

# Perovskite Solar Cells

## Weekly Intelligence Report

2026-07-12 | 45 articles | 10 countries

troy-technical.jp

This Week's Keyword

## Perovskite Tandem Cells

Efficiency records & commercialization accelerate

45

articles

Total Articles

10

countries

Source Countries

34.82

%

Highest Tandem Efficiency

5.0

B USD

Market Size by 2035

### All 45 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 | n-i-p Perovskite 26.6%        | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Achieved 26.6% efficiency with phosphite-assisted chemical protection, boosting precursor solution stability (21 days) and device stability (90% after 600 hrs).          |
| #02 | Flexible Semi-Tandem 27.7%    | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Flexible semitransparent PSCs hit 21.4% efficiency, 61.3% NIR transparency; tandem with flexible c-Si reached 27.7%, 94.5% efficiency after 2000 bends.                   |
| #03 | JinkoSolar 34.82% Tandem      | Corporate Strategy | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | JinkoSolar achieved a world-record 34.82% efficiency for perovskite-silicon tandem solar cells, certified by SIMIT, accelerating commercial deployment.                   |
| #04 | Triple-Junction All-PSC 29.1% | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Triple-junction all-perovskite solar cells with self-assembling hole contacts achieved 29.1% certified efficiency and 90% retention after 500 hours.                      |
| #05 | CIGS-Perovskite 25.5%         | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Berlin team achieved 25.5% efficiency for CIGS-perovskite tandem solar cells, certified by Fraunhofer ISE, with optimized interface engineering.                          |
| #06 | WBG Perovskite 18.15%         | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Wide-bandgap perovskite solar cells made by thermal co-evaporation achieved 18.15% efficiency with BaI <sub>2</sub> vapor treatment, opening way for tandem applications. |
| #07 | Carbazole SAMs 27.1%          | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Carbazole SAMs boosted inverted PSC efficiency to 27.1% (26.6% certified) and achieved over 5000 hours stability at 85°C, addressing a key commercialization barrier.     |
| #08 | Ion Exchange PSC 19.38%       | Research           | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Synergistic ion exchange and passivation achieved 19.38% efficiency in inverted PSCs, significantly reducing interfacial defects and improving reliability.               |
| #09 | PSC Architecture Review       | Review             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Review highlights inverted PSCs exceeding 26% and perovskite/silicon tandems reaching 34.85% efficiency, driven by SAMs and data-driven design.                           |

| #   | Article Title                       | Type                 | Tech Novelty                                                       | Market Proximity                                                   | Market Impact                                                      | Data Reliability                                                   | US/EU Relevance                                                    | Summary                                                                                                                                                                                       |
|-----|-------------------------------------|----------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #10 | Lead-Free Sn PSC 12.6%              | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Lead-free tin perovskite solar cells achieved 12.6% efficiency with SrF <sub>2</sub> additive, suppressing Sn <sup>2+</sup> oxidation and enhancing stability.                                |
| #11 | Sr <sup>2+</sup> Halide Segregation | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Sr <sup>2+</sup> ion addition enabled wide-bandgap perovskites to resist halide segregation, achieving 20.18% efficiency at 1.77 eV, crucial for tandem applications.                         |
| #12 | PQD Stability 6000h                 | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Aromatic molecules controlled perovskite quantum dot ripening, achieving 93% efficiency retention after 6000 hours storage, improving stability for PQD solar cells.                          |
| #13 | All-PSC Tandem 29.51%               | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | All-perovskite tandem solar cells achieved 29.51% efficiency and 80% retention after 1200 hours using pH-modulated NiOx buried contacts.                                                      |
| #14 | PSC Market \$5B by 2035             | Market Overview      | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Perovskite solar cell module market projected to reach \$5 billion by 2035, driven by advancements like Panasonic's 18.1% glass-integrated PV and Oxford PV's 20% power boost.                |
| #15 | Co-SAMs Tandem 30.61%               | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Co-SAMs boosted WBG perovskite solar cells to 23.02% efficiency, achieving 30.61% in a 4-terminal perovskite/silicon tandem configuration.                                                    |
| #16 | Hot Phonon Bottleneck               | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Research re-examines "hot-phonon bottleneck" in PSCs, providing new insights into charge carrier dynamics for improved efficiency.                                                            |
| #17 | DMF-Free R2R Process                | Process Development  | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Developed an environmentally friendly DMF-free cosolvent ink for roll-to-roll manufacturing of flexible perovskite solar cells, reducing environmental impact and cost.                       |
| #18 | Molecular Lubricant SAMs            | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Molecular lubricants mitigate SAM aggregation in PSCs, improving device performance and stability by controlling molecular packing and reducing interfacial defects.                          |
| #19 | Air-Processed PSC 25.33%            | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Air-processed perovskite solar cells achieved NREL-certified 25.33% efficiency (26.1% lab) via thermally activated proton transfer, significantly reducing manufacturing costs.               |
| #20 | Multifunctional Additive 34.28%     | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Multifunctional additive boosted perovskite/silicon tandem solar cells to 34.28% efficiency (certified 1.001 cm <sup>2</sup> ), with 93% retention after 2000 hours at 65°C (unencapsulated). |
| #21 | ALD SnOx/AZO Tandem 33.25%          | Research             | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | All-ALD SnOx/AZO bilayer suppressed interfacial reactions in perovskite/silicon tandem solar cells, achieving 33.25% efficiency and 96% retention after 1000 hours.                           |
| #22 | Inkjet WBG Perovskite 20%           | Process Development  | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Inkjet printing with quenching controlled WBG perovskite crystal orientation, achieving over 20% efficiency at 1.69 eV, suitable for silicon-perovskite tandems.                              |
| #23 | Trina Solar 29.2% Module            | Product Announcement | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Trina Solar achieved 29.2% efficiency and 907W output for an industrial perovskite-silicon tandem module, certified by TÜV SÜD, accelerating large-scale deployment.                          |
| #24 | Inverted PSC Review 26.15%          | Review               | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | <div><div></div><div></div><div></div><div></div><div></div></div> | Review highlights inverted PSCs surpassing n-i-p type in 2024 with 26.15% certified efficiency, driven by SAMs and manufacturing process advancements.                                        |



