

PerovskiteSolarCells

Weekly Intelligence Report

2026-07-19 | 17 articles | 8 countries

troy-technical.jp

This Week's Keyword

Perovskite Tandem Cells

Efficiency records & commercialization push

17

articles

Total Articles

8

countries

Source Countries

35.5

%

Record Lab Efficiency

31.0

%

Record Mini-Module Eff.

All 17 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	LONGi 35.5% Tandem Cell	Research						LONGi sets new world record 35.5% efficiency for perovskite-silicon tandem cell, ESTI certified.
#02	China 28.04% Perovskite-Org	Research						Chinese scientists achieve 28.04% efficiency and 625hr stability in perovskite-organic tandem.
#03	HZB 3-Junction 27.3%	Research						HZB develops 3-junction perovskite cell with 27.3% efficiency and 770hr stability.
#04	CAS 28.04% Perovskite-Org	Research						CAS achieves world record 28.04% efficiency in perovskite-organic tandem cells with TDB.
#05	LONGi 35.5% Record	Corporate Strategy						LONGi re-confirms 35.5% efficiency for perovskite-silicon tandem cell, ESTI certified.
#06	MeXT Ligand 26.19%	Research						US-led team uses novel MeXT ligand for precision interface chemistry, boosting PSC efficiency to 26.19%.
#07	Indium-Free 31% Mini-Mod	Research						Indium-free perovskite-silicon tandem mini-module achieves 31% efficiency and 3 months outdoor stability.
#08	Carborane ETM 31.5%	New Material						US team develops carborane ETM, boosting perovskite-silicon tandem efficiency by 2.4% to 31.5%.
#09	LONGi 35.5% World Record	Corporate Strategy						LONGi achieves 35.5% world record efficiency for perovskite-silicon tandem solar cell.
#10	Qcells UL/IEC Certs	Corporate Strategy						Qcells secures industry-first UL/IEC certifications for perovskite-silicon tandem tech.
#11	Oxford PV 25%+ Field Test	Market Overview						Oxford PV demonstrates 25%+ tandem efficiency in field tests, targeting 27% next year.
#12	PSCs Extreme Environments	Research						Review details PSC degradation in extreme environments, proposing AI for ultra-stable designs.
#13	Accio Report 30.6% Comm.	Market Overview						Accio report: PSCs achieve 34.85% lab, 30.6% commercial module efficiency, driving low-cost options.

#	Article Title	Type	Tech Novelty	Market Proximity	Market Impact	Data Reliability	US/EU Relevance	Summary
#14	Dual Passivation 25.11%	Research	●●●●○ ○	●●●●○ ○	●●●●○ ○	●●●●● ●	●●●●● ●	Dual surface passivation boosts PSC efficiency from 21.37% to 25.11% and enhances long-term stability.
#15	Oxford/Japan 40%+ Target	Research	●●●●● ○	●●●●○ ○	●●●●● ●	●●●●○ ○	●●●●● ●	Oxford/Japan target 35%+ all-perovskite and 40%+ perovskite/silicon hybrid solar cells.
#16	TCI TM-DHP Additive	New Material	●●●●○ ○	●●●●● ○	●●●●○ ○	●●●●○ ○	●●●●○ ○	TCI launches TM-DHP additive to remove tin impurities in tin-based perovskite solar cells.
#17	Qcells Space Solar Wkshp	Corporate Strategy	●●●●○ ○	●●●●○ ○	●●●●○ ○	●●●●○ ○	●●●●● ○	Hanwha Qcells hosts space solar workshop, showcasing perovskite-silicon tandem pilot line.

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

Three Questions That Demand Your Decision This Week

❶ Is your PV strategy keeping pace with Asian efficiency records?

Chinese firms like LONGi are consistently breaking perovskite-silicon tandem efficiency records (35.5%). Does your R&D; roadmap account for this rapid pace, and are you investing enough to remain competitive?

❷ Are you prepared for certified perovskite tandem products?

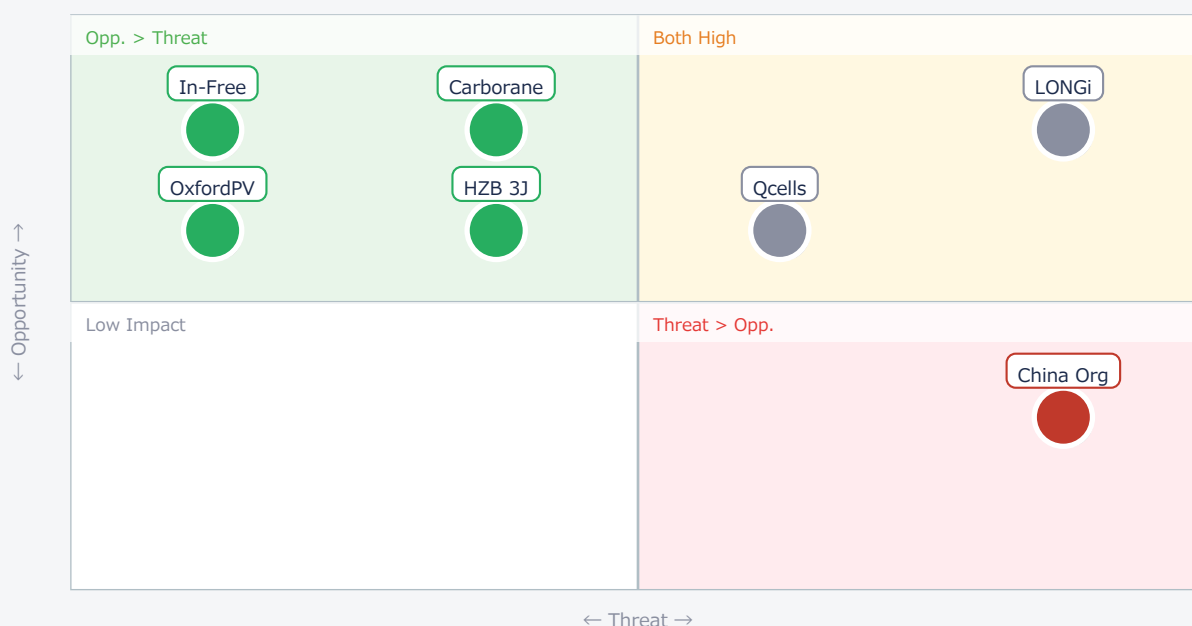
Qcells has achieved industry-first UL/IEC certifications for its perovskite-silicon tandem technology. This signals imminent commercialization. Is your procurement team evaluating these next-gen modules, and how will they impact your product portfolio?

❸ How will new materials impact your supply chain and IP?

Novel materials like carborane-based ETMs (31.5% efficiency boost) and indium-free designs (31% mini-module) are emerging. Is your supply chain exposed to critical material dependencies, and are you securing IP for these innovations?

Opportunities vs. Threats for US/European Companies

Opportunity vs. Threat Matrix for US/European Companies



Item	Quadrant	↑ Opportunity	↓ Threat
● LONGi	Critical	Efficiency benchmark	Asian market lead
● Qcells	Critical	Validated tech	Early market entry
● In-Free	Opp.	Cost/supply chain	—
● Carborane	Opp.	New ETM material	—
● OxfordPV	Opp.	EU commercialization	—
● HZB 3J	Opp.	EU research lead	—
● China Org	Threat	—	Flexible PV lead

Deep Dive ① — Novel Carborane ETM Boosts Tandem Efficiency

#08 | 2026/07/16 | EurekAlert! | Tech Novelty●●●●○ Proximity●●●●○ Market Impact●●●●○ Data Reliability●●●●○ US/EU Relevance●●●●●

Steve Albrecht's team developed a novel carborane-based electron transport material (ETM) that significantly boosts perovskite solar cell efficiency. This ETM improved single p-i-n perovskite cells by 1.5% (to 24.9%) and perovskite-silicon tandem cells by 2.4% (to 31.5%).

The patented material, now commercially available, replaces traditional fullerene (C60) layers, reducing charge carrier losses at the interface and optimizing electron transfer for enhanced device longevity.

► Strategic Analyst's Perspective

Strategic Analyst's Perspective: This is a tangible, near-market material innovation. [Opportunity] for US/EU materials suppliers to integrate this ETM into their product lines, offering a direct performance upgrade to PV manufacturers. OEMs can leverage this for higher-efficiency modules. [Threat] is limited if US/EU companies can quickly adopt or license this patented material. The published numbers appear realistic given the specific material innovation. Next actions: [R&D;] Evaluate carborane ETMs for next-gen designs by end of month. [Procurement] Identify suppliers and assess commercial availability/cost by end of month. [Business Dev] Explore licensing opportunities if not readily available.

Deep Dive ② — Indium-Free Tandem Mini-Module Hits 31% Efficiency

#07 | 2026/07/17 | PV Magazine | Tech Novelty●●●●○ Proximity●●●●○ Market Impact●●●●○ Data Reliability●●●●○ US/EU Relevance●●●●●

An international team, with German leadership, developed an indium-free perovskite-silicon tandem mini-module achieving 31.0% certified efficiency (33.6% for small cells). This breakthrough uses a low-damage reactive plasma deposition for tin oxide layers.

The dense, uniform tin oxide films improve interfaces, reduce non-radiative recombination, and suppress halide ion migration, demonstrating robust performance with over three months of outdoor operation.

► Strategic Analyst's Perspective

Strategic Analyst's Perspective: This is a critical development for sustainable and cost-effective PV. [Opportunity] for US/EU materials and component suppliers to develop and commercialize indium-free transparent conductive oxides (TCOs) and deposition equipment. OEMs can reduce material costs and supply chain risks. [Threat] to companies heavily invested in ITO-based TCOs or those unable to adapt to new deposition techniques. The 31% mini-module efficiency with outdoor stability is highly credible. Next actions: [R&D;] Investigate reactive plasma deposition for SnO₂ and indium-free TCOs immediately. [Procurement] Assess current indium dependency and explore alternative TCO suppliers by next quarter. [Strategy] Evaluate long-term cost advantages of indium-free solutions.

Deep Dive ③ — LONGi Sets 35.5% Perovskite-Silicon Tandem Record

#01 | 2026/07/15 | PV Magazine Global | Tech Novelty●●●●○ Proximity●●●○○ Market Impact●●●●○ Data Reliability●●●●○ US/EU Relevance●●●●○

Chinese PV giant LONGi achieved a new world record power conversion efficiency of 35.5% for its two-terminal perovskite-silicon tandem solar cell, certified by ESTI. This surpasses their previous 34.85% record.

The company also reported high efficiencies for larger tandem cells (34.3% for 261 cm²) and modules (31.4%), indicating rapid progress from lab to industrial application and promising cost-effective solar energy.

► Strategic Analyst's Perspective

Strategic Analyst's Perspective: LONGi's continuous record-breaking pace highlights China's aggressive lead in next-gen PV. [Opportunity] for US/EU R&D; to benchmark against these efficiencies and accelerate internal development. The certification by ESTI (European) lends strong credibility to the numbers. [Threat] to US/EU PV manufacturers who risk falling behind in efficiency, potentially impacting market share and LCOE competitiveness. The challenge remains scaling these lab records to stable, large-area, cost-effective modules. Next actions: [R&D;] Conduct immediate competitive analysis of LONGi's reported cell and module architectures. [Strategy] Re-evaluate long-term investment in tandem PV R&D;, potentially seeking strategic partnerships. [Executive] Assess the geopolitical implications of China's PV dominance by end of quarter.

Other Notable Articles

Qcells Achieves Industry-First UL and IEC Certifications for Perovskite-Silicon Tandem Solar Technology (PV Tech)

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

Qcells' certifications are a major step towards commercialization, validating reliability for market entry.

