US/EU Relevance●●●●○

Additive-free stability breakthrough from US/Korea collaboration sets new durability benchmark for perovskite cells.

#05 Fraunhofer ISE Establishes German Mass Production R&D; Hub for Perovskite Tandem Solar Cells (ペロブスカイトニュース)
Tech Novelty●●○○○ Proximity●●●○○ Market Impact●●●●○ Data Reliability●●○○○ US/EU Relevance●●●●●

Europe's strategic move to industrialize perovskite tandem cells, focusing on mass production and module integration.

#10 Perovskite Solar Cells in 2026: Sekisui Chemical Commercializes Film-Type PV, Global Competition Intensifies (note (chatarow))
Tech Novelty●●○○○ Proximity●●●●● Market Impact●●●●○ Data Reliability●●●○○ US/EU Relevance●●●●○

Sekisui Chemical's commercial launch of flexible film-type perovskite cells signals market entry and intensifies competition.

#17 Sungkyunkwan University Develops Scalable Inverted Perovskite Solar Cells with 27.3% Efficiency via Atomic Layer Deposition (ALD) (RSC Advances)
Tech Novelty●●●●○ Proximity●●○○○ Market Impact●●●●○ Data Reliability●●●●● US/EU Relevance●●●○○

ALD-enabled scalable perovskite cells with 27.3% efficiency address critical large-area manufacturing challenges.

#20 Huazhong University Achieves 29.80% Efficiency in All-Perovskite Tandem Solar Cell via Laser Polishing (pv magazine)
Tech Novelty●●●●● Proximity●●○○○ Market Impact●●●●○ Data Reliability●●●●○ US/EU Relevance●●●○○

Chinese team achieves near-30% all-perovskite tandem efficiency using novel laser polishing for defect reduction.

Recommended Actions This Week

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

Immediate (this week)

- [R&D;] Review latest efficiency and stability benchmarks (27.6% single, 29.9% tandem, 24,800hr lifetime) to update internal targets.
- [Strategy] Assess competitive landscape shifts due to Sekisui's commercial launch and Hanwha's near-30% tandem.

Short-term (1 month)

- [Procurement] Investigate supply chain implications of Japanese METI's overseas demo funding, especially for materials and equipment.
- [Business Dev] Identify potential US/EU partners for flexible perovskite R2R manufacturing, following Toyo Seikan/Perovion model.
- [R&D;] Initiate feasibility study on molecular design strategies (e.g., 3-PMPCl) and ALD for scalable perovskite manufacturing.

Medium-long term (quarter+)

- [Strategy] Develop a comprehensive roadmap for perovskite tandem and flexible PV, considering both lead-based and lead-free options.
- [Legal/IP] Monitor international standardization efforts for perovskite solar cells, especially those influenced by Japanese and Korean demonstration projects.
- [Executive] Allocate increased budget for advanced encapsulation R&D; to match Hanwha's progress and ensure long-term product viability.

PerovskiteSolarCells — Selected Articles

Date: 2026-05-18

Articles: 18

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#21 Chinese Academy of Sciences Boosts Perovskite Solar Cell Efficiency and Stability to 26.17% (Cell) & 23.14% (Mini-Module) with Glutathione Additive

#22 オールペロブスカイトタンデム太陽電池市場予測2026-2032：QY Researchが市場動向と商業化経路を分析

Toyo Seikan Group Partners with TNO Spin-off Perovion to Scale Perovskite Solar Cell Production Globally

Published May 15, 2026　東洋製罐グループホールディングス　Japan

OVERVIEW

Toyo Seikan Group Holdings has formed a strategic partnership with Perovion Technologies B.V., a spin-off from the Netherlands Organization for Applied Scientific Research (TNO), to accelerate the global commercialization of perovskite solar cells. Perovion will commercialize TNO's roll-to-roll (R2R) manufacturing technology for lightweight, flexible perovskite cells, aiming for mass production. Toyo Seikan Group will optimize its proprietary 'MiraNeo®' functional materials, such as front and back sheets and edge sealants, for TNO's R2R assembly line, establishing a stable supply system through phased demonstration projects, initially targeting European markets.

IN DEPTH

Background

The urgent need for climate change mitigation and the establishment of sustainable energy systems has intensified interest in perovskite solar cells as a next-generation photovoltaic technology. Their inherent advantages, including lightweight, flexibility, and potential for low-cost manufacturing, position them favorably for novel applications such as building-integrated photovoltaics (BIPV) and urban environments with spatial constraints. However, successful commercialization has been hindered by challenges in stability, long-term durability, and the scalability of manufacturing processes for large-area devices.

Key Findings / Results

Toyo Seikan Group Holdings has announced a strategic partnership with the Netherlands Organization for Applied Scientific Research (TNO) and its spin-off company, Perovion Technologies B.V., to drive the global implementation of perovskite solar cells. This collaboration is anchored in the commercialization of TNO's advanced roll-to-roll (R2R) manufacturing technology, developed at its pilot line for perovskite solar cells. Toyo Seikan Group will contribute its "MiraNeo®" functional materials, including advanced front sheets, back sheets, and edge sealants, optimizing them for seamless integration into TNO's R2R production infrastructure. This tripartite alliance aims to elevate Perovion's perovskite cells into high-performance, durable modules, thereby streamlining the entire supply chain. The partnership is designed to facilitate the rapid establishment of mass production capabilities and a reliable supply system, supported by incremental demonstration projects.

Technical Significance & Outlook

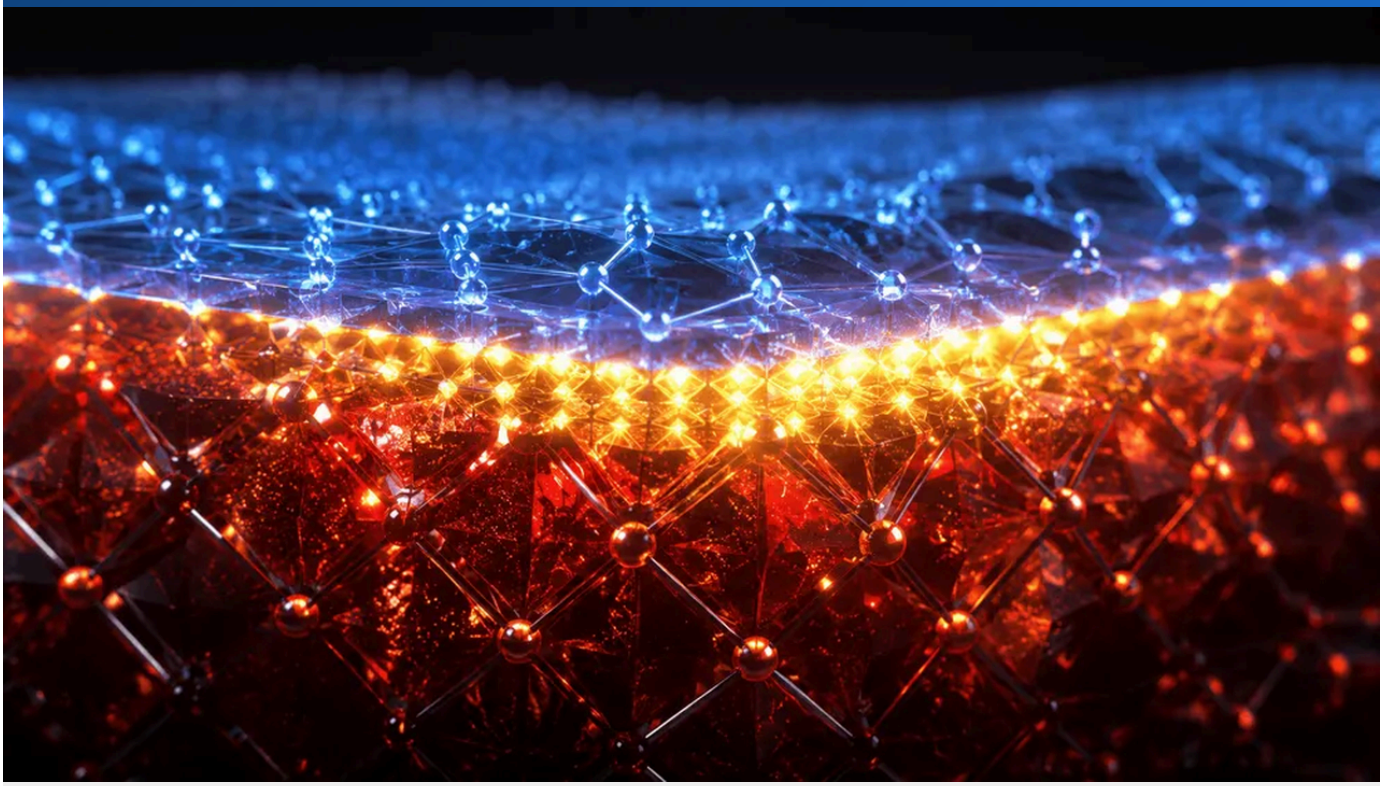
This partnership marks a significant milestone in the journey towards commercializing perovskite solar cells. The synergy between TNO's cutting-edge research, Toyo Seikan Group's material science expertise, and Perovion's commercialization drive exemplifies international innovation. The integration of R2R manufacturing with flexible materials is particularly crucial, promising to accelerate the market introduction of lightweight and aesthetically versatile solar cells. This enables their deployment in unconventional applications, such as building facades, vehicle surfaces, and wearable electronics, where traditional silicon panels are impractical. Initial efforts will focus on establishing product value in the Japanese market, followed by a broader global rollout starting with Europe, aiming to significantly contribute to a sustainable energy future. Furthermore, this collaboration has the potential to influence international technical standardization and the broader supply chain architecture for perovskite technology, warranting close observation of its future developments.