| #   | Article Title               | Type                 | Tech Novelty | Market Proximity | Market Impact | Data Reliability | US/EU Relevance | Summary                                                                                                                                                                                          |
|-----|-----------------------------|----------------------|--------------|------------------|---------------|------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #25 | Chinese Inverted PSC 27.31% | Research             | ●●●●●<br>○   | ●●●●●<br>○       | ●●●●●<br>○    | ●●●●●<br>○       | ●●●●●<br>○      | Chinese team achieved world-record 27.31% certified efficiency for inverted PSCs via dual-molecule interface engineering, with 21.54% on 766 cm <sup>2</sup> and 92% retention after 2000 hours. |
| #26 | Tandem Low-Light Perf.      | Overview             | ●○○○○<br>○   | ●●○○○<br>○       | ●●●●●<br>○    | ●●○○○<br>○       | ●●●●●<br>○      | Perovskite-silicon tandem solar cells expected to exceed 30% efficiency, offering superior low-light performance and broader applications.                                                       |
| #27 | Ultrathin Transparent PSCs  | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●○○○<br>○    | ●●○○○<br>○       | ●●●●●<br>○      | NTU developed ultrathin transparent perovskite solar cells, 10,000x thinner than hair, with highest efficiency for type, enabling power-generating glass surfaces.                               |
| #28 | Flexible Semi-Tandem 27.7%  | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●●●●<br>○    | ●●●●●<br>●       | ●●●●●<br>○      | Buried-interface engineering yielded 21.4% flexible semitransparent PSCs and 27.7% flexible 4-terminal perovskite/silicon tandems, with excellent stability and mechanical durability.           |
| #29 | HZB Triple-Junction 27.3%   | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●●●●<br>○    | ●●●●●<br>○       | ●●●●●<br>●      | HZB team achieved 27.3% efficiency and 770-hour stability with a GO/SAM bilayer in perovskite triple-junction solar cells.                                                                       |
| #30 | Trinasolar 29.2% Module     | Product Announcement | ●●●●●<br>○   | ●●●●●<br>○       | ●●●●●<br>●    | ●●●●●<br>○       | ●●●●●<br>○      | Trinasolar achieved world record 907W power output and 29.2% efficiency for perovskite/crystalline silicon tandem module, verified by TÜV SÜD.                                                   |
| #31 | Oxford PV Shipments         | Corporate Strategy   | ●●●●●<br>○   | ●●●●●<br>●       | ●●●●●<br>●    | ●●●●●<br>○       | ●●●●●<br>●      | Oxford PV shipping 24.5% efficient commercial tandem modules to US; JinkoSolar achieved 34.82% efficiency, accelerating commercialization.                                                       |
| #32 | IPSC 25.95% Stable          | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●●●●<br>○    | ●●●●●<br>●       | ●●●●●<br>○      | Synergistic buried-interface engineering achieved 25.95% efficiency and 100% retention after 1200 hours for inverted PSCs (1 cm <sup>2</sup> ).                                                  |
| #33 | WBG Passivation 23.54%      | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●●●●<br>○    | ●●●●●<br>○       | ●●●●●<br>○      | Chinese researchers achieved 23.54% efficiency and improved stability for WBG perovskite solar cells using dual-molecule surface passivation.                                                    |
| #34 | Space Solar Factory         | Corporate Strategy   | ●●●●●<br>●   | ●●●●●<br>○       | ●●●●●<br>○    | ●●○○○<br>○       | ●●●●●<br>○      | Stellar Power (Beijing) building world's first space perovskite solar factory; samples showed over 200 days stable operation on Tiangong Space Station.                                          |
| #35 | Cyclohexylamine Passiv.     | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●●●●<br>○    | ●●●●●<br>●       | ●●●●●<br>○      | Protonated cyclohexylamine passivation layer boosted PSC efficiency to 21.53% and demonstrated 80% retention after 720 hours stability.                                                          |
| #36 | Dazheng 100MW Flexible      | Corporate Strategy   | ●●●●●<br>○   | ●●●●●<br>○       | ●●●●●<br>○    | ●●●●●<br>○       | ●●●●●<br>○      | Dazheng Micro-Nano secured A4 funding for world's first 100 MW flexible perovskite module production line, aiming for 800,000 m <sup>2</sup> annual capacity.                                    |
| #37 | Maxwell P-HJT 600MW         | Product Announcement | ●●●●●<br>○   | ●●●●●<br>○       | ●●●●●<br>●    | ●●●●●<br>○       | ●●●●●<br>○      | Maxwell Technologies unveiled P-HJT tandem production solutions exceeding 31% efficiency, with a 600MW commercial line operational, supporting 210mm formats.                                    |
| #38 | Atomistic Modeling Pass.    | Research             | ●●●●●<br>●   | ●○○○○<br>○       | ●○○○○<br>○    | ●●●●●<br>●       | ●●●●●<br>○      | Data-driven atomistic modeling elucidated surface passivation mechanism of hybrid halide perovskites, providing fundamental insights for robust PSC design.                                      |
| #39 | Photodetector Interface     | Research             | ●●●●●<br>○   | ●●○○○<br>○       | ●●○○○<br>○    | ●●●●●<br>●       | ●●●●●<br>○      | Redox-modulated polyoxometalate-incorporated carbazole interface boosts perovskite photodetector performance by improving energy alignment and defect passivation.                               |
| #40 | PSC Startup Landscape       | Market Analysis      | ●○○○○<br>○   | ●●●●●<br>●       | ●●●●●<br>●    | ●●●●●<br>○       | ●●●●●<br>●      | Analysis shows 36 perovskite solar startups globally, 28 funded, 18 Series A+; US leads with 10 companies, Swift Solar secured \$42.4M.                                                          |