Helmholtz-Zentrum Berlin Develops 3-Junction Perovskite Solar Cell Achieving 27.3% Efficiency and Over 770 Hours of Stable Operation (ConnectSci)

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

HZB's 3-junction cell with graphene/SAMs shows high efficiency and stability, pushing EU research boundaries.

Solar Module Price Stabilization Shifts Focus to Perovskite Technology; Oxford PV Demonstrates Over 25% Tandem Efficiency, Targets 27% Next Year (pv magazine Global)

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

Oxford PV's field tests and 27% target highlight EU's commercialization efforts in tandem PV.

Chinese Scientists Achieve Record 28.04% Efficiency and 625-Hour Stability in Perovskite-Organic Tandem Solar Cell with Novel TDB Additive (Renewables Now)

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

China's breakthrough in flexible perovskite-organic cells with enhanced stability opens new application areas.

Oxford University and Japan Collaborate to Develop Ultra-High-Efficiency Solar Cells: Targeting 35%+ for All-Perovskite Tandems and 40%+ for Perovskite/Silicon Hybrids (jobRxiv)

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

Ambitious UK-Japan collaboration targets 40%+ efficiency, signaling long-term disruptive potential.

Recommended Actions This Week

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

■ Immediate (this week)

- [R&D;] Benchmark current perovskite R&D; against LONGi's 35.5% record and Qcells' certified modules. Identify gaps.
- [Procurement] Initiate assessment of supply chain exposure to indium and explore alternative TCO materials.
- [Strategy] Monitor Chinese and Korean perovskite commercialization timelines for competitive intelligence.

■ Short-term (1 month)

- [R&D;] Evaluate commercially available carborane-based ETMs (e.g., from Steve Albrecht's team) for performance gains.
- [Business Dev] Engage with Qcells and Oxford PV to understand their commercialization roadmaps and potential partnerships.
- [Legal/IP] Review IP landscape for novel interface chemistries and lead-free additives (e.g., TCI's TM-DHP).

■ Medium-long term (quarter+)

- [R&D;] Increase investment in multi-junction (3-junction) perovskite architectures and advanced stability solutions (e.g., HZB's work).
- [Strategy] Develop a comprehensive strategy for lead-free perovskite technology, including material sourcing and manufacturing.
- [Executive] Formulate a long-term plan to compete in high-efficiency PV, considering potential 40%+ targets from Oxford/Japan collaborations.

troy-technical.jp/en | Original curation. Article copyrights belong to respective authors. | Gemini API + Claude | 2026-07-19

PerovskiteSolarCells — Selected Articles

Date: 2026-07-19

Articles: 17

Table of Contents

#01 LONGi Achieves New World Record of 35.5% Efficiency for Perovskite-Silicon Tandem Solar Cell

#02 Chinese Scientists Achieve Record 28.04% Efficiency and 625-Hour Stability in Perovskite-Organic Tandem Solar Cell with Novel TDB Additive

#03 Helmholtz-Zentrum Berlin Develops 3-Junction Perovskite Solar Cell Achieving 27.3% Efficiency and Over 770 Hours of Stable Operation with Graphene and SAMs

#04 Chinese Academy of Sciences Achieves World Record 28.04% Efficiency in Perovskite-Organic Tandem Solar Cells

#05 LONGi Breaks World Record Again with 35.5% Efficient Crystalline Silicon-Perovskite Tandem Solar Cell

#06 Precision Interface Chemistry Propels Perovskite Solar Cell Efficiency Beyond 26% Mark in International Collaboration

#07 International Team Develops 31%-Efficient Indium-Free Perovskite-Silicon Tandem Mini-Module Using Reactive Plasma Deposition

#08 Steve Albrecht's Team Boosts Perovskite Solar Cell Efficiency by Up to 2.4% with Novel Carborane-Based Electron Transport Material

#09 LONGi Achieves 35.5% World Record Efficiency for Perovskite-Silicon Tandem Solar Cell

#10 Qcells Achieves Industry-First UL and IEC Certifications for Perovskite-Silicon Tandem Solar Technology, Paving Way for Commercialization

#11 Solar Module Price Stabilization Shifts Focus to Perovskite Technology; Oxford PV Demonstrates Over 25% Tandem Efficiency, Targets 27% Next Year

#12 Perovskite Solar Cells for Extreme Environments Target Ultra-Stability with Degradation Mechanism Elucidation and AI Prediction

#13 Perovskite Solar Cells Achieve 34.85% Lab Efficiency and 30.6% Commercial Module Efficiency, Driving Towards Low-Cost Options

#14 Dual Surface Passivation Boosts Perovskite Solar Cell Efficiency from 21.37% to 25.11% and Enhances Long-Term Stability

#15 Oxford University and Japan Collaborate to Develop Ultra-High-Efficiency Solar Cells: Targeting 35%+ for All-Perovskite Tandems and 40%+ for Perovskite/Silicon Hybrids

#16 TCI Launches TM-DHP Additive for Tin-Based Perovskite Solar Cells, Licensed from Enecoat Technologies, to Remove Tin Impurities

#17 Hanwha Qcells Hosts Space Solar Power Workshop, Showcasing Perovskite-Silicon Tandem Pilot Line to 40 International Experts for Enhanced Collaboration

#01 LONGi Achieves New World Record of 35.5% Efficiency for Perovskite-Silicon Tandem Solar Cell

Published July 15, 2026 PV Magazine Global China



OVERVIEW

Chinese PV giant LONGi has announced a new world record power conversion efficiency of 35.5% for its two-terminal perovskite-silicon tandem solar cell, as certified by the European Solar Test Installation (ESTI). This significant achievement marks a continuous improvement from the company's previous record of 34.85% in less than a year. The record, along with high efficiencies demonstrated in larger tandem cells and modules, underscores the rapid progress in transitioning perovskite technology from lab-scale research to industrial application, promising a future of more cost-effective solar energy.

Key Findings

LONGi, a leading Chinese photovoltaic (PV) manufacturer, has achieved a new world record power conversion efficiency of 35.5% for its two-terminal crystalline silicon-perovskite tandem solar cell. This remarkable milestone, independently certified by the European Solar Test Installation (ESTI), represents a significant leap forward in the commercialization potential of perovskite solar cell technology.

Technical and Research Details

The record-breaking efficiency demonstrates LONGi's continuous innovation, improving upon its previous record of 34.85% in less than a year. Beyond small-area cell records, the company also reported high certified efficiencies for larger tandem cells: 34.3% for a 261 cm² cell and 32.2% for a 274 cm² cell. Furthermore, tandem modules achieved impressive efficiencies of 31.4% and 29.4%. These results are crucial as they suggest that the high efficiencies achieved in laboratory settings can be scaled up for larger-scale manufacturing, fueling optimism for future mass production. The tandem structure, which combines silicon and perovskite solar cells, is particularly promising because the perovskite layer efficiently utilizes light energy that silicon alone cannot absorb, potentially pushing efficiencies beyond the theoretical limits of single-junction solar cells.

Background and Industry Context

Perovskite solar cells are at the forefront of next-generation solar technology research and development globally. Their high efficiency and potential for low-cost manufacturing are expected to revolutionize the traditional silicon solar cell market. The tandem structure, combining perovskite with existing silicon technology, is widely considered one of the most promising commercialization strategies. The continuous breaking of world records by major manufacturers like LONGi highlights the increasing maturity of the technology and is poised to accelerate competition and innovation across the entire industry.

Outlook and Strategic Significance

While LONGi has stated that this achievement is a laboratory record and has not yet announced a specific timeline for commercial production, the high efficiencies achieved in larger cells and modules indicate that technical challenges related to practical application are being overcome. Should this technology reach mass production, it could significantly reduce the cost of solar electricity generation, further accelerating the adoption of renewable energy. The ongoing R&D efforts by LONGi and competition from other players are expected to further drive the market introduction of perovskite solar cells.

Source: <https://pv-magazine.com/2026/07/15/longi-sets-new-world-record-with-35-5-efficient-perovskite-silicon-tandem-cell/>

Collected: July 17, 2026 | Automated Research System (Gemini API)

#02 Chinese Scientists Achieve Record 28.04% Efficiency and 625-Hour Stability in Perovskite-Organic Tandem Solar Cell with Novel TDB Additive

Published July 15, 2026 Renewables Now China



OVERVIEW

A team of Chinese scientists has set a new world record for perovskite-organic tandem solar cell efficiency, reaching 28.04% certified steady-state power conversion. The breakthrough relies on a novel light-converting additive molecule, TDB, which effectively suppresses halide phase separation during fabrication and operation, dramatically enhancing device stability. This innovation enables the mass production of lightweight, flexible, and low-cost solar cells, accelerating their practical application in diverse fields from wearables to space stations.

Key Findings

A team of Chinese scientists has established a new world record for perovskite-organic tandem solar cell efficiency, achieving a certified steady-state power conversion efficiency of 28.04%. This groundbreaking achievement significantly advances the practical application of flexible, lightweight, and highly efficient photovoltaic technology. Crucially, the introduction of a novel light-converting additive molecule, TDB, has dramatically enhanced the long-term stability of the device during both fabrication and operation.

Technical and Research Details

This tandem solar cell leverages a perovskite top layer for efficient absorption of high-energy light and an organic bottom layer for capturing near-infrared radiation, thereby utilizing a much broader spectrum of solar light than conventional single-layer devices. The core technical innovation lies in the incorporation of the TDB additive molecule. TDB effectively suppresses halide phase separation during the manufacturing process and throughout the device's operational lifetime, leading to a substantial improvement in stability. As a result, the device successfully maintained an impressive 90% of its initial performance after 625 hours of continuous light exposure, a critical advancement in overcoming the long-standing stability issues associated with traditional perovskite solar cells. The research findings have been published in the prestigious journal "Nature," receiving international recognition for their scientific and technological significance.

Background and Industry Context

Perovskite solar cells have garnered significant attention as a next-generation photovoltaic technology due to their outstanding optoelectronic conversion properties. The tandem architecture, combining perovskite with organic solar cells, is a particularly promising approach that exploits the advantages of both materials to achieve even higher efficiencies by absorbing a wider range of the solar spectrum. However, the stability of perovskite materials, especially degradation due to environmental factors and phase separation, has been a major barrier to commercialization. This research from China presents an innovative molecular-level solution to this stability problem, significantly paving the way for practical applications.