Source: https://www.tskg-hd.com/news/detail/20260515_newsrelease.html

Collected: May 15, 2026 | Automated Research System (Gemini API)

Additive-Free Interfacial Strategy Boosts Perovskite Cell Efficiency to 26.25% and Extends Lifetime to 24,800 Hours

Published May 14, 2026 XenoSpectrum Japan



OVERVIEW

An international team including Seoul, Korea, and Toledo Universities has achieved a certified 25.61% (reported 26.25%) conversion efficiency and an estimated 24,800-hour operational lifetime for perovskite solar cells using a novel, additive-free "Contact-Induced Cation Interaction" (CCI) method. This breakthrough physically manipulates 2D/3D perovskite interfaces to resolve internal crystal distortions and reconstruct an ideal lattice structure, fundamentally enhancing long-term stability without chemical additives. The simple, physical interface control represents a significant step towards commercializing highly efficient and stable perovskite technology, especially for tandem applications.

IN DEPTH

Background

Perovskite solar cells (PSCs) have garnered significant attention as a promising next-generation photovoltaic technology due to their remarkable power conversion efficiencies (PCEs). However, their widespread commercialization has been consistently hampered by issues related to long-term stability and durability, particularly under operational stress from heat and light. Traditional approaches to enhance stability have largely relied on chemical additives, which can sometimes compromise device performance or complicate manufacturing processes. A key challenge has been addressing intrinsic defects and strain within the perovskite crystal structure, which are primary drivers of degradation.

Key Findings / Results

An international research collaboration, involving Seoul National University, Korea University, and the University of Toledo, has introduced a groundbreaking, additive-free method termed "Contact-Induced Cation Interaction (CCI)." This innovative strategy dramatically improves the crystal quality of perovskite solar cells. The CCI method involves the physical contact between 2D and 3D perovskite components, which electromagnetically constrains cation rotation within the 3D crystal. Subsequent thermal annealing fundamentally resolves internal crystal distortions, leading to the reconstruction of an ideal lattice structure and a significant reduction in defect density. As a direct result, PSCs fabricated with this CCI approach achieved a certified power conversion efficiency of 25.61% (with a reported peak efficiency of 26.25%). Crucially, the long-term operational stability was drastically improved, demonstrating an estimated operational lifetime of approximately 24,800 hours under accelerated aging conditions, a substantial advancement over prior technologies.

Technical Significance & Outlook

The CCI method represents a profound technical breakthrough, offering a viable solution to the long-standing stability issues that have been a major impediment to the commercialization of perovskite solar cells. By focusing on physical interface control without the need for chemical additives, this approach also promises to simplify manufacturing processes and potentially reduce production costs. The enhanced stability, particularly the 24,800-hour estimated lifetime, brings perovskite technology closer to the 20-25 year operational lifespan typically expected from commercial solar panels, thereby boosting its real-world viability. This technology is expected to yield significant advantages in high-efficiency tandem solar cells, such as perovskite-silicon tandems, where improved stability of the perovskite component is paramount. Future work will involve scaling up this method for large-area modules and conducting extensive outdoor performance validation to confirm its robustness and versatility in practical applications, ultimately accelerating the deployment of perovskite solar cells as a sustainable energy solution.

Source: https://xenospectrum.com/perovskite-solar-cell-efficiency-durability-breakthrough/

Collected: May 15, 2026 | Automated Research System (Gemini API)

Tokyo City University and AIST Achieve Record 25.14% Efficiency in Perovskite/CIGS Tandem Solar Cell

Published May 11, 2026　ペロブスカイトニュース　Japan

OVERVIEW

Tokyo City University and the National Institute of Advanced Industrial Science and Technology (AIST) have achieved a world-record conversion efficiency of 25.14% for a perovskite/CIGS tandem solar cell. This breakthrough surpasses the theoretical limits of single-junction devices by leveraging the complementary bandgaps of perovskite and CIGS materials. The integration of perovskite's tuneable bandgap and low-cost processing with CIGS's high efficiency and stability marks a significant stride towards next-generation, high-efficiency solar cells applicable to diverse fields.

IN DEPTH

Background

Further expansion of solar energy necessitates technologies that can surpass the theoretical conversion efficiency limits (Shockley-Queisser limit) of conventional single-junction solar cells. Tandem solar cells, which stack multiple solar cells with different bandgaps, are a promising approach to utilize the solar spectrum more effectively and achieve higher efficiencies. Perovskite solar cells are considered ideal top-cell materials for tandem structures due to their excellent light absorption properties and ease of bandgap tuning. Copper Indium Gallium Selenide (CIGS) solar cells, a thin-film technology, are known for their high efficiency and good stability, making their combination with perovskites highly anticipated.

Key Findings / Results

A joint research team from Tokyo City University and the National Institute of Advanced Industrial Science and Technology (AIST) has announced the development of a new perovskite/CIGS tandem solar cell, achieving a world-record power conversion efficiency of 25.14%. This unprecedented efficiency was realized through a design that maximizes the spectral response characteristics of both materials: the high-bandgap perovskite layer efficiently absorbs short-wavelength light, while the CIGS bottom cell captures the remaining long-wavelength photons. The research team implemented innovative interface engineering to minimize charge recombination losses at the perovskite/CIGS interface and precisely optimized the material composition and thickness of each layer. These efforts significantly improved current matching between the two sub-cells, leading to a substantial enhancement in the overall performance of the tandem structure.

Technical Significance & Outlook

The achievement of 25.14% efficiency in perovskite/CIGS tandem solar cells represents a critical milestone in the evolution of next-generation photovoltaic technology. This breakthrough demonstrates the potential to overcome the efficiency limitations of traditional silicon solar cells, enabling more power generation from a smaller installation area. Combining perovskite's flexibility with CIGS's durability opens up broad application possibilities, including building-integrated photovoltaics (BIPV), lightweight flexible devices, and even aerospace applications. The research team plans to scale up this high-efficiency technology for larger module areas and conduct long-term reliability evaluations to pave the way for commercialization. This accomplishment not only reinforces Japan's position at the forefront of global solar cell research and development but also contributes significantly to the proliferation of renewable energy.

Source: #

Fraunhofer ISE Establishes German Mass Production R&D Hub for Perovskite Tandem Solar Cells

Published May 08, 2026　ペロブスカイトニュース　Germany

OVERVIEW

Fraunhofer ISE, Europe's largest solar energy research institute, has established a dedicated development base in Germany for the mass production of tandem perovskite solar cells. This strategic move underscores Europe's strong commitment to industrializing high-efficiency perovskite tandem technology. The new facility will focus on scaling up manufacturing processes for tandem cells, aiming to bridge the gap between laboratory research and large-scale commercial deployment by addressing challenges in module integration, stability, and cost-effective production.