| #   | Article Title             | Type                 | Tech Novelty | Market Proximity | Market Impact | Data Reliability | US/EU Relevance | Summary                                                                                                                                                                                 |
|-----|---------------------------|----------------------|--------------|------------------|---------------|------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #41 | F&S;: AI Drives PV Future | Market Analysis      | ●○○○<br>○    | ●●●●<br>●        | ●●●●<br>●     | ●●●○<br>○        | ●●●●<br>●       | Frost & Sullivan identifies perovskite solar cells as core materials innovation for future PV, with AI accelerating discovery for higher efficiency and lower costs.                    |
| #42 | IDTechEx 2026 Comm.       | Market Overview      | ●○○○<br>○    | ●●●●<br>●        | ●●●●<br>●     | ●●○○<br>○        | ●●●●<br>●       | IDTechEx webinar to assess 2026 perovskite PV commercialization, focusing on progress, high-value applications, and scaling realities.                                                  |
| #43 | Saule Inkjet BIPV         | Product Announcement | ●●●○<br>○    | ●●●○<br>○        | ●●●○<br>○     | ●●○○<br>○        | ●●●●<br>●       | Saule Technologies unveiled new generation inkjet-printed perovskite solar cells, poised to transform BIPV and daily products with flexible, semi-transparent designs.                  |
| #44 | ISFH CalTeC Calibration   | Corporate Strategy   | ●●○○<br>○    | ●●●●<br>●        | ●●●●<br>●     | ●●●○<br>○        | ●●●●<br>●       | German ISFH CalTeC launched calibration services for large-area perovskite-silicon tandem solar cells, accelerating certification and market entry.                                     |
| #45 | 2D PSC Predictive Design  | Research             | ●●●●<br>○    | ●○○○<br>○        | ●●○○<br>○     | ●●○○<br>○        | ●●●○<br>○       | Researchers developed a predictive framework to optimize 2D perovskite solar cell design, boosting efficiency and stability by integrating computational science and experimental data. |

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

## Three Questions That Demand Your Decision This Week

### ❶ Is your PV product roadmap competitive with 34%+ efficiency?

Chinese firms JinkoSolar and Trina Solar are pushing perovskite-silicon tandem efficiencies to 34.82% (cell) and 29.2% (module, 907W). Oxford PV is already shipping 24.5% commercial modules. How will your next-gen products compete?