Outlook and Strategic Significance

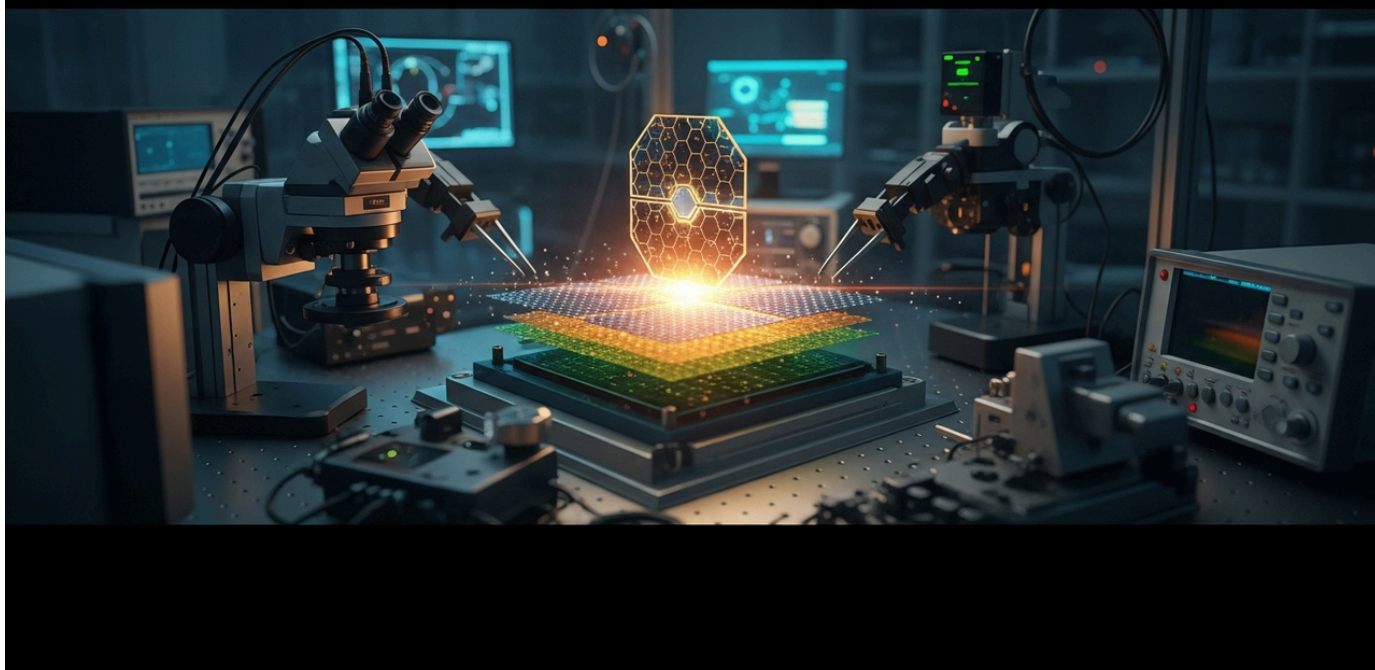
This record-breaking 28.04% efficiency, coupled with dramatically improved stability, opens doors for the mass production of lightweight, flexible, and low-cost solar cells. Specifically, it is expected to accelerate the practical adoption of solar power in a wide array of applications where traditional rigid and heavy silicon solar cells are unsuitable, including wearable electronics, IoT devices, smart building facades, and even aerospace applications like space stations. This technology has the potential to play a crucial role in China's drive to establish leadership in renewable energy technologies and could significantly impact the global energy transition.

Source: <https://renewablesnow.com/news/china-achieves-record-28-04-percent-efficiency-in-perovskite-tandem-solar-cell-1298058/>

Collected: July 17, 2026 | Automated Research System (Gemini API)

#03 Helmholtz-Zentrum Berlin Develops 3-Junction Perovskite Solar Cell Achieving 27.3% Efficiency and Over 770 Hours of Stable Operation with Graphene and SAMs

Published July 11, 2026 ConnectSci Germany



OVERVIEW

Researchers at Helmholtz-Zentrum Berlin (HZB) have developed a novel 3-junction perovskite solar cell that delivers a power conversion efficiency of 27.3% while exhibiting remarkable durability, with minimal degradation after over 770 hours of continuous operation. This breakthrough leverages a dual-layer interface of graphene oxide and self-assembled monolayers instead of traditional PEDOT:PSS, simultaneously boosting both efficiency and stability. The team anticipates further improvements could push efficiency beyond 30%, marking a significant step towards commercial viability for high-performance perovskite PVs.

Key Findings

Researchers at Germany's Helmholtz-Zentrum Berlin (HZB) have developed a groundbreaking 3-junction perovskite solar cell that achieves a high power conversion efficiency of 27.3%. This novel device also demonstrates exceptional durability, showing negligible performance degradation after more than 770 hours of continuous operation. This dual achievement marks a significant advance in addressing the critical challenge of simultaneously achieving high efficiency and long-term stability, which are essential for the commercialization of perovskite solar cells.

Technical and Research Details

The innovative design meticulously stacks three distinct perovskite semiconductor layers, optimized to efficiently absorb a broader range of the solar spectrum. A key aspect of this advancement lies in the sophisticated interface engineering between these layers. The research team employed a bilayer structure of graphene oxide (GO) and self-assembled monolayers (SAMs) as the interlayer, replacing the conventionally used charge transport material, PEDOT:PSS. This GO/SAM system effectively facilitates efficient charge separation and transport while suppressing internal device defects and enhancing resistance to moisture and heat. This careful interface control is crucial for minimizing recombination losses and significantly contributes to both the high conversion efficiency and the extended operational stability of the device.

Background and Industry Context

Perovskite solar cells are garnering considerable attention as a next-generation solar technology due to their high efficiency and potential for low-cost manufacturing. However, ensuring stability, particularly in multi-junction (tandem) configurations, and simplifying manufacturing processes have been key hurdles for commercialization. HZB's research sets an important benchmark for the industry by achieving both high efficiency and practical stability in a complex 3-junction structure. The approach of using more stable inorganic or molecular layers as alternatives to organic materials like PEDOT:PSS holds significant promise for future perovskite technology development.

Outlook and Strategic Significance

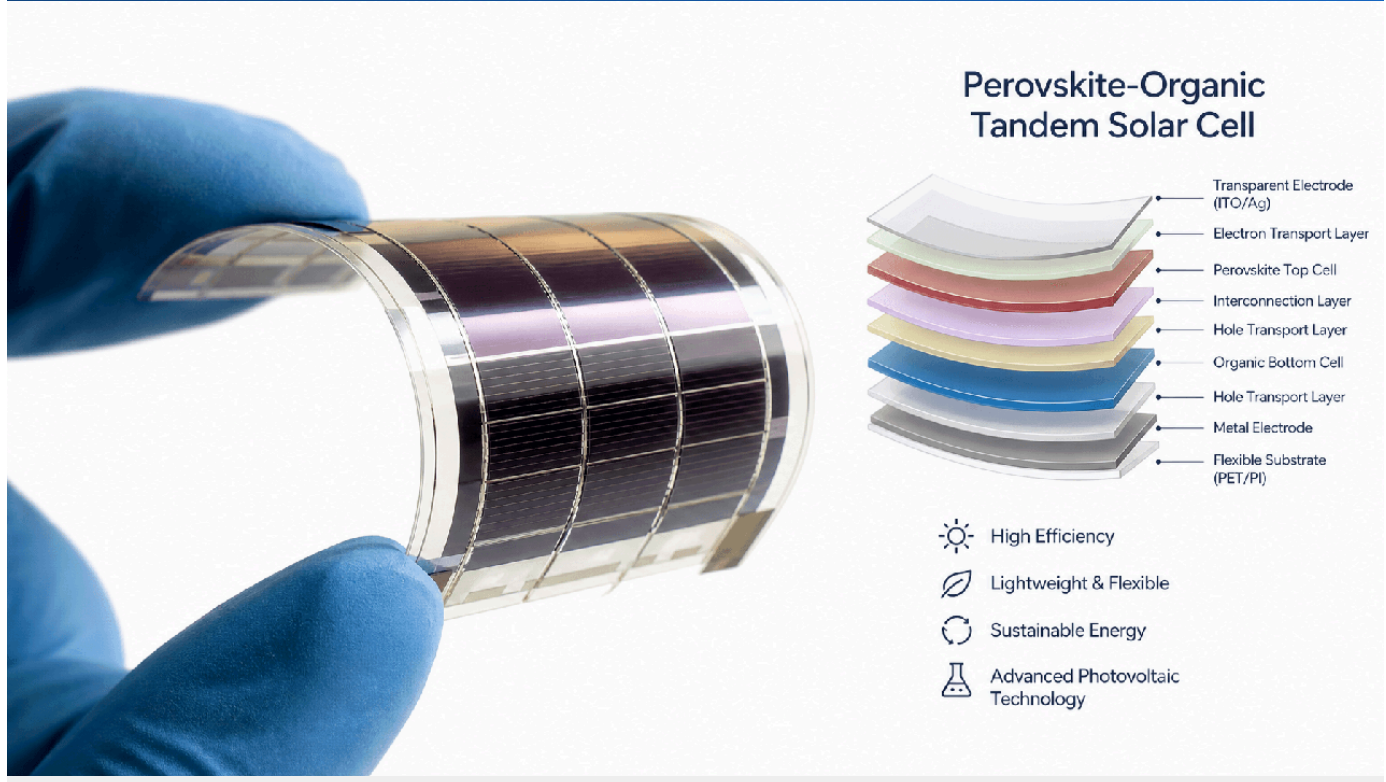
The research team predicts that further improvements in the quality of individual perovskite absorber layers and optimization of the interlayer films could boost the power conversion efficiency of this 3-junction architecture to over 30%. If this technology can be further scaled for large-volume manufacturing, it has the potential to drastically reduce the cost of solar power generation and become a powerful tool for accelerating the adoption of renewable energy. Perovskite solar cells that combine high efficiency and stability are expected to play an indispensable role in future energy supply.

Source: <https://connectsci.com/article/new-perovskite-solar-cell-shows-high-efficiency-and-little-degradation>

Collected: July 17, 2026 | Automated Research System (Gemini API)

#04 Chinese Academy of Sciences Achieves World Record 28.04% Efficiency in Perovskite-Organic Tandem Solar Cells

Published July 14, 2026 Pandaily China



OVERVIEW

Researchers at the Chinese Academy of Sciences Chemistry Institute have set a new world record for perovskite-organic tandem solar cells, achieving a certified steady-state power conversion efficiency of 28.04%. This breakthrough, published in *Nature*, employs a full-phase regulation strategy with a photo-convertible additive molecule (TDB) to ensure uniform halide distribution and suppress defect formation. The technology maintains 90% of its efficiency after 625 hours of continuous light soaking, demonstrating significant potential for lightweight, flexible applications in BIPV, portable energy, and aerospace.

Key Findings

A research team from the Chinese Academy of Sciences Chemistry Institute has achieved a new world record for perovskite-organic tandem solar cells, reaching a certified steady-state power conversion efficiency of 28.04%. This significant advancement, published in *Nature*, marks a crucial step in pushing the theoretical limits of solar energy conversion and highlights China's leading role in next-generation photovoltaic research.

Technical Details and Innovation

The record-breaking efficiency was made possible through a novel full-phase regulation strategy that incorporates a photo-convertible additive molecule, TDB. This innovative approach ensures a highly uniform distribution of halides within the perovskite layer, effectively mitigating defect formation that typically compromises cell performance and stability. The resulting devices not only exhibit superior initial efficiency but also demonstrate exceptional operational stability, retaining 90% of their initial efficiency after 625 hours of continuous light soaking under maximum power point tracking. This robust performance is critical for real-world applications where long-term durability is paramount.

Background and Industry Context

Perovskite solar cells are widely regarded as a promising alternative to traditional silicon-based photovoltaics due to their high efficiency, low manufacturing costs, and inherent flexibility. Tandem configurations, which stack multiple absorber layers, are particularly attractive as they can harvest a broader spectrum of sunlight, theoretically surpassing the Shockley–Queisser limit of single-junction cells. The integration of organic materials in this tandem architecture further enhances the devices' lightweight and flexible characteristics, opening avenues for applications where conventional rigid and heavy solar cells are impractical.

Strategic Significance and Outlook

This world-record efficiency has profound implications for various high-value applications. The lightweight, flexible, and thin nature of these perovskite-organic tandem cells makes them ideal for building-integrated photovoltaics (BIPV), where they can be seamlessly incorporated into architectural elements. Furthermore, their potential extends to portable energy solutions, wearable electronics, and even aerospace applications, where high power-to-weight ratios are essential. While challenges remain in scaling up manufacturing and ensuring long-term stability under diverse environmental conditions, this research unequivocally positions perovskite-organic tandem solar cells as a leading contender in the race for a more efficient and versatile clean energy future. The team aims to further refine the technology and accelerate its path to commercialization, potentially transforming how we generate and utilize solar power globally.