IN DEPTH

Background

As photovoltaic technology continues to evolve, further enhancements in efficiency and cost reduction are paramount to meet the escalating global energy demand. Tandem solar cells hold the potential to surpass the physical limits of single-junction cells, with perovskite materials anticipated to drive significant breakthroughs in this technology. Europe is actively pursuing leadership in this sector through aggressive investments in renewable energy and proprietary technological development, with rapid transition from research to industrialization being a key strategic objective.

Key Findings / Results

Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE), Europe's most prominent solar energy research institution, has announced the establishment of a state-of-the-art mass production development hub for perovskite tandem solar cells in Germany. This new facility is specifically designed to efficiently scale up manufacturing processes for tandem structures, which integrate perovskite layers with existing silicon solar cells, from laboratory to industrial scale. Key research areas at the hub will include developing uniform large-area deposition techniques, highly efficient interface designs, and encapsulation technologies to ensure long-term reliability. The establishment of this center clearly demonstrates the European Union's strong commitment to industrializing high-efficiency next-generation solar cell technologies to achieve its ambitious energy transition targets.

Technical Significance & Outlook

The establishment of this mass production R&D hub by Fraunhofer ISE reflects Europe's strong resolve to play a leading role in the technological development and commercialization of perovskite tandem solar cells. Through this facility, advancements in module integration, assurance of long-term stability, and the establishment of cost-effective production methods are expected to accelerate. This is critically important for translating record laboratory efficiencies into viable, market-ready products. In the future, these technological innovations are anticipated to contribute to Europe's energy self-sufficiency and foster the creation of new high-value-added industries. Furthermore, this initiative is expected to revitalize Germany's domestic solar cell industry and strengthen Europe's technological advantage in the global competitive landscape, drawing considerable attention from the worldwide solar industry.

Source: #

NTU Pioneers Ultrathin Transparent Perovskite Solar Cells with 41% Transmittance and 7.6% Efficiency for Urban BIPV

Published May 15, 2026 XenoSpectrum Japan

OVERVIEW

Nanyang Technological University (NTU) in Singapore has developed ultrathin, semi-transparent perovskite solar cells achieving 41% visible light transmittance and 7.6% power conversion efficiency. This innovation shifts from toxic solvent-based coating to an industrial-scale thermal evaporation method, ensuring uniform, defect-free thin films. These cells can efficiently generate electricity from scattered light, offering a solution for integrating solar energy into urban high-rises where rooftop space is limited, potentially transforming glass facades into power plants and addressing aesthetic and energy needs.

IN DEPTH

Background

The integration of renewable energy in urban environments faces significant challenges due to limited space and the imperative to preserve architectural aesthetics. High-rise buildings, in particular, often lack sufficient rooftop area for conventional photovoltaic systems. Consequently, there has been a strong demand for transparent or semi-transparent, highly efficient solar cell technologies that can be effectively integrated into building facades, such as windows and exterior walls. Perovskite solar cells, with their excellent light absorption properties and ease of film thickness control, have shown promise for such applications.

Key Findings / Results

A research team at Nanyang Technological University (NTU) in Singapore has successfully developed ultrathin, semi-transparent perovskite solar cells, astonishingly thin at 1/10,000th the thickness of a human hair. These groundbreaking devices achieve a remarkable 7.6% power conversion efficiency while maintaining a 41% visible light transmittance. A key innovation lies in the manufacturing process: the team abandoned conventional toxic solvent-based coating methods in favor of an industrial-scale thermal evaporation technique. This method allows for the formation of uniform, defect-free thin films, significantly enhancing device performance and reliability. Notably, these cells are capable of generating electricity efficiently not only under direct sunlight but also in overcast conditions or from scattered light prevalent in urban canyons, unlike traditional silicon-based solar cells.

Technical Significance & Outlook

The ultrathin, transparent perovskite solar cells developed by NTU possess the potential to revolutionize urban landscapes. By transforming skyscraper windows and facades into active power generators, this technology opens new avenues for renewable energy integration in densely populated urban areas. Its ability to combine aesthetics with power generation offers a substantial advantage in the building-integrated photovoltaics (BIPV) market. Furthermore, their enhanced efficiency under diffuse light conditions, where conventional silicon panels typically underperform, makes them particularly suitable for diverse urban environments. Future challenges include further increasing efficiency, evaluating long-term outdoor durability, and establishing large-area module manufacturing techniques. Nevertheless, this technology stands as a crucial enabling component for smart city initiatives and the realization of Zero Energy Buildings (ZEBs), with strong expectations for its broad societal implementation.

Source: https://xenospectrum.com/ultrathin-transparent-perovskite-solar-cells-ntu/

Collected: May 15, 2026 | Automated Research System (Gemini API)

METI Boosts International Deployment of Perovskite Solar Cells, Funding Overseas Demonstrations in Europe, US, and Southeast Asia

Published May 08, 2026　ペロブスカイトニュース　Japan

OVERVIEW

Japan's Ministry of Economy, Trade and Industry (METI) has strengthened its support for overseas demonstration projects of perovskite solar cells in Europe, the United States, and Southeast Asia. Revised on April 15, 2026, the "Next-Generation Solar Cell Development" project aims to accelerate the global deployment of Japanese-developed perovskite technology. This initiative targets "Advanced Country Urban Models" in nations like Germany and the Netherlands, focusing on dense urban areas and public infrastructure where conventional silicon panels are challenging to install. The goal is to establish international standards, enhance Japanese companies' competitiveness, and integrate technological development with rule-making through these international demonstrations.

IN DEPTH

Background

While Japan has maintained a global lead in fundamental research for perovskite solar cells, effectively deploying this technology in international markets requires more than domestic demonstrations. It necessitates performance evaluation under diverse real-world conditions abroad and the establishment of international standards. In an increasingly competitive global landscape, integrating Japanese-developed technology into global supply chains and establishing international standards are crucial for long-term competitiveness. Recognizing this, the government has identified a strategic need to support the overseas expansion of perovskite solar cells.

Key Findings / Results

Through revisions to its "Next-Generation Solar Cell Development" project, approved on April 15, 2026, the Ministry of Economy, Trade and Industry (METI) has announced a significant reinforcement of its support for the international expansion of perovskite solar cells. The cornerstone of this enhanced strategy is the promotion of demonstration experiments across Europe, the United States, and Southeast Asia. Specifically, METI will back "Advanced Country Urban Model" projects in nations such as Germany, the Netherlands, and the United States. These projects will focus on deploying perovskite solar cells in densely populated urban areas and public infrastructure, including public transportation facilities and building facades, where the installation of conventional silicon solar panels faces significant challenges. The objective is to leverage perovskite's inherent characteristics like flexibility and lightweight properties to open up new markets.

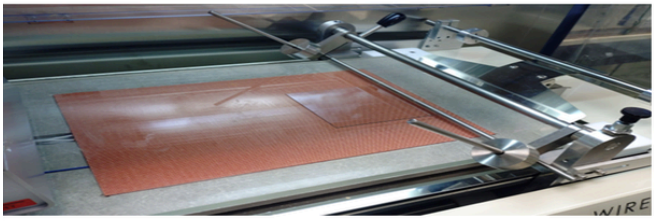
Technical Significance & Outlook

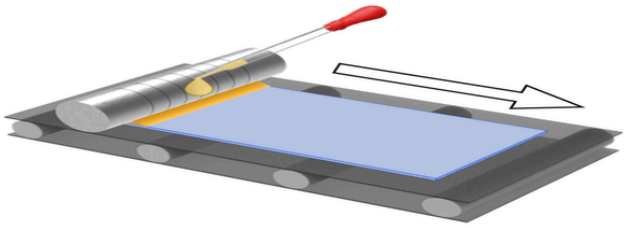
METI's strengthened support for international deployment underscores Japan's strong commitment to establishing global leadership in perovskite solar cell technology. Overseas demonstration experiments will provide Japanese companies with crucial opportunities to prove their products' performance under various climatic conditions and regulatory requirements, thereby enhancing their credibility in international markets. Furthermore, data and insights garnered from these demonstrations are vital for influencing the formulation of international technical standards, ensuring that Japanese initiatives are reflected. This strategic participation allows Japanese firms not only to supply technology but also to contribute to rule-making, potentially securing long-term competitive advantages. It is anticipated that these strategies will accelerate the global adoption of perovskite solar cells and contribute to the realization of a sustainable energy society under Japanese leadership. This policy is also expected to stimulate related domestic industries, contributing to job creation and economic growth.