### ❷ Are you prepared for air-processed, stable perovskite manufacturing?

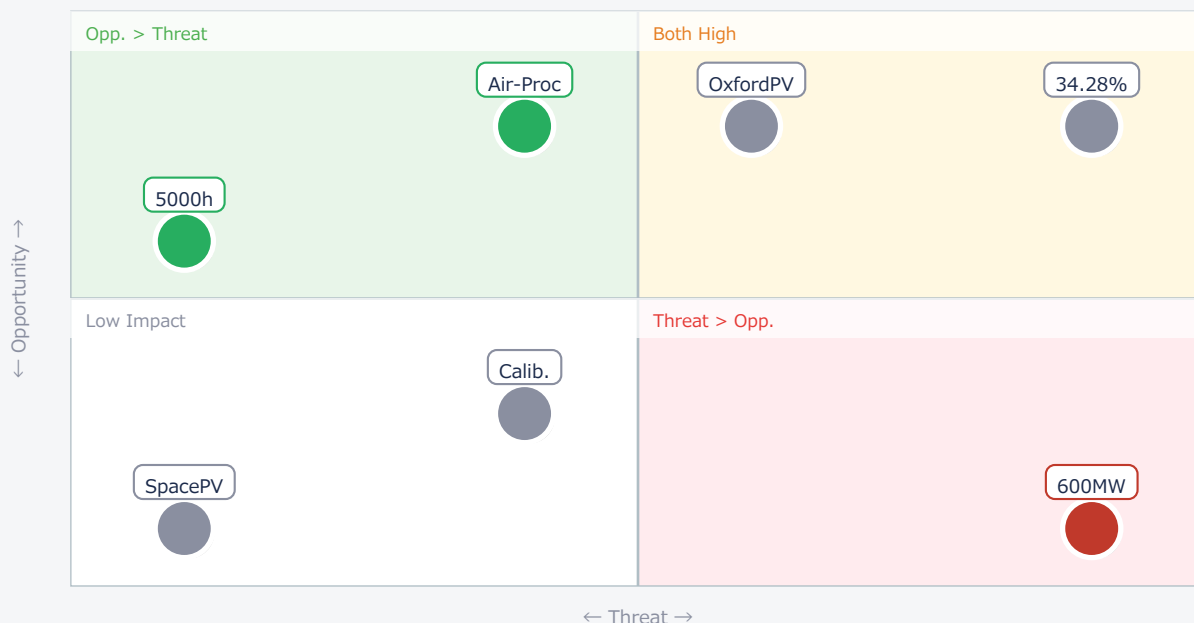
New research shows NREL-certified 25.33% efficient perovskite cells made in ambient air, drastically cutting manufacturing costs. Coupled with 5000+ hour stability, this changes the production landscape. What is your strategy for low-cost, high-volume production?

### ❸ How will you leverage or counter China's space PV leadership?

Stellar Power (Beijing) is building the world's first space perovskite solar factory, with samples already stable for 200+ days on Tiangong. This creates a new market segment. What are your plans for high-reliability, lightweight space PV?

## Opportunities vs. Threats for US/European Companies

Opportunity vs. Threat Matrix for US/European Companies



| Item       | Quadrant | ↑ Opportunity           | ↓ Threat                  |
|------------|----------|-------------------------|---------------------------|
| ● 34.28%   | Critical | New efficiency standard | Obsolete product lines    |
| ● OxfordPV | Critical | Market entry validation | Lagging commercialization |
| ● Air-Proc | Opp.     | Lower mfg cost          | High CAPEX disadvantage   |
| ● 5000h    | Opp.     | Enhanced reliability    | Stability gap widens      |
| ● 600MW    | Threat   | New equipment sales     | Chinese mfg lead          |
| ● SpacePV  | Ref.     | Niche market entry      | China space dominance     |
| ● Calib.   | Ref.     | Standardization         | Certification hurdle      |

## Deep Dive ① — 34.28% Tandem Efficiency with 2000h Stability

#20 | 2026/07/08 | Energy & Environmental Science | Tech Novelty●●●●● Proximity●●○○○ Market Impact●●●●● Data Reliability●●●●● US/EU Relevance●●●●●

A multifunctional additive synergistically optimized crystallization and band alignment, enabling perovskite/silicon tandem solar cells to achieve an astonishing 34.28% power conversion efficiency (certified on 1.001 cm<sup>2</sup>).

Unencapsulated devices demonstrated excellent stability, retaining over 93% of initial efficiency after 2,000 hours of continuous 1-sun illumination at 65°C, a pivotal step towards commercialization.

### ► Strategic Analyst's Perspective

Strategic Analyst's Perspective: This is a critical breakthrough, pushing the efficiency frontier for perovskite/silicon tandems to a new high, with impressive stability for unencapsulated devices. [Opportunity] for US/EU materials suppliers to develop similar multifunctional additives and for OEMs to license or acquire this technology to stay competitive. [Threat] for existing PV manufacturers whose product roadmaps don't account for such rapid efficiency gains. Next actions: [R&D;] Evaluate additive chemistry and interface engineering by Q4 2026. [Strategy] Re-evaluate 5-year product roadmap against 34%+ efficiency by Q1 2027.

## Deep Dive ② — Oxford PV Ships Commercial Tandem Modules

#31 | 2026/07/02 | Solar Panel Cost Guide Australia | Tech Novelty●●●●○ Proximity●●●●● Market Impact●●●●● Data Reliability●●●○○ US/EU Relevance●●●●●

Oxford PV has commenced shipments of its first commercial tandem modules, boasting approximately 24.5% module efficiency, for utility-scale projects in the US. This marks a significant transition from lab to market.