Source: <https://pandaily.com/perovskite-organic-tandem-solar-cell-world-record-jul2026>

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

#05 LONGi Breaks World Record Again with 35.5% Efficient Crystalline Silicon-Perovskite Tandem Solar Cell

Published July 15, 2026 LONGi News China



OVERVIEW

LONGi announced a new world record power conversion efficiency of 35.5% for a two-terminal crystalline silicon-perovskite tandem solar cell, certified by the European Solar Test Installation (ESTI). This achievement surpasses LONGi's previous record of 34.85% from April 2025. The company highlights the continuous technological breakthroughs and the potential of tandem cells to exceed the Shockley–Queisser limit for single-junction cells, accelerating the evolution of photovoltaic technology.

Key Findings

LONGi, a global leader in solar technology, has announced a groundbreaking achievement: a new world record power conversion efficiency of 35.5% for a two-terminal crystalline silicon-perovskite tandem solar cell. This remarkable feat was independently certified by the European Solar Test Installation (ESTI) and was presented at the 2026 Solar and Storage Innovation Technology Conference.

Technical Details and Innovation

This latest record surpasses LONGi's own previous benchmark of 34.85% achieved in April 2025, demonstrating an accelerated pace of innovation within the company. Tandem solar cells, which integrate multiple light-absorbing layers, are designed to overcome the fundamental Shockley–Queisser limit of single-junction cells (theoretically around 33.7%). By optimally combining a silicon bottom cell with a perovskite top cell, LONGi's technology maximizes photon absorption and charge separation efficiency across a broader spectrum of sunlight. This continuous improvement highlights the rapid maturation of tandem cell technology and its potential to deliver significantly higher energy yields from a given surface area.

Background and Industry Context

The solar photovoltaic industry is relentlessly pursuing higher efficiencies and lower costs to meet global energy demands and combat climate change. Perovskite solar cells, with their unique properties and high intrinsic efficiencies, are at the forefront of this quest. Integrating perovskites with established, high-performance crystalline silicon technology in a tandem configuration is particularly attractive, offering a clear pathway to efficiencies well beyond what silicon alone can achieve. The consistent breaking of efficiency records by major players like LONGi underscores the intense research and development efforts being poured into this field, signaling its growing readiness for widespread commercialization.

Strategic Significance and Outlook

LONGi's repeated breakthroughs underscore the immense potential of tandem solar cell technology to redefine the performance benchmarks for photovoltaics. Efficiencies exceeding 35% translate directly into higher power output per unit area, making these cells exceptionally valuable for installations where space is constrained or where maximizing energy yield is critical. This progress holds significant promise for reducing the Levelized Cost of Electricity (LCOE) for solar power, thereby accelerating the global transition to clean energy. LONGi is committed to further advancing its tandem cell research and development, aiming to solidify its leadership in a market segment poised for explosive growth and to contribute substantially to a more sustainable energy future.

Source: <https://www.longi.com/en/news/crystalline-silicon-perovskite-tandem-solar-cell-new-world-efficiency-2026/>

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

#06 Precision Interface Chemistry Propels Perovskite Solar Cell Efficiency Beyond 26% Mark in International Collaboration

Published July 17, 2026 EurekAlert! USA



OVERVIEW

An international research collaboration has developed a novel bidentate molecular ligand, MeXT, to precisely control residual lead iodide (PbI_2) at the perovskite interface. This strategy resulted in perovskite solar cells achieving a power conversion efficiency of 26.19% in an n-i-p architecture, coupled with strong operational stability under prolonged illumination and elevated temperature. This technology effectively addresses interfacial disorder and nonradiative voltage losses, paving the way for automated discovery in photovoltaic materials.

Key Findings

An international research team has successfully pushed the power conversion efficiency (PCE) of perovskite solar cells beyond 26%, reaching 26.19% through advanced precision interface chemistry. This breakthrough relies on a novel bidentate molecular ligand, MeXT, designed to precisely control the distribution of residual lead iodide (PbI_2) at the critical perovskite interface. The resulting devices exhibit not only high efficiency but also remarkable operational stability under extended illumination and elevated temperatures.

Technical Details and Innovation

The core of this innovation lies in addressing interfacial disorder and non-radiative voltage losses, which are major limitations in perovskite solar cell performance. The MeXT ligand acts as a precise modulator, effectively passivating defects at the interface between the perovskite layer and the charge transport layers. This targeted chemical intervention leads to a significant reduction in charge carrier recombination, thereby enhancing both open-circuit voltage and fill factor. In an n-i-p architecture, the cells demonstrated a certified PCE of 26.19%, a substantial improvement over previous designs. Furthermore, the robust interface provided by MeXT contributes to suppressing halide ion migration, a key factor in improving the long-term stability of perovskite devices under stress conditions.

Background and Industry Context

Perovskite solar cells are widely recognized for their potential to revolutionize solar energy, offering high efficiencies comparable to or even exceeding traditional silicon photovoltaics, coupled with lower manufacturing costs and material versatility. However, challenges related to stability and scalability, particularly at interfaces, have been critical hurdles for commercialization. This research represents a significant step forward by offering a sophisticated yet effective method for interface engineering. Such precision control over material properties at the nanoscale is vital for overcoming current bottlenecks and accelerating the transition of perovskite technology from laboratory to industrial application. It also points towards a future where automated discovery platforms can leverage precise chemical design for novel photovoltaic materials.

Strategic Significance and Outlook

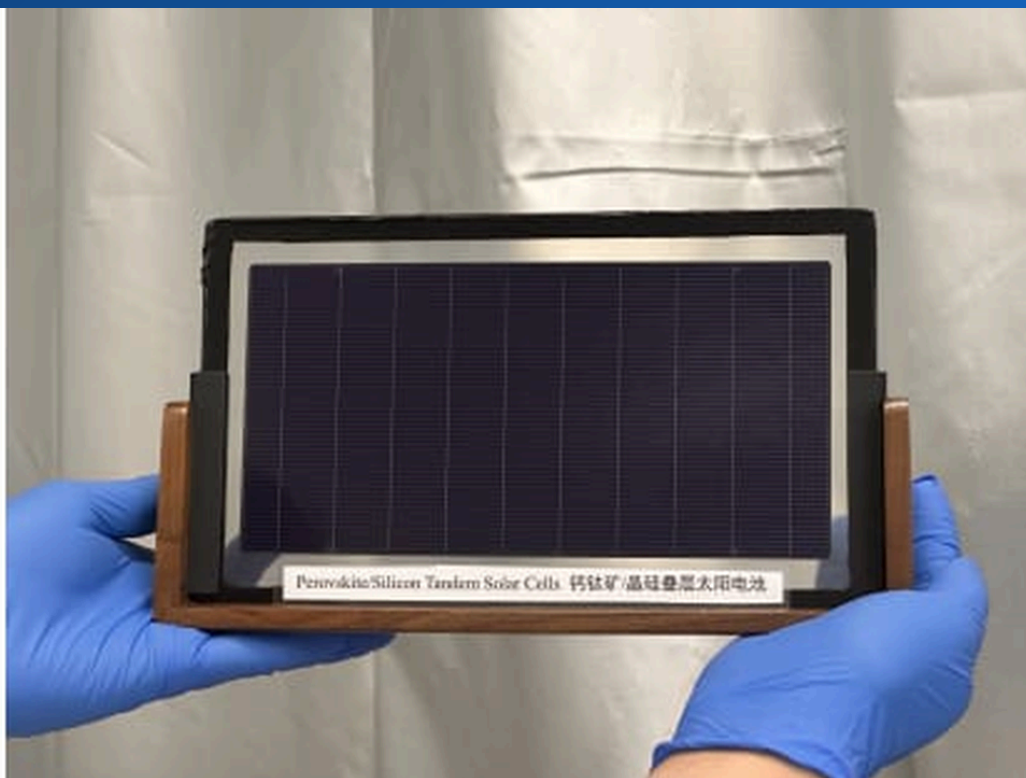
The development of MeXT and the associated interface chemistry strategy provide a powerful tool for simultaneously boosting the efficiency and stability of perovskite solar cells. This dual benefit is crucial for widespread adoption in various practical applications, including building-integrated photovoltaics (BIPV), flexible solar panels for consumer electronics, and high-performance power generation systems. The research not only delivers an immediate improvement in device performance but also establishes a foundation for future advancements in materials science, potentially enabling the rapid identification and optimization of new photovoltaic compounds. This innovative approach could accelerate the deployment of perovskite technology, significantly contributing to global clean energy targets and fostering new market opportunities for high-performance, cost-effective solar solutions.

Source: <https://www.chemeurope.com/en/news/1189290/precision-interface-chemistry-pushes-perovskite-solar-cells-beyond-26-efficiency.html>

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

#07 International Team Develops 31%-Efficient Indium-Free Perovskite-Silicon Tandem Mini-Module Using Reactive Plasma Deposition

Published July 17, 2026 PV Magazine Germany



OVERVIEW

An international research team has developed an indium-free perovskite-silicon tandem solar cell using a low-damage reactive plasma deposition process for tin oxide layers. This innovation achieved certified efficiencies of 33.6% for small-area devices and 31.0% for a mini-module. The dense and uniform tin oxide films improved the interface for self-assembled monolayers, reducing non-radiative recombination and suppressing halide ion migration, demonstrating strong performance under various environmental conditions and outdoor operation for over three months.

Key Findings

An international research team has successfully developed an innovative indium-free perovskite-silicon tandem solar cell, achieving a certified efficiency of 31.0% for a mini-module. This breakthrough leverages a low-damage reactive plasma deposition process for tin oxide layers, resulting in a small-area device efficiency of 33.6% and demonstrating robust performance over three months of outdoor operation.

Technical Details and Innovation

The core of this advancement lies in the precise engineering of the electron transport layer. The team employed a reactive plasma deposition (RPD) method to create dense and uniform tin oxide (SnO_2) films, which effectively replace the more expensive and supply-constrained indium tin oxide (ITO). The RPD process is crucial as it minimizes damage to underlying layers, a common issue in traditional deposition techniques. These high-quality SnO_2 films significantly improve the interface with self-assembled monolayers (SAMs), leading to a drastic reduction in non-radiative recombination losses, where charge carriers dissipate energy as heat instead of generating electricity. Furthermore, the optimized interface and dense SnO_2 layer effectively suppress the migration of halide ions, a primary cause of instability in perovskite solar cells. This intricate control over materials and interfaces enabled the achievement of 33.6% efficiency for laboratory-scale cells and a highly promising 31.0% for a practical 25.8 cm^2 mini-module, verified by independent certification.

Background and Industry Context

Tandem solar cells are critical for surpassing the efficiency limits of single-junction devices, and perovskite-silicon tandems are particularly promising due to their potential for high performance combined with the scalability of silicon technology. However, the reliance on indium for transparent conductive electrodes has been a challenge, given its high cost and limited global supply. The development of an indium-free solution addresses these commercial and sustainability concerns directly. This research not only offers a pathway to more cost-effective and environmentally friendly solar cells but also demonstrates a significant leap in manufacturing control and materials integration for next-generation photovoltaics.