Source: #

Kanazawa University Develops Long-Life Perovskite Solar Cell Modules Stable Under Ambient Conditions

Published February 06, 2026 金沢大学 Japan





OVERVIEW

Kanazawa University has successfully developed long-life perovskite solar cell modules capable of stable operation under ambient atmospheric conditions. This breakthrough precisely controls crystal grain boundaries and reduces defects, suppressing performance degradation caused by moisture and oxygen. Demonstrated enhanced durability in atmospheric exposure tests represents a significant advance towards widespread commercialization. By utilizing specific material modifications to inhibit thermal diffusion and maintain structural integrity, the technology aims to achieve practical lifetimes competitive with conventional silicon solar cells.

IN DEPTH

Background

While perovskite solar cells (PSCs) offer promising high power conversion efficiencies, one of their most significant challenges has been their stability and durability. PSCs are particularly susceptible to environmental factors such as atmospheric moisture, oxygen, heat, and UV radiation, making it difficult to maintain performance over long periods in real-world conditions. Without resolving this stability issue, widespread outdoor installation and competition with established silicon solar cell technologies have remained formidable. Therefore, developing PSCs with a practical operational lifespan has been a top global priority for commercialization.

Key Findings / Results

A research team at Kanazawa University has announced the successful development of long-life perovskite solar cell modules that operate stably even under ambient atmospheric conditions. This innovative technology focuses on precisely controlling the crystal grain boundaries within the perovskite layer and effectively reducing internal material defects. Specifically, by introducing particular material modification techniques, the team managed to suppress thermal diffusion—a primary cause of solar cell performance degradation—and maintain the structural integrity of the crystal over extended periods. This significantly improved the resistance to harmful atmospheric substances like moisture and oxygen, demonstrating excellent durability in rigorous atmospheric exposure tests. This achievement provides an effective solution to the long-standing problem of perovskite solar cell instability.

Technical Significance & Outlook

This research outcome from Kanazawa University represents a major step towards the commercialization of perovskite solar cells. The assurance of long-term stability under ambient conditions dramatically enhances their applicability in outdoor photovoltaic systems. By overcoming the critical durability bottleneck, perovskite solar cells are expected to accelerate their adoption in a wide range of applications, including building-integrated photovoltaics (BIPV), flexible devices, as well as automotive and wearable electronics. Future challenges include further long-term reliability evaluations under even harsher environmental conditions (e.g., meeting IEC standards) and establishing large-area module manufacturing techniques. Nevertheless, this technology marks a crucial milestone towards realizing practical products with lifetimes comparable to conventional silicon solar cells. This Japanese innovation holds the potential to significantly contribute to the global proliferation of renewable energy.

Source: https://www.kanazawa-u.ac.jp/miraichi/177609/

Collected: May 15, 2026 | Automated Research System (Gemini API)

Perovskite Solar Cells in 2026: Sekisui Chemical Commercializes Film-Type PV, Global Competition Intensifies

Published April 29, 2026 note (chatarow) Japan

OVERVIEW

The perovskite solar cell market in 2026 is evolving with a dual focus on commercialization and manufacturing equipment development. Sekisui Chemical began commercial sales of its film-type 'SOLAFIL' perovskite cells in March 2026, marking a significant step towards practical application. The global race is intensifying, with China's LONGi holding a 34.85% efficiency record and the UK's Oxford PV starting commercial shipments. Japan prioritizes 'application differentiation' leveraging lightweight and flexible properties, alongside economic security supported by its iodine resources. Japanese manufacturers like Seiko Epson are asserting dominance in the manufacturing equipment sector with inkjet-based production technologies.

IN DEPTH

Background

After several years of intensive research and development, perovskite solar cells (PSCs) are transitioning into the initial phases of commercialization in 2026. Their inherent advantages—lightweight, thinness, flexibility, and high-efficiency potential—position them to unlock new markets previously inaccessible to conventional silicon-based solar cells, such as curved roofs, building facades, and electric vehicle bodies. Against this backdrop, companies worldwide are accelerating not only technological development but also concrete strategies for mass production and market entry.

Key Findings / Results

As of 2026, the perovskite solar cell industry is characterized by active developments in two key areas: "commercialization" and "manufacturing equipment development." A notable example in commercialization is Japan's Sekisui Chemical Co. Ltd., which commenced commercial sales of its film-type perovskite solar cell, "SOLAFIL," on March 27, 2026. While SOLAFIL offers an efficiency of 15% and a durability of 10 years, its lightweight and flexible properties enable the integration of solar power generation in previously unutilizable spaces. In terms of international competition, China's LONGi set a high-efficiency record of 34.85% in 2025, maintaining a technological lead. Concurrently, the UK's Oxford PV began commercial shipments in 2024, indicating broader global market penetration. Beyond the efficiency race, Japan is strategically focusing on "application differentiation," leveraging perovskite's unique attributes for markets like Building-Integrated Photovoltaics (BIPV) and agrivoltaics. Furthermore, Japan's domestic iodine resources are recognized as a strength for economic security. In the manufacturing equipment sector, Japanese inkjet printer manufacturers such as Seiko Epson, Ricoh, and Konica Minolta are utilizing their expertise in solution-based processing and encapsulation technologies to play a crucial role in large-area production.

Technical Significance & Outlook

The commercialization momentum of perovskite solar cells is set to introduce new competition and innovation into the renewable energy market. Products like Sekisui Chemical's SOLAFIL, due to their unique properties, are poised to become "location-agnostic" solar cells, facilitating energy supply in diverse installation environments. This is expected to significantly contribute to urban energy self-sufficiency and the proliferation of distributed power sources. Global technological competition will intensify, with Chinese firms excelling in high efficiency and cost-competitiveness, European and American firms pursuing first-mover advantages in specific markets, and Japanese firms leveraging niche applications and manufacturing technology. The role of manufacturing equipment suppliers is also critical, with Japan's precision processing technology potentially becoming a key determinant of perovskite's mass production quality and cost-effectiveness. Future challenges include further enhancing product efficiency, ensuring long-term durability (particularly guarantees exceeding 20 years), and compliance with international certification standards. This dual-structure evolution represents a crucible for perovskite solar cells to truly become societal infrastructure, and its trajectory will continue to be closely watched globally.

Source: https://note.com/chatarow/n/n7475df307c75

Collected: May 15, 2026 | Automated Research System (Gemini API)

South Korea Accelerates Perovskite Solar Cell Commercialization, KAIST Achieves 25.56% Efficiency with High Stability

Published May 11, 2026 Chinapost South Korea

OVERVIEW

South Korea is aggressively pursuing the commercialization of next-generation perovskite solar cells, intensifying development competition with China, the US, and Europe. This technology offers advantages over silicon, being thinner, lighter, and cheaper. A joint team from KAIST and KRICT achieved 25.56% conversion efficiency with long-term stability. Hanwha Q CELLS is also advancing tandem cell development for BIPV and EV applications. Focus is also placed on environmentally friendly manufacturing processes and low-cost electrode materials.

IN DEPTH

Background

As global energy markets accelerate their transition towards renewable sources, the competition in developing next-generation solar cell technologies is intensifying. Perovskite solar cells (PSCs), with their high power conversion efficiency, thin, light, and flexible properties, and potential for low-cost manufacturing, are being pursued as a national strategic priority by countries worldwide. South Korea has also positioned this technology as a future growth engine, actively participating in the technological race for dominance against major players like China, the United States, and Europe.