Concurrently, JinkoSolar achieved 34.82% efficiency with an N-type TOPCon based tandem cell, further accelerating the commercialization race. Trina Solar also secured its first commercial customer for tandem panels.

### ► Strategic Analyst's Perspective

Strategic Analyst's Perspective: Oxford PV's commercial shipments to the US are a strong validation of perovskite tandem technology's market readiness. [Opportunity] for US/EU project developers and integrators to gain early access to higher-efficiency modules, and for materials suppliers to engage with these emerging supply chains. [Threat] for traditional silicon PV manufacturers who are not rapidly integrating tandem technology, as their market share could erode. Next actions: [Business Dev] Initiate discussions with Oxford PV and other tandem module suppliers by end of Q3 2026. [Procurement] Assess supply chain implications and potential for dual-sourcing by Q4 2026.

## Deep Dive ③ — Air-Processed Perovskite Cells NREL-Certified 25.33%

#19 | 2026/07/07 | Joule | Tech Novelty●●●●● Proximity●●○○○ Market Impact●●●●○ Data Reliability●●●●● US/EU Relevance●●●●●

Perovskite solar cells fabricated in ambient air achieved an NREL-certified quasi-steady-state efficiency of 25.33% (26.1% lab) through thermally activated proton transfer, approaching 27%.

This breakthrough promotes optimal crystallization of  $\alpha$ -phase FAPbI<sub>3</sub> films, leading to uniform cation distribution, large crystal grains, and reduced interfacial voids, significantly cutting manufacturing costs and complexity.

### ► Strategic Analyst's Perspective

Strategic Analyst's Perspective: Air processing is a game-changer for perovskite manufacturing, drastically reducing CAPEX and OPEX by eliminating inert atmosphere requirements. The NREL certification validates the performance. [Opportunity] for US/EU equipment manufacturers to develop compatible air-processing tools and for OEMs to adopt this low-cost production method. [Threat] for companies heavily invested in inert-atmosphere production lines, as their cost structure may become uncompetitive. Next actions: [R&D;] Investigate air-processing compatibility with existing perovskite formulations by Q4 2026. [Manufacturing] Conduct feasibility study on converting inert lines to air-process lines by Q1 2027.

## Other Notable Articles

JinkoSolar, ペロブスカイト-シリコンタンデム太陽電池で世界最高の34.82%変換効率を達成、SIMIT認証取得 (Winssolutions)  
Tech Novelty●●●●○ Proximity●●●○○ Market Impact●●●●●

Chinese giant sets new world record for tandem cell efficiency, intensifying global competition in high-performance PV.

カルバソールSAMsが逆型ペロブスカイト太陽電池の効率を27.1%（認証26.6%）に押し上げ、85°Cで5000時間超の安定性を実現 (ACS Energy Letters)  
Tech Novelty●●●●● Proximity●●○○○ Market Impact●●●●○

Unprecedented long-term stability (5000h at 85°C) for inverted PSCs, a major step towards practical durability.

Trina Solar, ペロブスカイト-シリコン産業用タンデムモジュールで29.2%効率・907W出力を達成、TÜV SÜD認証取得 (Logos Press)  
Tech Novelty●●●●○ Proximity●●●●○ Market Impact●●●●●

Industrial-scale tandem module with high efficiency and power output, certified by TÜV SÜD, signals near-market readiness.

Stellar Power (Beijing) Breaks Ground on World's FIRST Space Solar Factory for Perovskite Cells, Demonstrating Over 200 Days of Stable Operation on Tiangong Space Station (YouTube (Stellar Power (Beijing) Technology Co.))  
Tech Novelty●●●●● Proximity●●●○○ Market Impact●●●●○

China's entry into space-grade perovskite PV with a dedicated factory and in-orbit validation opens a new high-value market.

German ISFH CalTeC Launches Calibration Services for Large-Area Perovskite-Silicon Tandem Solar Cells, Accelerating Certification and Market Entry (pv magazine Global)  
Tech Novelty●●○○○ Proximity●●●●● Market Impact●●●●●

Establishment of official calibration services is crucial for building market confidence and accelerating commercial adoption in Europe.

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## Recommended Actions This Week

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

### ■ Immediate (this week)

- [Executive] Review competitive landscape for perovskite tandem efficiencies (34%+) and commercial module shipments (Oxford PV, Trina Solar) to identify immediate threats.
- [R&D;] Initiate rapid assessment of air-processing techniques and multifunctional additives for perovskite stability and efficiency.
- [Procurement] Begin preliminary supplier scouting for advanced perovskite precursor materials and interface engineering components.

### ■ Short-term (1 month)

- [Strategy] Develop a contingency plan for PV product roadmaps if 30%+ tandem efficiencies become mainstream faster than anticipated.
- [Business Dev] Explore potential partnerships or licensing opportunities with companies demonstrating breakthroughs in perovskite stability (e.g., 5000h+).
- [Legal/IP] Conduct an IP landscape analysis on key perovskite interface engineering and manufacturing process patents, especially from Chinese entities.