Strategic Significance and Outlook

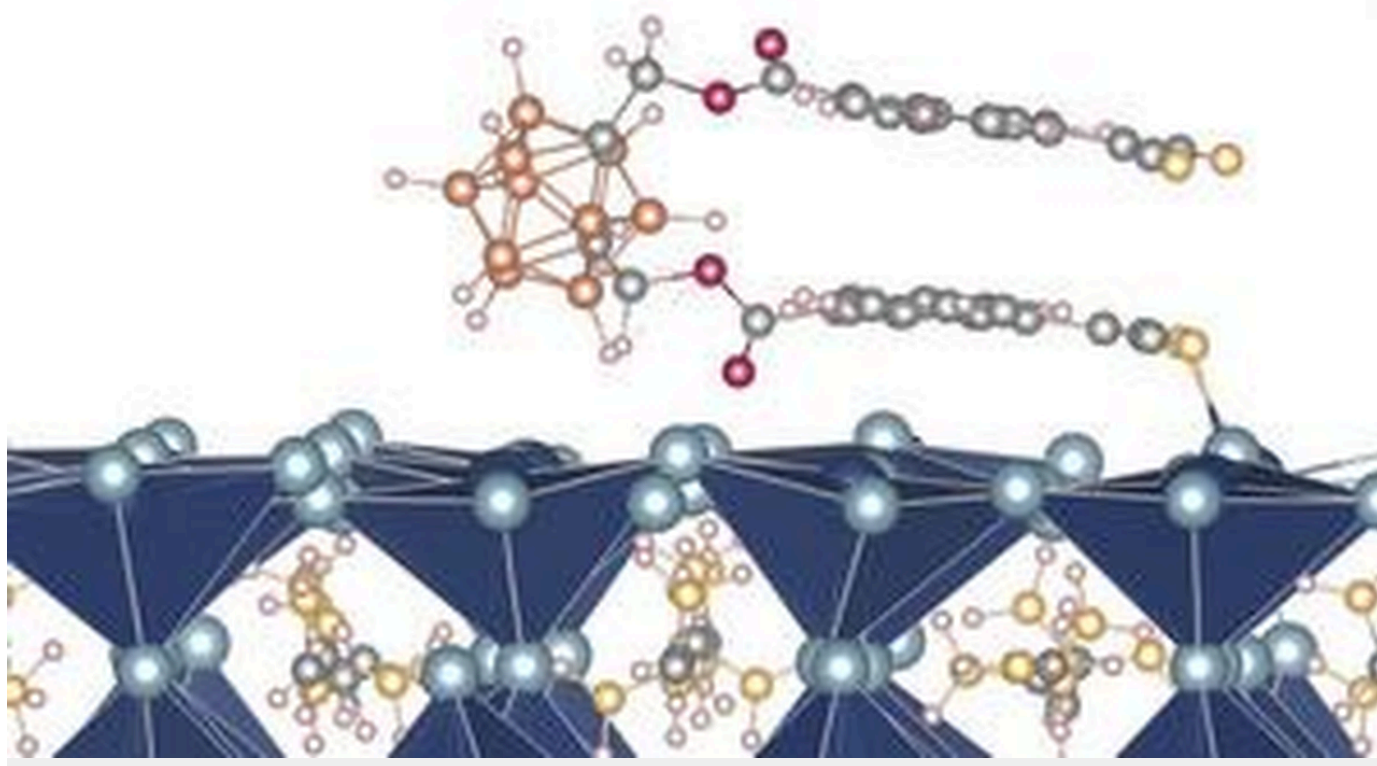
The achievement of 31.0% efficiency in an indium-free perovskite-silicon tandem mini-module marks a major milestone toward the widespread commercialization of this technology. The elimination of indium reduces material costs and supply chain risks, making large-scale production more viable and sustainable. This high efficiency, coupled with demonstrated outdoor stability, positions these cells as strong candidates for a variety of applications, from rooftop solar installations to flexible and portable power solutions. As the global demand for renewable energy continues to grow, such advancements in efficiency and cost-effectiveness will be crucial for accelerating the transition to a sustainable energy future. The international research team's work paves the way for a new generation of high-performance solar technology that is both economically competitive and environmentally responsible, promising to lower the Levelized Cost of Energy (LCOE) and expand the addressable market for solar power.

Source: <https://www.pv-magazine.com/2026/07/17/research-breakthrough-develops-indium-free-tandem-solar-cell-with-31-efficiency/>

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

#08 Steve Albrecht's Team Boosts Perovskite Solar Cell Efficiency by Up to 2.4% with Novel Carborane-Based Electron Transport Material

Published July 16, 2026 EurekAlert! USA



OVERVIEW

Researchers led by Steve Albrecht's team have developed a novel carborane-based electron transport material (ETM) that significantly improves the efficiency of perovskite solar cells. This new ETM acts as a high-performance substitute for traditional fullerene (C60) layers, reducing charge carrier losses at the interface and improving efficiency by an absolute 1.5% for single p-i-n perovskite cells and an absolute 2.4% for perovskite-silicon tandem cells. The patented material is now commercially available, holding significant promise for future tandem solar cell advancements.

Key Findings

A research team led by Steve Albrecht has successfully developed a novel carborane-based electron transport material (ETM) that dramatically enhances the power conversion efficiency of perovskite solar cells. This innovative ETM led to an absolute efficiency increase of 1.5% for single p-i-n perovskite cells (from 23.4% to 24.9%) and a remarkable 2.4% absolute gain for perovskite-silicon tandem cells (from 29.1% to 31.5%). This high-performance material, now patented and commercially available, presents a significant alternative to conventional fullerene (C60) layers.

Technical Details and Innovation

The newly developed carborane-based ETM is engineered to reduce charge carrier losses at the critical interface between the perovskite absorber and the electron transport layer. While traditional fullerene derivatives like C60 have been effective, they often present challenges in terms of long-term stability and optimal charge extraction efficiency. Carborane molecules, known for their unique electronic structure and robust chemical stability, provide a more efficient pathway for electron transfer and suppress non-radiative recombination events. The particularly significant absolute improvement of 2.4% in perovskite-silicon tandem cells underscores the material's ability to optimize charge separation and transport even in complex device architectures. This ETM combines excellent electron conductivity with superior resilience against degradation, contributing to enhanced device longevity.

Background and Industry Context

Perovskite solar cells are garnering substantial global attention as a next-generation photovoltaic technology, offering the potential for high efficiencies and low manufacturing costs. Tandem configurations, especially those combining perovskites with high-performance silicon solar cells, are considered one of the most promising avenues to exceed the theoretical efficiency limits of single-junction devices. However, maximizing the performance and ensuring the long-term reliability of these devices critically depends on optimizing charge transport at the interfaces between different layers. The development of this novel ETM directly addresses this crucial need, accelerating the commercialization pathway for high-efficiency solar cells.

Strategic Significance and Outlook

The introduction of this carborane-based ETM opens new possibilities for further boosting the performance of perovskite solar cells, particularly within the tandem architecture. The fact that this material is already patented and commercially available facilitates a rapid transition from research to market, potentially having a substantial impact on the broader solar energy industry. In the future, this technology is expected to become a standard component in the design of next-generation solar cells, thereby accelerating the deployment of clean energy and making significant contributions towards achieving energy efficiency and sustainability targets. The research team is now focused on further optimizing this material and exploring its application across various device architectures to cement its role in the future of solar power.

Source: <https://www.eurekalert.org/news-releases/1136395>

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

#09 LONGi Achieves 35.5% World Record Efficiency for Perovskite-Silicon Tandem Solar Cell

Published July 15, 2026 Perovskite-Info China



OVERVIEW

LONGi has announced a new world record power conversion efficiency of 35.5% for its perovskite-crystalline silicon tandem solar cell, certified by the European Solar Test Installation (ESTI). This achievement represents a significant leap beyond the theoretical limits of single-junction silicon cells and underscores the rapid progress in high-efficiency perovskite PV technology. While this is a research cell record, it marks a critical milestone towards the commercialization of next-generation solar cells.

Key Findings

LONGi has achieved a groundbreaking 35.5% power conversion efficiency for its perovskite-crystalline silicon tandem solar cell, a new world record independently certified by the European Solar Test Installation (ESTI). This monumental accomplishment significantly surpasses the established efficiency benchmarks for solar photovoltaics and positions LONGi at the forefront of advanced solar technology development. The achievement is a direct outcome of the company's 'Technology Forest' strategy, which prioritizes cutting-edge research and development in high-efficiency solar solutions.

Technical Details

The record-breaking efficiency stems from a meticulously engineered tandem architecture that integrates a perovskite top cell with a crystalline silicon bottom cell. This design synergistically broadens the spectrum of absorbed sunlight: the perovskite layer efficiently converts high-energy photons (blue and green light), while the underlying silicon layer captures lower-energy photons (red and infrared light) that the perovskite layer cannot. This approach maximizes photon utilization, moving beyond the Shockley-Queisser limit for single-junction cells. Key to this success are innovations in interface engineering between the two layers, optimized charge transport materials, and advanced passivation techniques that minimize energy losses and enhance overall device performance in the research-scale cell.

Background & Context

The solar industry is relentlessly pursuing higher efficiencies and lower levelized cost of electricity (LCOE) to accelerate the global energy transition. Traditional silicon solar cells are approaching their theoretical efficiency limits, making tandem architectures, especially perovskite-silicon, a critical area of innovation. LONGi, a global leader in solar technology, has invested heavily in this domain. Their latest record demonstrates that perovskite technology is rapidly maturing from academic curiosity to a viable commercial pathway. This aggressive development by Chinese manufacturers is intensifying the global race for solar supremacy, pushing the boundaries of what's possible in renewable energy generation.

Strategic Significance & Outlook

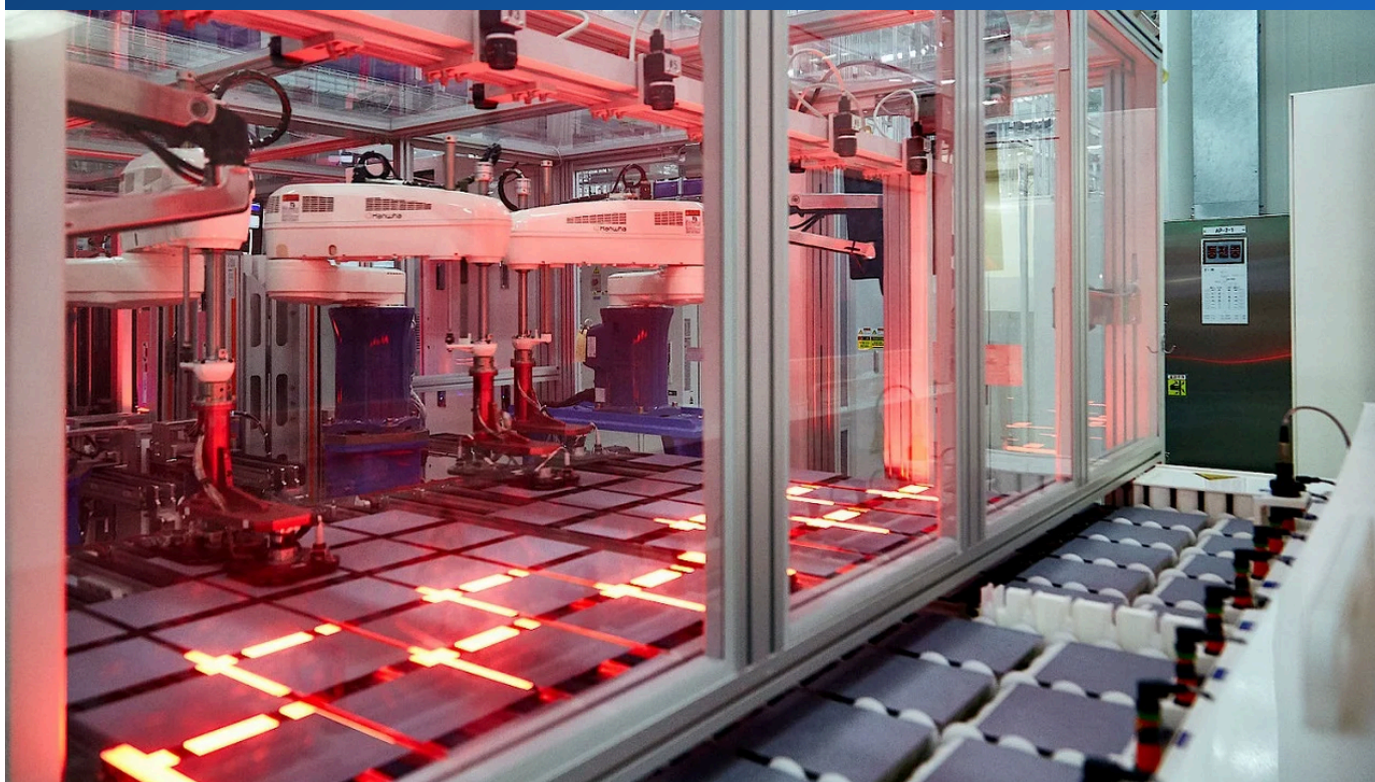
While the 35.5% efficiency record applies to a research-scale cell, not a commercial module, it provides a compelling vision for future solar power. It signals the potential for mass-produced solar modules to exceed 30% efficiency, which would dramatically increase energy yield per unit area and further reduce installation costs. This breakthrough is particularly appealing for applications with space constraints, such as rooftop solar, building-integrated photovoltaics (BIPV), and even electric vehicles. The next challenges for LONGi and the broader industry will involve translating this lab-scale success into stable, durable, and cost-effective manufacturing processes for large-area modules, ultimately aiming for widespread commercial availability in the late 2020s. This progress is pivotal for solar energy's role in achieving global carbon neutrality targets.