Key Findings / Results

The South Korean government and research institutions are vigorously promoting the commercialization of perovskite solar cells, with continuous announcements of significant achievements. Notably, a joint research team from the Korea Advanced Institute of Science and Technology (KAIST) and the Korea Research Institute of Chemical Technology (KRICT) reported groundbreaking research: simultaneously achieving a high efficiency of 25.56% and long-term stability in a single-junction perovskite solar cell. This achievement was made possible through optimized perovskite material composition and advancements in interface control technology. In the industrial sector, major solar cell manufacturer Hanwha Q CELLS is actively developing tandem cells, combining perovskite with silicon, aiming for efficiencies approaching 30%. These technologies are anticipated to find diverse applications in areas where conventional silicon solar cells face limitations, such as building facades and windows (BIPV), electric vehicle roofs (EVs), wearable devices, and even aerospace applications. Environmental aspects are also prioritized for commercialization, with a focus on low-environmental-impact thin-film deposition processes and the development of low-cost electrode materials that do not rely on scarce metals.

Technical Significance & Outlook

South Korea's national focus on perovskite solar cell development has the potential to significantly enhance its competitiveness in the global energy market. The simultaneous achievement of high efficiency and stability by KAIST and KRICT underscores the importance of fundamental research and elevates international technological standards. The involvement of major corporations like Hanwha Q CELLS is crucial for rapidly translating research findings into mass production and accelerating market entry. The diverse application possibilities of perovskite solar cells are expected to create ripple effects across related industries, including construction, automotive, and electronics, generating new market value. However, commercialization requires not only technological maturity but also further reductions in manufacturing costs, assurance of long-term reliability, and the establishment of international certification standards. South Korea's proactive approach is anticipated to further stimulate international technological competition and serve as a vital driving force in paving the way for perovskite solar cells to become a core technology for a sustainable society.

Source: https://finance.biggo.jp/news/kPcDFZ4B-PfaobXfEk4B

Collected: May 15, 2026 | Automated Research System (Gemini API)

GIST Launches Integrated Research Initiative for World's First Perovskite Solar Cell Commercialization

Published May 14, 2026 Daum (東亜サイエンス) South Korea

OVERVIEW

Gwangju Institute of Science and Technology (GIST) has launched the "World's First Perovskite Solar Cell Commercialization Strategic Research Consortium," aiming to overcome lab-scale limitations and achieve global commercialization. This integrated research system, involving GIST, UNIST, KITECH, and others, covers materials, devices, modules, processes, and demonstrations. The consortium focuses on establishing large-area (0.72㎡) module production and ensuring long-term stability compliant with international standards to secure global technological competitiveness.

IN DEPTH

Background

Perovskite solar cells (PSCs) hold immense promise as a next-generation photovoltaic technology due to their high theoretical efficiency and potential for low-cost manufacturing. However, past research and development have primarily focused on achieving high efficiencies in small, laboratory-scale devices. Critical challenges for commercialization, such as uniform performance over large areas, long-term operational stability, and scalable mass production processes, have remained. To overcome these hurdles and elevate research findings to an industrial scale, an integrated approach, covering everything from material development to real-world demonstrations, became imperative.

Key Findings / Results

The Gwangju Institute of Science and Technology (GIST) has spearheaded the establishment of the "World's First Perovskite Solar Cell Commercialization Strategic Research Consortium," aiming to achieve global commercialization of PSCs. This consortium includes prominent institutions such as GIST, Ulsan National Institute of Science and Technology (UNIST), Korea Institute of Industrial Technology (KITECH), Korea Electric Power Research Institute, Gwangju Technopark, and the private company Leasel. They have forged an integrated research system encompassing the entire lifecycle of perovskite solar cell development: materials, devices, modules, processes, and field demonstrations. A primary focus is scaling up the high efficiencies demonstrated in laboratories to large-area modules, targeting 0.72 ㎡. Furthermore, ensuring long-term stability compliant with international standards, such as those from the International Electrotechnical Commission (IEC), is a top priority. Through rigorous demonstration tests and the establishment of mass production infrastructure, the consortium aims to secure global technological competitiveness.

Technical Significance & Outlook

This extensive collaboration, led by GIST and involving academia, industry, and government, signifies South Korea's strong ambition to lead the world in perovskite solar cell commercialization. The integrated research framework, covering the entire development cycle, is expected to enable rapid identification and efficient resolution of challenges at each stage, significantly accelerating the pace of development. The specific target of 0.72 ㎡ for large-area module development and the commitment to achieving international standard stability provide a clear roadmap towards practical implementation. If successful, this initiative could unlock new markets previously inaccessible to conventional silicon solar cells (e.g., lightweight flexible, BIPV, IoT power sources) and provide a new growth engine for South Korea's renewable energy industry. Moreover, it has the potential to establish South Korea's technological leadership in global competition and influence international standardization efforts, making its progress a focus of global attention.

Source: https://v.daum.net/v/20260514105715609

NYCU Improves Lead-Free Tin Perovskite Solar Cell Efficiency and Stability to 9.1% PCE and 5000hr T80 with Stirring-Controlled HTL

Published May 08, 2026 ACS Energy Letters Taiwan

OVERVIEW

Researchers at Taiwan's National Yang Ming Chiao Tung University (NYCU) have reported a new hole-transporting layer (HTL) technology boosting the efficiency and stability of lead-free tin-based perovskite solar cells (TPSCs). By optimizing the stirring time of a benzodipyrrole-based conjugated polymer HTL, they achieved uniform film formation and enhanced charge extraction. This resulted in a 9.1% power conversion efficiency and 80% stability after 5000 hours (T80), marking a significant advance in addressing lead toxicity and commercializing next-generation lead-free solar cells.

IN DEPTH

Background

Perovskite solar cells (PSCs) are renowned for their high power conversion efficiency, but the prevalent use of lead raises environmental concerns. Consequently, there is intense research into lead-free perovskite materials, particularly tin (Sn)-based PSCs (TPSCs). However, tin perovskites typically suffer from lower efficiency and stability compared to their lead-based counterparts due to their susceptibility to oxidation. Overcoming this challenge requires not only intrinsic material improvements but also optimization of charge transport layers and interfaces.

Key Findings / Results

A research team from Taiwan's National Yang Ming Chiao Tung University (NYCU) has developed a novel hole-transporting layer (HTL) technology that significantly enhances the performance of lead-free tin-based perovskite solar cells (TPSCs). They employed a heptacyclic ladder-type triarylamine-functionalized conjugated polymer based on benzodipyrrole (BDP) as the HTL. Critically, by precisely controlling the "stirring time" of the polymer solution, they optimized its aggregation state, leading to the formation of a highly uniform film within the device. This optimized HTL was shown to suppress non-radiative recombination and substantially improve charge extraction efficiency. As a result, the developed inverted TPSCs achieved a high power conversion efficiency (PCE) of 9.1%. Furthermore, the devices demonstrated excellent long-term stability, maintaining 80% of their initial efficiency (T80) after 5000 hours of operation. This represents a major breakthrough in addressing the stability issues of tin perovskites and overcoming existing limitations.

Technical Significance & Outlook

This research outcome marks a significant advance toward the practical application of lead-free perovskite solar cells. It provides a pathway to achieve both practical efficiency and long-term stability while addressing the environmental concerns associated with lead toxicity. The study particularly emphasizes that the design of the hole-transporting layer material and its process control critically influence the overall device performance. The achievement of such substantial performance enhancement through a relatively simple process control like stirring time also holds implications for cost reduction and manufacturing efficiency in future large-scale production. Moving forward, scaling up this technology for large-area modules, further increasing efficiency, and conducting long-term reliability tests to comply with international certification standards will be crucial. NYCU's achievement highlights Taiwan's contribution to sustainable energy technology development and represents a vital step in accelerating the adoption of lead-free technologies in the next-generation solar cell market.