### ■ Medium-long term (quarter+)

- [R&D;] Establish internal R&D; programs for lead-free perovskites and flexible/transparent applications, aligning with future market demands and environmental regulations.
- [Manufacturing] Investigate the feasibility and ROI of converting or building new production lines compatible with air-processed perovskite technology.
- [Strategy] Formulate a long-term strategy for space-grade PV, considering China's advancements and potential for new market entry or competitive response.
- [Executive] Allocate dedicated budget for perovskite technology development, including materials, process, and certification, to secure future market position.

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troy-technical.jp/en | Original curation. Article copyrights belong to respective authors. | Gemini API + Claude | 2026-07-12

# PerovskiteSolarCells — Selected Articles

Date: 2026-07-12

Articles: 45



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#36 Protonated Cyclohexylamine Passivation Layer Boosts Perovskite Solar Cell Efficiency to 21.53%, Demonstrates 720-Hour Stability

#37 Dazheng Micro-Nano Secures A4 Funding Round to Boost Flexible Perovskite Solar Production, Plans 100 MW Production Line

#38 Maxwell Technologies Unveils Perovskite-HJT Tandem Production Solutions Exceeding 31% Efficiency at SNEC 2026, 600MW Commercial Line Operational

#39 Data-Driven Atomistic Modeling Unravels Surface Passivation Mechanism of Hybrid Halide Perovskites

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#43 Perovskite Solar Startup Landscape: U.S. Leads with 10 Companies, Swift Solar Secures \$42.4M in Total Funding

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#50 Researchers Develop Predictive Framework to Optimize 2D Perovskite Solar Cell Design, Significantly Boosting Efficiency and Stability

# #01 n-i-p型ペロブスカイト太陽電池が認証効率26.6%を達成、前駆体溶液の安定性が600時間・21日間大幅向上

Published July 08, 2026 ACS Applied Materials & Interfaces USA



## OVERVIEW

A novel phosphite-assisted chemical protection strategy has enabled n-i-p type perovskite solar cells to achieve a certified power conversion efficiency of 26.6%. This technology dramatically enhances both the long-term shelf stability of the precursor solution, which remained effective for 21 days in ambient air, and the operational stability of the devices, retaining 90% of initial efficiency after 600 hours of continuous light exposure. This breakthrough offers a practical solution to key commercialization challenges for perovskite solar cells, namely stability and manufacturing process reliability.

### Background

Perovskite solar cells have garnered considerable attention as a next-generation photovoltaic technology due to their high power conversion efficiency and potential for low-cost manufacturing. However, their instability to humidity, heat, and light has been a major impediment to commercialization. Degradation of precursor solutions during storage, in particular, has directly impacted manufacturing yield and reliability. While previous research often focused on improving device stability, this study addresses the fundamental issue of precursor solution stability, enhancing the overall reliability of the manufacturing process.

### Key Findings

This study reports a breakthrough in n-i-p type perovskite solar cells, achieving a certified power conversion efficiency of 26.6%. This exceptional performance is attributed to a novel phosphite-assisted chemical protection strategy, which dramatically enhances the stability of perovskite solar cells, both at the precursor solution level and in the final device.

### Technical Details

The developed phosphite-assisted chemical protection method ensures the long-term shelf stability of the perovskite precursor solution. Specifically, devices fabricated from a precursor solution stored in ambient air for 21 days exhibited equivalent efficiency to those made from a fresh solution. This significantly improves the reliability and lifetime of precursor solutions in a manufacturing setting. Furthermore, the technology contributes to the operational stability of the device itself, demonstrating retention of 90% of its initial efficiency after 600 hours of continuous light exposure under maximum power point tracking. This substantial improvement in long-term reliability strengthens the potential for practical solar cell applications. The protection strategy plays a critical role in enhancing perovskite film stability and maintaining device performance over time.

## Strategic Significance and Outlook

The phosphite-assisted chemical protection technology developed here is expected to simplify the manufacturing process of perovskite solar cells and directly lead to improvements in cost-efficiency and yield for large-scale production. Extending the shelf-life of precursor solutions increases supply chain flexibility and reduces manufacturing overheads. Moreover, the enhanced long-term stability of the devices themselves will improve reliability in real-world outdoor installations, accelerating commercial adoption. This technology is poised to be a crucial step in driving the market entry and widespread deployment of perovskite solar cells, offering a significant advantage over conventional solar technologies in terms of processability and performance durability.