Source: <https://www.perovskite-info.com/longi-reports-355-certified-efficiency-perovskite-silicon-tandem-cell>

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

#10 Qcells Achieves Industry-First UL and IEC Certifications for Perovskite-Silicon Tandem Solar Technology, Paving Way for Commercialization

Published July 17, 2026 PV Tech South Korea



OVERVIEW

South Korean PV manufacturer Qcells announced it has secured the industry's first UL and IEC certifications for its perovskite-silicon tandem solar cell technology. The certifications, granted by TÜV Rheinland, confirm compliance with IEC 61215 and UL 61215 requirements for its 2-terminal tandem solar cells on M10 substrates produced at its German pilot line. This achievement addresses a major barrier to commercialization by proving technical reliability and bankability, marking a significant milestone for Qcells in bringing next-generation solar technology to market.

Qcells Secures Industry-First UL and IEC Certifications for Perovskite-Silicon Tandem Technology, Accelerating Commercialization

Qcells, a leading South Korean solar PV manufacturer, announced it has achieved an industry-first by securing UL and IEC certifications for its perovskite-silicon tandem solar cell technology. This groundbreaking certification from TÜV Rheinland confirms compliance with IEC 61215 and UL 61215 requirements, which are international standards for evaluating the technical reliability and bankability of solar PV products. This significant milestone addresses a major hurdle in the commercialization of perovskite tandem technology, clarifying its path to practical application.

Technical Details and Industry Implications

- **Certified Technology:** The certifications apply to Qcells' 2-terminal tandem solar cells on M10 substrates, manufactured at its pilot line in Germany. This technology aims to achieve power conversion efficiencies beyond conventional silicon modules by integrating a high-efficiency perovskite layer with existing crystalline silicon solar cells.
- **Significance of Certification:** UL and IEC certifications are crucial for ensuring international credibility regarding product safety, performance, and durability, especially for nascent technologies like perovskite solar cells. This "industry-first" status unequivocally demonstrates that Qcells' technology has reached a maturity level that meets stringent international standards.
- **Competitive Landscape:** While Qcells leads in certification, other players like UK-based Oxford PV are also making commercial strides through partnerships with Fraunhofer ISE and licensing agreements with First Solar and TrinaSolar, intensifying competition in the market. Qcells' early certification, however, may provide a significant market advantage.

Background and Industry Context

Perovskite-silicon tandem solar cells are gaining global attention from research institutions and companies as a next-generation technology capable of exceeding the theoretical efficiency limits of traditional silicon solar cells. However, despite their high efficiency, challenges related to material stability, long-term reliability, and large-scale manufacturing have been significant barriers to commercialization. Qcells' certification is a critical step in overcoming these challenges, moving the technology into a practical deployment phase.

Future Outlook

Qcells views this certification as a pivotal step in its product commercialization strategy and is expected to accelerate efforts towards establishing mass production and market launch. This technology holds the potential to significantly reduce electricity generation costs and optimize installation footprint, thus powerfully advancing the global transition to clean energy. Broad adoption is anticipated across various applications, from residential to large-scale power plants, where high power output and efficiency are paramount.

Source: <https://www.pv-tech.org/qcells-secures-first-ul-iec-certifications-for-perovskite-tandem-tech/>

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

#11 Solar Module Price Stabilization Shifts Focus to Perovskite Technology; Oxford PV Demonstrates Over 25% Tandem Efficiency, Targets 27% Next Year

Published July 16, 2026 pv magazine Global Germany



OVERVIEW

As global solar module prices stabilize, attention is shifting to next-generation perovskite solar cell technology, particularly perovskite-silicon tandem modules. UK-based Oxford PV has already deployed tandem modules with efficiencies slightly above 25% in large-scale field tests and aims to achieve 27% efficiency next year. This trend underscores the industry's pivot towards high-efficiency solutions to drive future growth and wider adoption.

Solar Module Price Stabilization Accelerates Investment and Focus on Perovskite Technology

The prolonged rise in solar PV module prices has halted, bringing a period of stabilization to the market. This price equilibrium signals that the solar industry is moving beyond the maturity phase of existing silicon technologies and transitioning towards its next growth stage. Against this backdrop, industry attention is increasingly converging on next-generation technologies that promise higher conversion efficiencies and diverse applications, particularly perovskite solar cells.

Technology and Market Trends

- **Expectations for Perovskite Technology:** Perovskite solar cells offer a compelling combination of high efficiency, lightweight properties, flexibility, and transparency—characteristics difficult to achieve with conventional crystalline silicon solar cells. These attributes provide significant advantages for integrated applications like Building-Integrated Photovoltaics (BIPV) and tandem modules combining perovskites with existing silicon cells.
- **Oxford PV's Concrete Achievements:** Oxford PV, a leading UK company, is aggressively pursuing the commercialization of perovskite-silicon tandem technology. The company has already initiated large-scale field tests with tandem modules demonstrating power conversion efficiencies slightly exceeding 25%, actively gathering real-world performance data. Furthermore, Oxford PV has set an ambitious goal to increase the efficiency of these tandem modules to 27% by next year, outlining a clear technological roadmap for commercialization.
- **Market Impact:** The stabilization of module prices makes overall solar PV system costs more predictable, reducing risk for investors and project developers. This environment is likely to accelerate investment in innovative solutions such as high-efficiency perovskite technologies.

Background and Industry Context

Solar power plays a central role in the global energy transition, but its further proliferation requires continuous improvements in power generation efficiency and cost reduction. As the efficiency gains for crystalline silicon solar cells approach their physical limits, tandem structures like perovskites are considered one of the most promising approaches to break through these barriers. Tandem technologies, in particular, which can leverage existing silicon infrastructure, are expected to see early market adoption.

Future Outlook

Advances in perovskite technology are poised to enhance the cost-effectiveness of solar power, enabling broader deployment across more regions and applications. If ongoing R&D and demonstration efforts by companies like Oxford PV succeed, perovskite-silicon tandem solar cells could become a significant component of the global solar PV market within a few years. The target of 27% efficiency will be a crucial benchmark for assessing the impact of this technology as a next-generation energy solution.

Source: <https://www.pv-magazine.com/2026/07/16/rise-in-solar-module-prices-comes-to-a-halt/>

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

#12 Perovskite Solar Cells for Extreme Environments Target Ultra-Stability with Degradation Mechanism Elucidation and AI Prediction

Published July 16, 2026 MDPI Switzerland



OVERVIEW

A comprehensive review in MDPI focuses on perovskite solar cells (PSCs) for space and extreme environments. It details degradation mechanisms like vacuum-induced volatile desorption, UV-induced halide segregation, and thermomechanical failure at embedded interfaces, emphasizing advanced engineering strategies to overcome these. Crucially, integrating AI, especially deep learning for State of Health (SOH) prediction monitoring, is proposed as essential for designing ultra-stable and radiation-hardened PSCs.

Perovskite Solar Cells for Extreme Environments: Advancing Ultra-Stable Design Through Degradation Mechanism Elucidation and AI Prediction

A comprehensive review article published in MDPI highlights the evolution of perovskite solar cells (PSCs) aimed at operating under significantly different and harsh conditions, particularly in space and extreme terrestrial environments. The paper meticulously analyzes the unique degradation mechanisms PSCs face in these specialized settings and proposes cutting-edge engineering strategies and the integration of artificial intelligence (AI) as solutions. This work significantly broadens the possibilities for energy supply in next-generation space exploration and specialized applications.

Technical and Research Details

- **Primary Degradation Mechanisms:** Key mechanisms hindering PSC performance in extreme environments include:
 - **Vacuum-Induced Volatile Desorption:** In the vacuum of space, organic components and volatile additives within PSCs can desorb from the device, leading to performance degradation.
 - **UV-Induced Halide Segregation:** Intense ultraviolet radiation accelerates the segregation of halide ions within the perovskite crystal structure, causing bandgap changes and efficiency reduction.
 - **Thermomechanical Failure at Embedded Interfaces:** Orbital changes for spacecraft or temperature cycling on planetary surfaces can induce stress due to thermal expansion coefficient mismatches between different layers within PSCs, leading to physical damage such as interface delamination and cracks.
 - **Radiation Damage:** Space radiation (protons, electrons, heavy ions) generates defects in perovskite materials and charge transport layers, increasing carrier recombination and decreasing efficiency.

- **Advanced Engineering Strategies:** To counter these degradation mechanisms, the review emphasizes the following strategies:
 - **Novel Material Design:** Development of more robust and stable perovskite compositions (e.g., incorporating inorganic cations) and charge transport materials with extreme environment resilience.
 - **Interface Engineering:** Improving interface stability and suppressing charge recombination through the introduction of defect passivation layers and barrier layers.
 - **Robust Encapsulation Technologies:** Innovative encapsulation materials and structures to protect devices from moisture, oxygen, vacuum, and radiation.
- **Integration of AI Prediction Monitoring:** Of particular note is the proposed integration of State of Health (SOH) prediction monitoring using AI, specifically deep learning architectures. This approach enables real-time monitoring of PSC degradation and prediction of future performance decline, thereby optimizing device lifespan and enhancing mission reliability. AI also serves as a powerful tool for learning patterns from complex degradation mechanism data to guide optimal material design and operational strategies.

Background and Industry Context

Space solar power holds significant potential for sustainable space exploration and the future of energy supply on Earth. While conventional space solar cells (e.g., gallium arsenide) have faced challenges regarding high cost and weight, perovskite solar cells are emerging as an attractive alternative for space applications due to their high efficiency, lightweight nature, and flexibility. Ensuring reliability in extreme environments is key to the widespread adoption of this technology.