Source: https://pubs.acs.org/doi/10.1021/acsenergylett.6c00952

Korean-Chinese Team Achieves 27.6% Certified Efficiency in Single-Junction Perovskite Solar Cell with Molecular Design Strategy

Published May 15, 2026 Daum (DBR) South Korea

OVERVIEW

A joint Korean-Chinese research team, led by Professor Nam-Gyu Park of Sungkyunkwan University, has achieved a world-leading 27.6% certified power conversion efficiency for a single-junction perovskite solar cell. This breakthrough utilizes a molecular design strategy to stabilize both the internal crystal and surface, rather than relying on external passivation. Incorporating a "3-PMPCl" additive and bismuth (Bi) electrodes, the cell maintained over 93% of its initial efficiency after 1011 hours under high temperature and solar illumination. Published in 'Science,' this advances next-generation solar cell performance.

IN DEPTH

Background

Perovskite solar cells (PSCs) are advancing rapidly worldwide as a leading candidate for next-generation photovoltaics, primarily due to their high power conversion efficiency and cost-effective manufacturing potential. However, further improvements in efficiency and, critically, ensuring long-term stability under real-world operating conditions have remained pressing challenges for commercialization. Previous approaches to enhance stability largely depended on external protective layers or encapsulation technologies, but a fundamental solution to stabilize the internal structure of the crystal material itself was sought.

Key Findings / Results

A joint Korean-Chinese research team, led by Professor Nam-Gyu Park of Sungkyunkwan University (in collaboration with Huazhong University of Science and Technology, among others), has achieved a world-class certified power conversion efficiency of 27.6% for a single-junction perovskite solar cell. This groundbreaking achievement is based on an innovative strategy that stabilizes both the internal crystal and the surface of the perovskite at a molecular design level, rather than solely relying on external passivation. The research team introduced a special additive called "3-PMPCl" into both the interior and surface of the perovskite crystal, enhancing the intrinsic stability of the crystal structure. This additive optimizes crystal growth and significantly reduces defect density. Furthermore, by applying bismuth (Bi) electrodes instead of conventional silver (Ag) or gold (Au) electrodes, although the efficiency slightly decreased to 26.8%, the cells demonstrated exceptionally high operational stability, retaining over 93% of their initial efficiency after 1011 hours under solar-level continuous illumination and high-temperature environments. This research was published in the international academic journal "Science," acknowledging its significant technical value.

Technical Significance & Outlook

The achievement of 27.6% high efficiency and excellent stability by this joint Korean-Chinese research team holds critical implications for resolving major challenges in perovskite solar cell commercialization. The molecular-level stabilization strategy fundamentally improves device long-term reliability and significantly contributes to extending lifetimes in practical operating conditions. Notably, the potential use of low-cost and abundant bismuth as an electrode material also contributes to manufacturing cost reduction, enhancing economic viability for large-scale production. By maintaining high efficiency while dramatically improving durability, this technology will enable PSCs to compete more effectively with conventional silicon solar cells and accelerate their widespread adoption across various applications. Further research and development are expected to continue, focusing on scaling up to large-area modules and meeting even stricter international certification standards. This achievement underscores the importance of international collaboration in cutting-edge technological development and further elevates the presence of the Asian region in the next-generation solar cell market.

Source: https://v.daum.net/v/20260515100715611

Sungkyunkwan University Develops Scalable Inverted Perovskite Solar Cells with 27.3% Efficiency via Atomic Layer Deposition (ALD)

Published May 09, 2026 RSC Advances South Korea

OVERVIEW

Researchers at Sungkyunkwan University, South Korea, have developed scalable inverted perovskite solar cells (iPSCs) using atomic layer deposition (ALD), achieving 27.3% power conversion efficiency. This technology addresses the critical challenge of performance degradation during scale-up from lab-scale to large-area modules. The ALD-deposited ultrathin nickel oxide (NiO) hole-transporting layer (HTL) offers precise thickness control and high conformality, resulting in improved operational stability, low hysteresis, and compatibility with flexible substrates, making it promising for integration into tandem devices.

IN DEPTH

Background

Perovskite solar cells (PSCs) have garnered significant attention as a next-generation photovoltaic technology due to their impressive power conversion efficiencies (PCEs). However, a major impediment to their commercialization has been the substantial performance drop observed when scaling up high efficiencies achieved in small, laboratory-scale cells to large-area modules. Challenges primarily stem from maintaining film uniformity and quality control during large-area solution processing, necessitating precise thin-film deposition techniques. Inverted PSCs (iPSCs) are particularly promising due to their superior stability and reduced hysteresis characteristics.

Key Findings / Results

A research team at Sungkyunkwan University in South Korea has successfully developed scalable inverted perovskite solar cells (iPSCs) using atomic layer deposition (ALD), a highly precise thin-film deposition technique. In their study, the researchers systematically evaluated performance across active areas of 0.06, 0.25, and 1 cm^2 to identify intrinsic performance losses associated with increasing device size. They adopted an innovative approach by utilizing ALD to deposit an ultrathin nickel oxide (NiO) hole-transporting layer (HTL). Compared to NiO films formed by solution processes or sol-gel methods, ALD enables precise thickness control at the nanometer level and offers excellent conformality over the substrate. This precise control led to a reduction in interface defects and optimized charge transport, resulting in a remarkably high power conversion efficiency (PCE) of 27.3%. Furthermore, the developed devices exhibited improved operational stability, low hysteresis, and compatibility with flexible substrates, also suggesting potential for integration into future tandem devices.

Technical Significance & Outlook

Sungkyunkwan University's development of scalable iPSCs using ALD is a breakthrough in overcoming the critical challenge of large-area scaling and associated performance degradation in perovskite solar cells for commercialization. ALD is a well-established technology in the existing semiconductor industry, and its integration enhances the industrial compatibility of perovskite solar cell manufacturing processes. The precise thickness control and uniformity achieved will significantly improve the quality and yield of large-area modules, contributing to reduced manufacturing costs. This technology holds substantial promise as an effective approach for fabricating high-efficiency tandem solar cells, particularly all-perovskite tandems or perovskite/silicon tandems, as either top or bottom cells. Future efforts will involve optimizing ALD processes, applying them to actual mass production lines, and conducting long-term reliability evaluations in outdoor environments to accelerate the further adoption and societal implementation of this technology. This Korean research stands out as an example leading the industrialization of next-generation solar cells.

Source: https://pubs.rsc.org/en/content/articlehtml/2026/ra/d6ra00056h

Hanwha Solutions Achieves 29.9% Efficiency in Tandem Solar Cells with High-Reliability Encapsulation

Published May 11, 2026 Daum (毎日経済新聞) South Korea

OVERVIEW

South Korean firm Hanwha Solutions has achieved 29.9% conversion efficiency in next-generation tandem solar cell technology, nearing the 30% commercialization threshold. The company is tackling the perovskite solar cell's vulnerability to moisture and heat through proprietary "high-reliability encapsulation" technology. This advancement allows for surpassing the theoretical limits of conventional silicon solar cells, positioning Hanwha Solutions as a key player in the next-generation solar market and enhancing the overall competitiveness of South Korean industry.

IN DEPTH

Background

To further enhance the efficiency and widespread adoption of solar power, technologies that can surpass the theoretical limits (approximately 29%) of conventional silicon single-junction solar cells are indispensable. As a breakthrough technology, "tandem solar cells," which layer perovskite and silicon solar cells, are being developed globally. Tandem cells are expected to achieve over 40% efficiency theoretically, as they can absorb a broader range of the solar spectrum. However, perovskite materials are susceptible to moisture and heat, making the assurance of long-term reliability in tandem structures the biggest challenge for commercialization.

Key Findings / Results

Hanwha Solutions, a leading South Korean energy company, has announced groundbreaking achievements in next-generation tandem solar cell technology. The company has reached a power conversion efficiency of 29.9%, which is remarkably close to the 30% threshold often considered key for commercialization. This high efficiency was achieved through an optimal combination of perovskite and silicon layers, coupled with precise engineering for current matching between the two layers. More significantly, to overcome perovskite solar cells' major weakness—vulnerability to moisture and heat—Hanwha Solutions has developed and applied its proprietary "high-reliability encapsulation" technology. This encapsulation aims to effectively protect the perovskite layer from the external environment, substantially enhancing long-term durability and reliability. This forms the foundation for extending the practical lifespan of tandem cells and establishing their credibility as commercial products.