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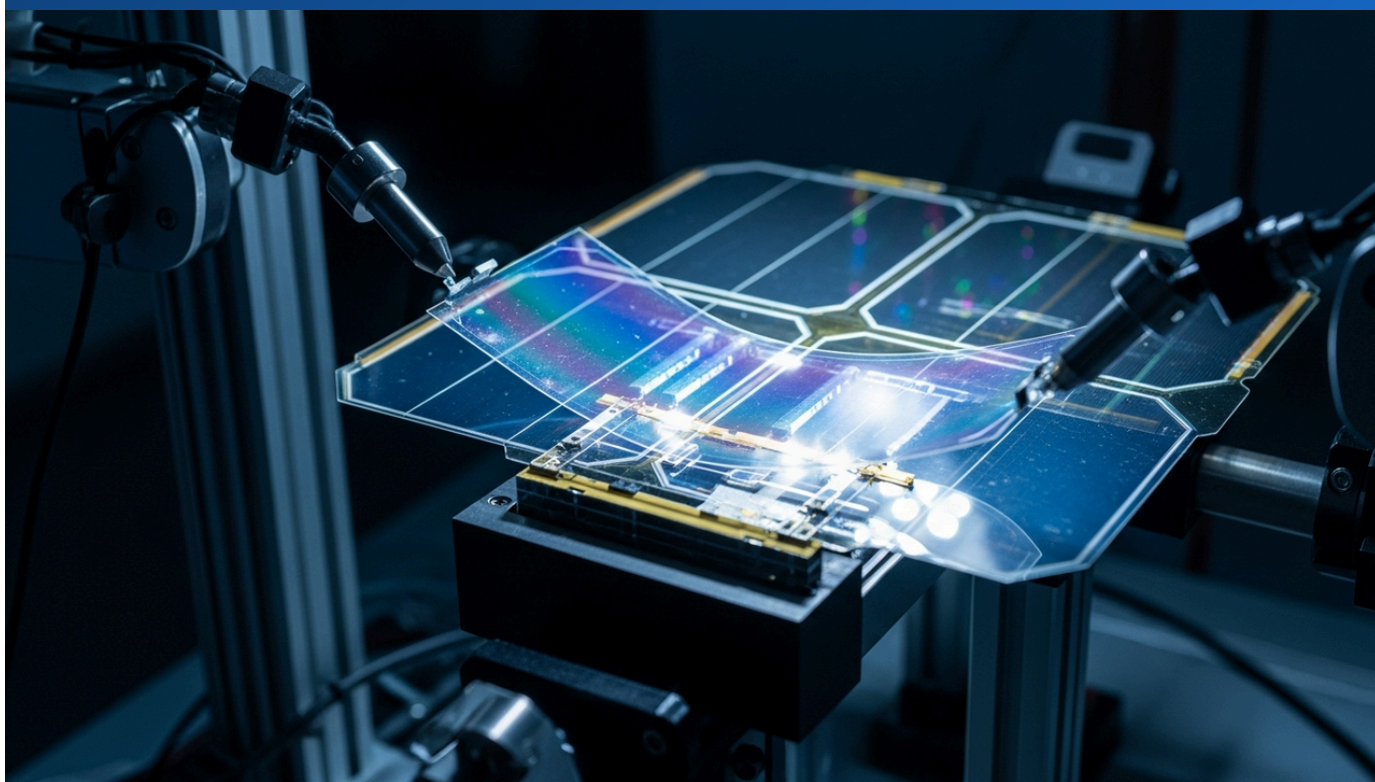
Source: <https://pubs.acs.org/doi/10.1021/acsami.6c07524>

Collected: July 10, 2026 | Automated Research System (Gemini API)



## #02 埋め込み界面工学によりフレキシブル半透明ペロブスカイト太陽電池が21.4%効率・61.3%近赤外透過率を達成、タンデムでは27.7%記録を樹立

Published July 08, 2026 ACS Energy Letters USA



### OVERVIEW

Researchers have achieved a new world record for flexible semitransparent perovskite solar cells (FS-PSCs), reaching 21.4% efficiency with 61.3% near-infrared transparency, thanks to advanced buried-interface engineering. These devices exhibit remarkable stability and mechanical durability, and when integrated into a four-terminal tandem configuration with a flexible silicon cell, they achieved an unprecedented 27.7% power conversion efficiency. This milestone promises to accelerate the deployment of highly efficient, flexible, and transparent solar technologies.

### Background

Flexible and transparent solar cells promise to transform applications currently beyond the reach of conventional rigid, opaque photovoltaics, such as building-integrated photovoltaics (BIPV), smart windows, wearable electronics, and IoT sensors. However, their widespread adoption has been hindered by the inherent difficulty in simultaneously achieving high efficiency, excellent operational stability, and superior mechanical durability. Developing high-performance devices on flexible substrates that can withstand long-term use has remained a significant hurdle. This new research presents a tangible solution to these challenges, leveraging advanced interface engineering and innovative tandem architectures, marking a substantial stride towards the practical realization of this versatile technology.

### Key Breakthroughs

This study unveils a significant leap forward in flexible semitransparent perovskite solar cells (FS-PSCs), reaching a champion power conversion efficiency of 21.4% while maintaining an impressive 61.3% near-infrared transparency. This remarkable performance was achieved through meticulous optimization of the buried interface within the cell structure. Even more significantly, when these FS-PSCs were integrated into a four-terminal tandem configuration with a flexible crystalline silicon bottom cell, the combined system achieved an unprecedented 27.7% power conversion efficiency, setting a new world record. This dual breakthrough dramatically elevates the performance benchmarks for next-generation solar cell technologies that combine the critical attributes of flexibility and transparency.