Future Outlook

This review article clearly defines the direction for R&D in PSCs for space and extreme environments. The combination of advanced materials science, engineering strategies, and innovative tools like AI is expected to enable the realization of ultra-stable and radiation-hardened perovskite solar cells. This will pave the way for PSCs to become a primary energy source in future space missions, high-altitude platforms, and terrestrial applications with specific power requirements.

Source: <https://www.mdpi.com/2571-8797/8/4/111>

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

#13 Perovskite Solar Cells Achieve 34.85% Lab Efficiency and 30.6% Commercial Module Efficiency, Driving Towards Low-Cost Options

Published July 13, 2026 Industry Insights (Accio) Unknown



OVERVIEW

An Accio report overview indicates that perovskite solar cells (PSCs) have reached up to 34.85% efficiency in laboratories and 30.6% in commercial modules, outperforming conventional silicon solar cells. The technology offers lightweight, flexible, and semi-transparent designs for applications such as BIPV, portable power, and specialized research. Key manufacturers include Saule Technologies, GCL Perovskite, UtmoLight, and Microquanta Semiconductor, with expected cost reductions accelerating adoption.

Perovskite Solar Cells Achieve 34.85% Lab Efficiency and 30.6% Commercial Module Efficiency, Driving Towards Low-Cost Options

This article provides an overview of a market research report published by Accio.

Report Overview

Accio's report, titled "Perovskite Solar Panels Price 2025: Low-cost options," offers comprehensive insights into the pricing trends, performance characteristics, and procurement aspects of perovskite solar cells (PSCs). This report analyzes the advantages PSCs hold over conventional solar cell technologies and their prospective role in the future market.

Key Findings

- **High Efficiency and Performance:** Perovskite solar cells have achieved remarkable power conversion efficiencies of up to 34.85% at the laboratory level, with commercial modules reportedly reaching 30.6%. This performance surpasses that of conventional crystalline silicon solar cells, clearly demonstrating their potential as a breakthrough in solar power generation.
- **Diverse Design Characteristics:** PSCs can be designed to be lightweight, flexible, and semi-transparent. These characteristics enable their application in a wide range of areas where conventional solar cells face limitations, including Building-Integrated Photovoltaics (BIPV), portable power sources, and specialized research applications.
- **Leading Manufacturers:** The report identifies key manufacturers driving the perovskite solar cell market, such as Saule Technologies, GCL Perovskite, UtmoLight, and Microquanta Semiconductor. These companies are advancing market growth through technological innovation and expanding production capabilities.
- **Outlook for Cost Reduction:** In addition to high efficiency and diverse characteristics, the simplification of manufacturing processes and reduction in material costs are expected to make perovskite solar cells a highly competitive, low-cost option in the future. If realized, this would further accelerate the adoption of PSCs.

About the Publisher

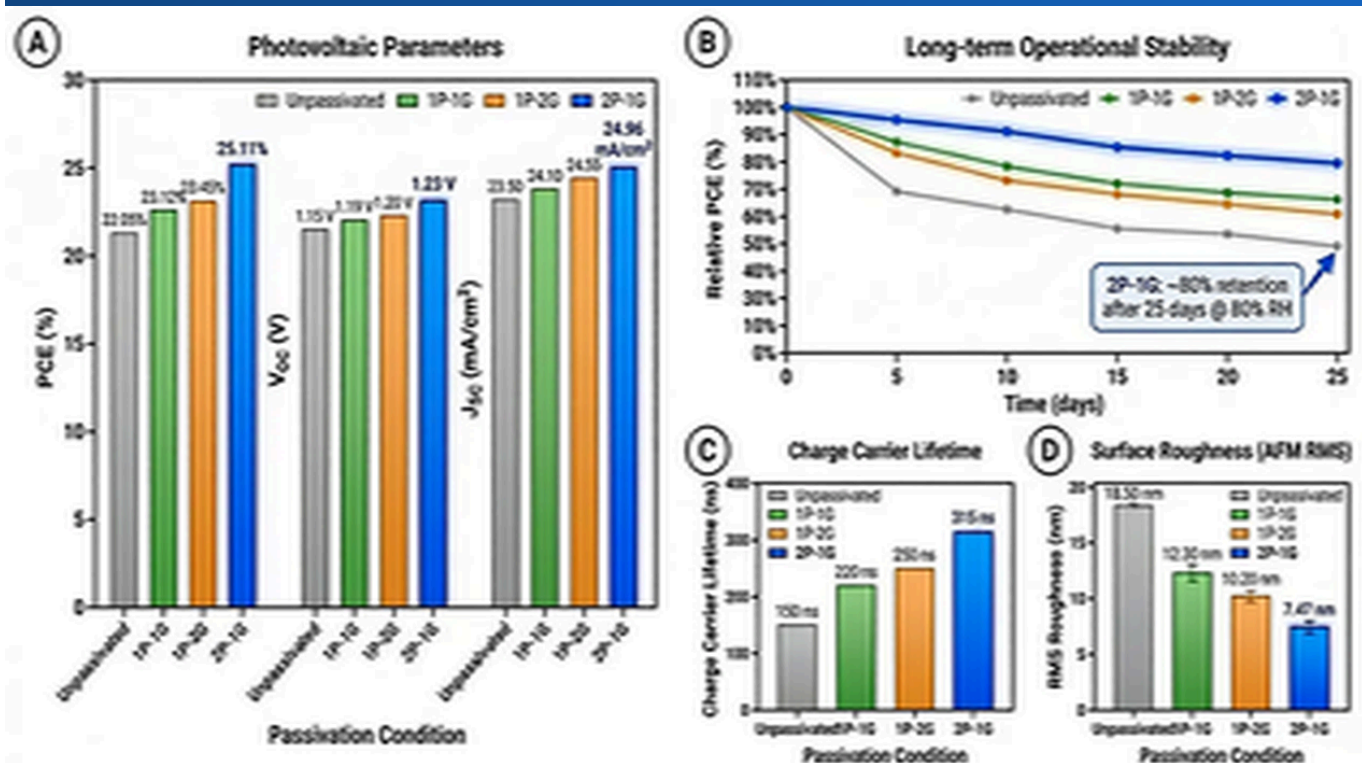
Accio is a company that provides market research reports and business insights across various industrial sectors. It offers information on technology trends, market analysis, and competitive intelligence to support strategic decision-making for businesses.

Source: <https://www.accio.com/plp/perovskite-solar-panels-price>

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

#14 Dual Surface Passivation Boosts Perovskite Solar Cell Efficiency from 21.37% to 25.11% and Enhances Long-Term Stability

Published July 10, 2026 PLOS One USA



OVERVIEW

A study published in PLOS One reports a significant performance improvement in perovskite solar cells (PSCs) through the introduction of dual surface passivation layers. This technique increased power conversion efficiency (PCE) from 21.37% to 25.11% compared to control cells, alongside a notable enhancement in long-term stability. The research demonstrates an effective approach to improving PSC efficiency by reducing defects and suppressing non-radiative recombination, addressing critical challenges for PSC commercialization.

Dual Surface Passivation Elevates Perovskite Solar Cell Efficiency to 25.11% and Significantly Boosts Long-Term Stability

A significant breakthrough toward enhancing the performance and ensuring the long-term stability of perovskite solar cells (PSCs) has been published in the academic journal PLOS One. This research demonstrates that the introduction of dual surface passivation layers dramatically improves the power conversion efficiency (PCE) of PSCs and substantially enhances the device's long-term stability. Specifically, compared to unpassivated control cells, PCE increased from 21.37% to 25.11%, a groundbreaking achievement that accelerates the practical application of next-generation solar PV technology.

Technical and Research Details

- **Mechanism of Dual Surface Passivation:** The perovskite layer's surface and bulk contain crystal defects and trap sites, which cause non-radiative recombination of charge carriers, leading to reduced PCE and compromised stability. The dual surface passivation technique employed in this study introduces specialized material layers on both the top and bottom surfaces of the perovskite layer, effectively passivating these defects. This extends the lifetime of charge carriers, improves photocurrent and open-circuit voltage, and consequently enhances overall conversion efficiency.
- **Efficiency Improvement and Stability:**
 - **Power Conversion Efficiency (PCE):** Passivation led to an increase in PCE from 21.37% to 25.11%. This represents an approximately 17.5% relative efficiency improvement, highlighting the critical importance of material design and interface engineering optimization.
 - **Long-Term Stability:** The passivation layers also act as a protective barrier against environmental factors like moisture and oxygen, significantly enhancing the device's long-term stability. This resolves one of the primary challenges for the practical outdoor deployment of PSCs.

- **Defect Reduction and Suppression of Non-Radiative Recombination:** The dual passivation layers effectively fill defects at perovskite grain boundaries and surfaces, reducing carrier trapping. This suppresses "non-radiative recombination," where photo-generated electrons and holes recombine and are lost as heat, allowing more charge carriers to be extracted to the external circuit.

Background and Industry Context

Perovskite solar cells have garnered significant attention as a promising alternative to traditional silicon solar cells due to their high power conversion efficiency and potential for low-cost manufacturing. However, their vulnerability to humidity and heat, and the resulting challenges in long-term stability, have been major barriers to commercialization. This dual surface passivation technology offers a concrete solution to this stability problem, significantly advancing the practical application of PSCs.

Future Outlook

These research findings open the door to significantly improving the long-term reliability of perovskite solar cells and enabling a wider range of applications. It is expected that research will accelerate to integrate this passivation strategy into large-scale manufacturing processes and to push the boundaries of efficiency and stability even further. Dual surface passivation technology is poised to become an essential component in realizing low-cost, high-performance next-generation solar power systems, with the potential to contribute significantly to the energy transition.

Source: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0351439>

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

#15 Oxford University and Japan Collaborate to Develop Ultra-High-Efficiency Solar Cells: Targeting 35%+ for All-Perovskite Tandems and 40%+ for Perovskite/Silicon Hybrids

Published July 14, 2026 jobRxiv UK



OVERVIEW

Oxford University is recruiting for a Postdoctoral Research Assistant in a collaborative project with Japanese institutions (AIST, Kyoto University, Nagoya University) and industry partners (Oxford PV, Enecoat). This international consortium aims to combine UK and Japanese expertise to develop ultra-high-efficiency 3-junction solar cells, targeting over 35% efficiency for all-perovskite tandems and over 40% for perovskite/silicon combinations.

Oxford University and Japan Strengthen Collaboration for Ultra-High-Efficiency Solar Cell Development: Aiming for Over 35% in All-Perovskite Tandems and 40%+ in Silicon Hybrids

Oxford University, a globally renowned research institution, is seeking a Postdoctoral Research Assistant for a significant collaborative project with leading Japanese research organizations and industry partners. This initiative brings together top Japanese research bodies like the National Institute of Advanced Industrial Science and Technology (AIST), Kyoto University, and Nagoya University, alongside industry leaders such as Oxford PV and Enecoat. The goal is to pool the expertise and technological strengths of both nations to develop next-generation, ultra-high-efficiency solar cells. Notably, the project sets ambitious performance targets designed to break through the limits of existing photovoltaic technologies, with the potential to profoundly impact the global energy transition.