Technical Significance & Outlook

Hanwha Solutions' achievement of 29.9% efficiency in tandem solar cells places it at the forefront of technological competition in the global solar industry. Critically, addressing stability issues through high-reliability encapsulation technology is paramount for overcoming the largest hurdles in perovskite technology commercialization. If this technology is successfully established, tandem solar cells will be capable of generating more electricity from smaller installation areas, accelerating their adoption in a wide range of applications, including residential, industrial, building-integrated photovoltaics (BIPV), and electric vehicles (EVs). This holds the potential to significantly transform the existing silicon solar cell market. Such advancements by Hanwha Solutions are expected to strengthen South Korea's renewable energy industry competitiveness and play a crucial role in establishing its leadership in the global market. Moving forward, the establishment of mass production technologies, cost reduction, and compliance with international long-term reliability certifications will be key to further accelerating the societal implementation of this technology.

Source: https://v.daum.net/v/20260512080005284?f=p

Material Engineering Breakthrough Significantly Boosts Perovskite Solar Cell Stability in 2026, Accelerating Commercialization

Published May 08, 2026 Sunhub USA

OVERVIEW

Significant advancements in perovskite solar cell long-term stability have been reported in 2026, driven by material engineering innovations. This breakthrough strengthens the perovskite crystal structure under operational stress, allowing cells to retain a high percentage of initial performance after prolonged thermal and light exposure. Overcoming a major durability barrier, this progress accelerates practical adoption, particularly for tandem solar cells, offering a substantial opportunity to enhance overall energy conversion efficiency and facilitate real-world photovoltaic deployment.

IN DEPTH

Background

Perovskite solar cells (PSCs) have garnered immense expectations as a next-generation photovoltaic technology due to their excellent power conversion efficiency and potential for low-cost manufacturing. However, a primary impediment to their widespread commercialization has been their long-term stability under operating conditions, specifically their vulnerability to heat, light, and humidity. Conventional perovskite cells have shown a tendency to degrade rapidly when exposed to these environmental factors, making it challenging to ensure a practical product lifespan. Resolving this stability issue is an indispensable step for PSCs to genuinely compete with existing silicon solar cells and penetrate the market.

Key Findings / Results

Entering 2026, groundbreaking progress in the long-term stability of perovskite solar cells has been reported. This breakthrough focuses on innovative material engineering techniques, aiming to fundamentally strengthen the crystal structure of perovskite materials under operational stress. Specifically, a combination of precise grain boundary control, defect passivation, and novel compositional designs has been employed, establishing mechanisms to suppress degradation from within the perovskite layer. The improved perovskite solar cells have demonstrated the ability to retain a high percentage of their initial performance even after prolonged exposure to heat and light. This significantly enhances the device's durability without sacrificing conversion efficiency, making a substantial contribution to achieving a practical operational lifetime.

Technical Significance & Outlook

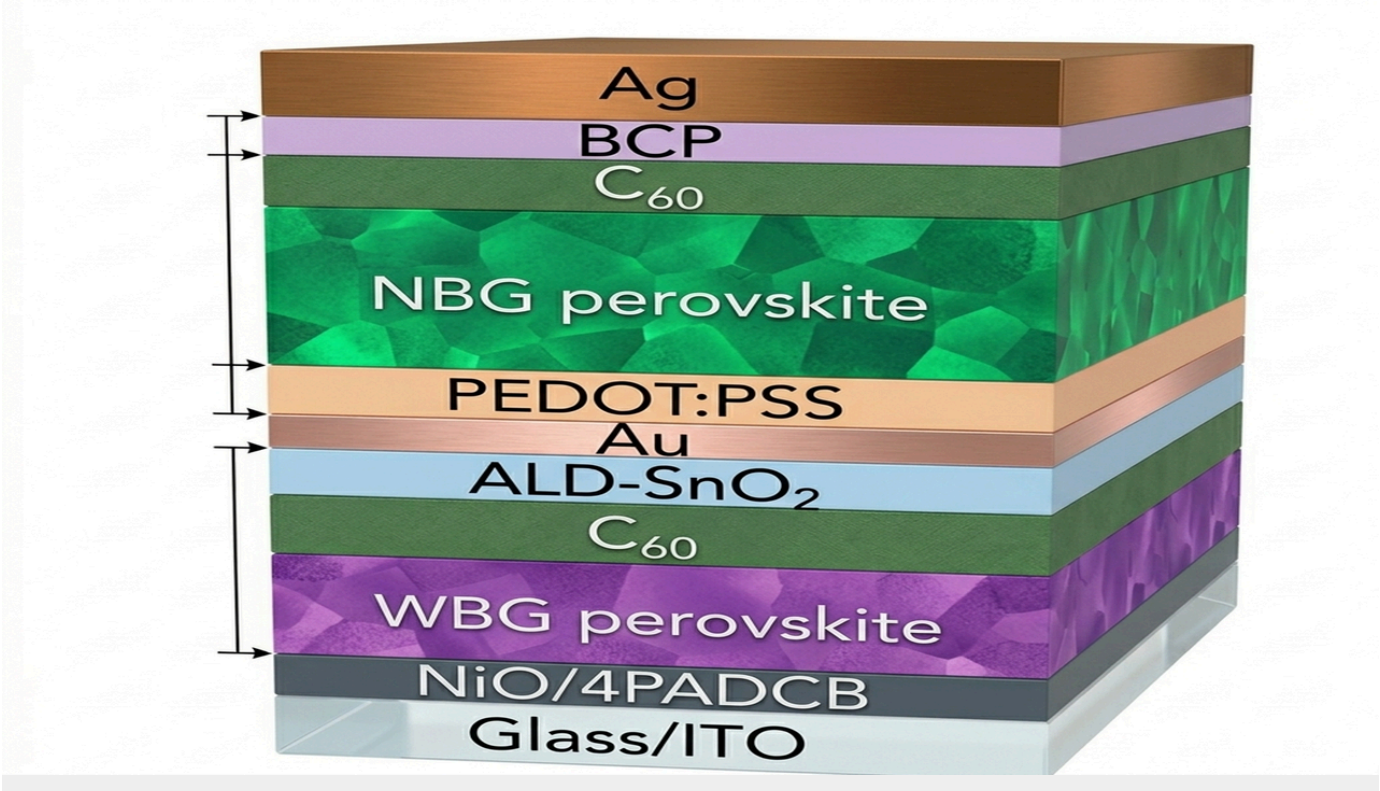
This advancement in stability holds paramount importance for the commercialization trajectory of perovskite solar cells. Given that durability has been one of the biggest barriers, this breakthrough has the potential to substantially accelerate market entry. Perovskite solar cells are particularly promising as top cells in tandem solar cells (e.g., perovskite-silicon tandems), and improved stability offers a significant opportunity to greatly enhance the overall performance and lifespan of tandem structures, thereby further increasing overall energy conversion efficiency. This will facilitate the adoption of perovskite solar cells in real-world photovoltaic installations across a wide range of applications, including rooftops, facades, and mobility. Moving forward, how these technologies are integrated into large-scale manufacturing processes and comply with international certification standards (e.g., IEC standards) will be key to their societal implementation. While challenges related to environmental safety and lead-free alternatives remain, this stability improvement is expected to provide a strong foundation for overcoming those hurdles.

Source: https://www.sunhub.com/blog/perovskite-solar-cells-stability/

Collected: May 15, 2026 | Automated Research System (Gemini API)

Huazhong University Achieves 29.80% Efficiency in All-Perovskite Tandem Solar Cell via Laser Polishing

Published May 12, 2026 pv magazine China



OVERVIEW

Researchers at China's Huazhong University of Science and Technology have achieved a 29.80% conversion efficiency in an all-perovskite tandem solar cell using a non-contact laser polishing strategy. This technique reduces surface defects in lead-tin perovskite films, enhancing charge extraction. The bottom cell efficiency improved from 19.64% to 24.07%, contributing to the record 29.80% overall efficiency. Furthermore, the device demonstrated strong operational stability, retaining approximately 80% of its initial performance after 650 hours under one-sun illumination, paving the way for commercialization of high-efficiency all-perovskite tandems.