Project Details and Technical Goals

- **Formation of an International Consortium:** This project represents an international research consortium uniting top academic and industrial players from the UK and Japan. By leveraging their respective strengths, the consortium aims for innovative breakthroughs across diverse areas including materials science, device physics, and manufacturing process technologies.
- **Ultra-High-Efficiency Solar Cell Development Targets:** At the core of the project is the development of two types of ultra-high-efficiency 3-junction solar cells:
 - **All-Perovskite Tandem Solar Cells:** Targeting over 35% power conversion efficiency. This involves multi-junction structures composed entirely of perovskite materials, aiming to surpass the limits of single-material cells.
 - **Perovskite/Silicon Tandem Solar Cells:** Setting an ambitious goal of over 40% power conversion efficiency. This aims to achieve efficiencies significantly exceeding the theoretical limits of silicon by stacking a perovskite layer on top of existing high-performance silicon solar cells.

- **Research Focus:** Beyond efficiency, the research also focuses on critical commercialization challenges such as ensuring long-term stability, reducing manufacturing costs, and achieving scalability for large-area devices. Specifically, this includes developing new perovskite materials, controlling interface defects, optimizing multi-junction device structures, and developing mass-producible processes.

Background and Industry Context

Increasing global energy demand and the imperative to address climate change necessitate further innovation in renewable energy technologies. Solar photovoltaics are a primary renewable energy source, but higher efficiency and lower costs are essential to accelerate their adoption. Perovskite solar cells are recognized as one of the most promising technologies to address this challenge, and multi-junction structures, particularly tandem configurations with silicon, are considered strategic approaches for dramatically enhancing efficiency. The collaboration between the UK and Japan aims to leverage the robust scientific and technological foundations of both countries to establish a leading position in this global competition.

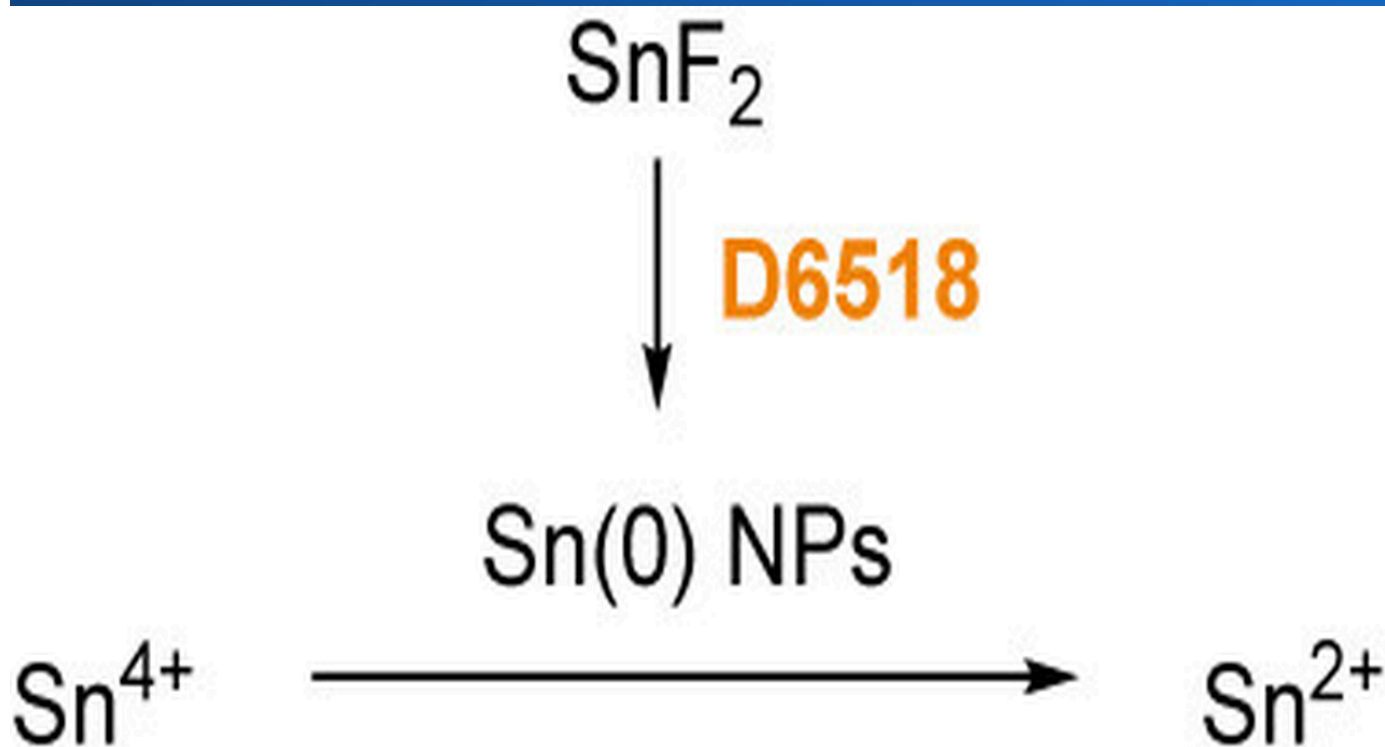
Future Outlook

If this international collaborative research project successfully achieves its ultra-high-efficiency solar cell targets, the cost-effectiveness of solar power will dramatically improve, becoming a powerful driver for the energy transition. An efficiency exceeding 40% would fundamentally redefine conventional solar cell concepts, enabling maximum power generation from limited land areas. The outcomes of this project are expected to have a significant impact not only on the energy industry but also on the entire scientific and technological community.

Source: <https://jobrxiv.org/job/postdoctoral-research-assistant-10/>

#16 TCI Launches TM-DHP Additive for Tin-Based Perovskite Solar Cells, Licensed from Enecoat Technologies, to Remove Tin Impurities

Published July 15, 2026 Perovskite-Info 이스라엘



OVERVIEW

Tokyo Chemical Industry (TCI) has introduced TM-DHP, an innovative additive licensed from Enecoat Technologies, aimed at significantly improving the performance and stability of tin-based perovskite solar cells (PSCs). Tin-based PSCs, vital for lead-free next-generation solar, suffer from efficiency degradation due to tin(II) oxidation into detrimental tin(IV) impurities. TM-DHP effectively traps these impurities, paving the way for high-efficiency, stable lead-free solar cell commercialization.

Background

Amid global efforts to combat climate change and achieve a sustainable society, the importance of renewable energy, particularly solar power, continues to grow. Perovskite solar cells (PSCs) are often lauded as "dream solar cells" due to their high power conversion efficiency (PCE) and potential for low-cost manufacturing. However, environmental regulations and health concerns necessitate a shift away from conventional lead-based perovskites. Tin (Sn)-based perovskites offer a promising low-lead or completely lead-free alternative, directly addressing the toxicity challenge.

A significant hurdle for tin-based PSCs is their inherent chemical instability: tin(II) readily oxidizes to tin(IV) upon exposure to oxygen and moisture. These tin(IV) impurities introduce defects within the perovskite layer, accelerating charge carrier recombination and severely reducing both the device's PCE and its long-term stability. Tokyo Chemical Industry (TCI), a leading chemical manufacturer, has now launched "TM-DHP," a critical new additive designed to overcome this very challenge. This product is manufactured and sold by TCI under an exclusive license from Enecoat Technologies Co., Ltd., exemplifying a successful academic-industrial partnership aimed at bringing cutting-edge research to market.

Key Findings

TM-DHP, developed by Enecoat Technologies and commercialized by TCI, functions by selectively trapping tin(IV) impurities, preventing their detrimental incorporation during the crucial perovskite crystal growth phase. This molecular design fundamentally enhances the purity and crystallinity of the tin-based perovskite material, thereby significantly reducing defect density within the active layer. The direct outcome is the effective prevention of PCE degradation and a marked improvement in device stability, addressing a critical bottleneck in the practical application of tin-based PSCs.

The introduction of TM-DHP is expected to dramatically accelerate the development of more robust and practical performance devices. By mitigating the pervasive stability-efficiency trade-off that has long plagued tin-based PSCs in the R&D stage, TM-DHP clarifies a viable path toward the commercialization of high-efficiency, lead-free perovskite solar cells. This innovation is poised to invigorate further research and development in the field, facilitating the faster adoption of environmentally friendly next-generation solar cells and bolstering the overall sustainability of the solar power industry. The collaboration between TCI and Enecoat Technologies underscores the profound impact that advanced material chemistry can have on the energy sector, with TM-DHP representing a pivotal step towards a greener energy future.

Source: <https://www.perovskite-info.com/tci-offers-tm-dhp-additive-perovskite-solar-cells-remove-tin-impurities>

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

#17 Hanwha Qcells Hosts Space Solar Power Workshop, Showcasing Perovskite-Silicon Tandem Pilot Line to 40 International Experts for Enhanced Collaboration

Published July 14, 2026 Business Korea South Korea



OVERVIEW

Hanwha Qcells hosted the "Space Solar Innovation Workshop 2026" in South Korea, inviting approximately 40 international experts in space solar power. The company unveiled its perovskite-silicon tandem pilot line at its Jincheon plant, demonstrating its manufacturing competitiveness and next-generation solar technology development capabilities. The workshop aimed to establish strategic partnerships and enhance global technical collaboration to secure a leading position in the burgeoning space solar power market.

Hanwha Qcells Strengthens International Cooperation at Space Solar Power Workshop, Highlighting Perovskite-Silicon Tandem Technology

Hanwha Qcells, a leading South Korean solar PV manufacturer, hosted the "Space Solar Innovation Workshop 2026" in South Korea on July 14, 2026. This significant event brought together approximately 40 experts in space solar power from South Korea, the United States, and the EU to discuss the potential of next-generation solar technologies, particularly perovskites, for space applications. Hanwha Qcells showcased its state-of-the-art perovskite-silicon tandem pilot line, constructed at its Jincheon plant, demonstrating its manufacturing competitiveness and innovative next-generation solar technology development capabilities to a global audience.

Workshop and Technology Showcase

- **Invitation of International Experts:** The workshop aimed to consolidate international knowledge and experience in the highly specialized field of space solar power. Generating solar electricity in Earth's orbit or deep space requires extreme durability, lightweight design, and high efficiency, necessitating cutting-edge materials science and device engineering.
- **Unveiling of Perovskite-Silicon Tandem Pilot Line:** Hanwha Qcells publicly presented its perovskite-silicon tandem technology pilot line at the Jincheon plant. This pilot line represents a crucial step towards the mass production of perovskite solar cells and underscores the company's technological leadership and production capacity. Perovskite-silicon tandem solar cells are particularly advantageous in space environments, where weight and installation area are severely restricted, due to their ability to achieve higher conversion efficiencies than traditional single-junction silicon cells.
- **Building Strategic Partnerships:** The workshop sought to establish a foundation for strategic partnerships aimed at securing Hanwha Qcells' leading position in the space solar power market. Interactions with international experts explored opportunities for joint R&D, technology licensing, and market development.

Background and Industry Context

Space Solar Power (SSP) has long been researched as a potential ultimate clean energy solution to meet Earth's energy demands. This technology, which involves capturing solar energy outside Earth's atmosphere and wirelessly transmitting it to the ground, holds the promise of stable power supply independent of day-night cycles or weather conditions. However, deployment in space presents extremely high technical hurdles, including weight reduction, radiation resistance, thermal control, and cost-effectiveness. Perovskite solar cells are emerging as a strong candidate to address these challenges.

Future Outlook

Hanwha Qcells is expected to further accelerate its R&D in space solar power technology, leveraging the insights gained and international collaborations fostered at this workshop. The maturation of perovskite-silicon tandem technology will dramatically enhance the feasibility of solar power generation in space environments, potentially revolutionizing future space infrastructure and power supply to remote areas on Earth. Hanwha Qcells' initiative in this field is anticipated to help solidify South Korea's position as a global leader in space solar power technology.

Source: <https://en.sedaily.com/finance/2026/07/14/hanwha-qcells-hosts-space-solar-innovation-workshop-to>