IN DEPTH

Background

All-perovskite tandem solar cells are gaining significant attention as a next-generation technology with the potential to surpass the efficiency limits of silicon-based photovoltaics. By stacking two perovskite layers with complementary bandgaps, these cells can utilize a broader range of the solar spectrum, leading to higher efficiencies. However, maximizing their performance requires effective control over film quality, especially minimizing interface defects, and enhancing both charge extraction efficiency and stability. Lead-tin-based perovskite bottom cells, in particular, have been limited by surface defects that compromise both efficiency and stability.

Key Findings / Results

A research team from China's Huazhong University of Science and Technology has introduced an innovative non-contact laser polishing strategy, elevating the power conversion efficiency of all-perovskite tandem solar cells to an impressive 29.80%. This technique aims to selectively and non-destructively remove surface defects present on lead-tin perovskite films. The laser polishing process effectively reduced rough surface layers, compositional non-uniformities, and Sn-related defects without causing damage to the underlying perovskite layer. Consequently, the efficiency of the tandem bottom cell significantly improved from 19.64% to 24.07%, leading to the achievement of a record-breaking overall champion conversion efficiency of 29.80%. Furthermore, the laser-polished devices demonstrated remarkable operational stability, maintaining approximately 80% of their initial performance after 650 hours of continuous operation under one-sun illumination.

Technical Significance & Outlook

The implementation of non-contact laser polishing technology by Huazhong University of Science and Technology marks a significant breakthrough in enhancing the performance of all-perovskite tandem solar cells. This surface modification strategy holds the potential to effectively mitigate performance bottlenecks caused by surface effects across various perovskite compositions, opening new avenues for achieving both high efficiency and stability. The 29.80% efficiency achieved is close to the current records for multi-junction solar cells, promising substantial contributions to large-scale energy generation. As this technology allows for precise control in the manufacturing process, it is also expected to contribute to future mass production and cost reduction. Future challenges include ensuring uniformity during scale-up to large-area modules and accumulating more long-term outdoor validation data. Nevertheless, this achievement positions laser polishing as a highly promising manufacturing approach that will play a crucial role in accelerating the transition of all-perovskite tandem solar cells from laboratory to commercial viability.

Source: https://www.pv-magazine.com/2026/05/12/all-perovskite-tandem-solar-cell-built-with-laser-polishing-achieves-29-80-efficiency/

Collected: May 15, 2026 | Automated Research System (Gemini API)

Chinese Academy of Sciences Boosts Perovskite Solar Cell Efficiency and Stability to 26.17% (Cell) & 23.14% (Mini-Module) with Glutathione Additive

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OVERVIEW

A research team at the Chinese Academy of Sciences developed a synergistic strategy based on glutathione (GSH) to simultaneously enhance the efficiency and stability of inverted perovskite solar cells. Combining "dynamic control" and "static protection," this method improves interfacial properties and film quality. It achieved 26.17% conversion efficiency in small-area cells and 23.14% in mini-modules, demonstrating robust operational stability under high temperature, high humidity, continuous illumination, and UV exposure. This technique is expected to accelerate practical application and large-scale deployment of perovskite solar cells.

IN DEPTH

Background

Perovskite solar cells (PSCs) have emerged as one of the most promising technologies in the field of photovoltaics. However, their commercialization faces two major challenges: maintaining high efficiency and ensuring long-term device stability. Specifically, effective strategies are needed to suppress defects at the perovskite layer interfaces and mitigate degradation mechanisms during operation. Traditional additive approaches often presented a trade-off, sacrificing either efficiency or stability, making a comprehensive, multi-functional approach essential to achieve both simultaneously.

Key Findings / Results

A research team from the Hefei Institutes of Physical Science, Chinese Academy of Sciences, has developed a novel synergistic strategy utilizing a glutathione (GSH) additive. This innovation successfully and simultaneously improved both the power conversion efficiency and operational stability of inverted perovskite solar cells (iPSCs). This groundbreaking strategy was realized by combining two functions of GSH: "dynamic control" and "static protection." Dynamic control optimizes the perovskite crystal growth process, leading to improved film uniformity and quality. Meanwhile, static protection effectively passivates interfacial defects and safeguards the device from degradation caused by environmental factors such as high temperature, high humidity, light exposure, and UV radiation. As a result of this comprehensive approach, the developed small-area cells achieved a high conversion efficiency of 26.17%, and the mini-modules recorded an excellent efficiency of 23.14%. These devices also demonstrated significantly enhanced long-term operational stability under harsh conditions.

Technical Significance & Outlook

This GSH-based synergistic strategy developed by the Chinese Academy of Sciences holds immense potential to significantly accelerate the practical application and large-scale deployment of perovskite solar cells. By simultaneously and fundamentally improving both efficiency and stability, this approach resolves the inherent trade-off issues faced by previous technologies. The demonstrated excellent performance at the mini-module level suggests that laboratory achievements are scalable for industrial applications, with widespread adoption expected in various fields, including building-integrated photovoltaics (BIPV) and flexible devices. Future work will involve further expanding this technology to larger-area modules and advancing evaluations to meet international long-term reliability certification standards (e.g., IEC standards). This achievement underscores China's reinforcing leadership in the technological development and commercialization of perovskite solar cells, and it is expected to have a significant impact on the future of sustainable energy technology.

Source: https://english.cas.cn/newsroom/research-news/202605/t20260511_1159072.shtml

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オールペロブスカイトタンデム太陽電池市場予測2026-2032：QY Researchが市場動向と商業化経路を分析

Published May 11, 2026　QY Research Inc.　USA

OVERVIEW

本記事はQY Research Inc.が発行した市場調査レポートの概要紹介です。2026年5月11日に公開されたレポートは、オールペロブスカイトタンデム太陽電池市場の2026年から2032年までの予測を提供しています。2025年には世界の生産量が約590 MWに達し、平均市場価格はkWあたり約400ドルであったと報告。2032年までに年平均成長率38.2%で22億7,900万米ドルに達すると予測されており、この技術がパイロットスケールから製造段階へと移行し、市場で大きく成長する可能性を示唆しています。

IN DEPTH

本記事はQY Research Inc.が発行した市場調査レポートの概要紹介です。

レポート概要

QY Research Inc.は、2026年から2032年までのオールペロブスカイトタンデム太陽電池市場に関する包括的な市場予測レポートを発表しました。このレポートは、ペロブスカイト前駆体サプライチェーンの戦略的分析、薄膜堆積技術、および次世代太陽光発電の商業化経路に焦点を当てています。市場規模、成長率、主要な推進要因、抑制要因、そして地域ごとのトレンドを詳細に分析し、今後の市場展開を予測しています。

主要な調査結果

レポートによると、オールペロブスカイトタンデム太陽電池は現在、パイロットスケールでの商業生産段階に移行しています。2025年には、世界のオールペロブスカイトタンデム太陽電池の生産量が約590 MWに達し、平均市場価格はkWあたり約400ドルであったと報告されています。この技術は、単接合セルの効率飽和、製造技術の成熟、および次世代高効率セル技術への業界の構造的ニーズの交差点に位置しています。QY Research Inc.は、2026年から2032年にかけて、オールペロブスカイトタンデム太陽電池市場が年平均成長率（CAGR）38.2%で成長し、2032年には22億7,900万米ドルに達すると予測しています。この予測は、量産規模、生産歩留まり、市場受容における根本的な変化と、オールペロブスカイトタンデムが実験室段階から製造現実へと移行していることを明確に示唆しています。

発行会社について

QY Research Inc.は、グローバル市場調査レポートとコンサルティングサービスを提供する主要企業です。同社は、新興技術、材料、化学、ヘルスケア、消費財など、幅広い産業分野にわたる専門知識を持っています。QY Research Inc.のレポートは、詳細な市場データ、競合分析、戦略的提言を提供することで、クライアントが情報に基づいたビジネス上の意思決定を行うのを支援しています。特に、技術トレンドの予測と市場機会の特定において高い評価を得ています。

Source: https://www.openpr.com/news/4508357/all-perovskite-tandem-solar-cells-market-forecast-2026-