## Technical Deep Dive

The core of this advancement lies in the precise engineering of the buried interface between the perovskite active layer and the adjacent charge transport layers. This meticulous control effectively minimizes non-radiative carrier recombination losses and maximizes the efficiency of charge extraction, leading to higher open-circuit voltages and fill factors. Beyond peak efficiency, the flexible semitransparent perovskite cells showcased exceptional operational stability, sustaining high performance for over 500 hours under continuous maximum power point tracking (MPPT) conditions. Mechanical robustness was also a key focus: the devices demonstrated remarkable resilience, retaining 94.5% of their initial efficiency even after 2000 cycles of bending, highlighting their suitability for highly dynamic and bendable electronic applications. The record-setting 27.7% power conversion efficiency was achieved using a four-terminal (4T) tandem architecture. This configuration is particularly advantageous as it allows for independent optimization of the top perovskite cell and the bottom crystalline silicon cell. The perovskite layer efficiently harvests shorter-wavelength light, while the silicon layer effectively converts the longer-wavelength light transmitted through the perovskite, thereby capturing a much broader portion of the solar spectrum than either material could achieve alone in a single-junction design.

## Outlook and Impact

This world-record achievement marks a crucial step toward the accelerated commercialization of flexible, semitransparent perovskite/silicon tandem solar cells. The development of transparent, high-efficiency solar cells unlocks unprecedented architectural design freedom, envisioning a future where urban landscapes are redefined by power-generating windows and building facades. Moreover, these flexible and transparent devices are poised to enable novel applications in wearable technology, portable electronics, and self-powered IoT sensors. The research team plans to continue pushing the boundaries of efficiency, actively working on scaling up the active area of these cells, and driving down manufacturing costs to make this technology economically viable. Ultimately, this innovative technology holds the promise of a future where solar energy harvesting is seamlessly and aesthetically integrated into the fabric of daily life, providing ubiquitous, distributed, and sustainable power solutions globally.

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Source: [https://vertexaisearch.cloud.google.com/grounding-api-redirect/AUZIYQGeQ7SuHF28ihFUaKnfaXKYL6lnTx2e\\_fu21yoqC2DGPLLxw-BxHPNEQTUJKHif5UjXrDY7IdyBX3fFm4HbeqLsaRwQS752IF3MNj8OwYVfx-VdpnLecuFL8VBsTq-PFaEShrkBhhZl2zRmCztN6V7X](https://vertexaisearch.cloud.google.com/grounding-api-redirect/AUZIYQGeQ7SuHF28ihFUaKnfaXKYL6lnTx2e_fu21yoqC2DGPLLxw-BxHPNEQTUJKHif5UjXrDY7IdyBX3fFm4HbeqLsaRwQS752IF3MNj8OwYVfx-VdpnLecuFL8VBsTq-PFaEShrkBhhZl2zRmCztN6V7X)

Collected: July 10, 2026 | Automated Research System (Gemini API)

## #03 JinkoSolar、ペロブスカイト-シリコンタンデム太陽電池で世界最高の34.82%変換効率を達成、SIMIT認証取得

Published July 02, 2026 Winssolutions China



### OVERVIEW

Chinese solar giant JinkoSolar has set a new world record for perovskite-silicon tandem solar cell efficiency, achieving 34.82%. This SIMIT-certified breakthrough surpasses their previous record and positions the technology as a core component for next-generation solar, promising significant strides in renewable energy production and cost reduction, and accelerating global energy transition.

### Background

Perovskite-silicon tandem solar cells are considered a prime candidate for next-generation photovoltaic technology, as their theoretical efficiency limit significantly exceeds that of standalone silicon (approx. 29%) or perovskite (approx. 27-28%) cells. A key advantage of this technology is its compatibility with existing silicon solar cell manufacturing infrastructure, which could facilitate a relatively smooth transition to commercialization. Proactive record-breaking by leading manufacturers like JinkoSolar accelerates the entire industry's technological development and moves perovskite technology closer to practical application. High efficiency is paramount for maximizing electricity generation per unit area and shortening the payback period for solar power systems.

### Key Findings

JinkoSolar, a leading Chinese solar manufacturer, has achieved a new world record power conversion efficiency of 34.82% for its perovskite-silicon tandem solar cell, surpassing its previous benchmark. This remarkable achievement has been rigorously certified by the Shanghai Institute of Microsatellite Engineering Technology (SIMIT) of the Chinese Academy of Sciences, solidifying the company's technological leadership.

### Technical Details

The 34.82% efficiency was realized through a tandem structure, where the perovskite top cell efficiently absorbs short-wavelength light, and the underlying silicon bottom cell converts the transmitted longer-wavelength photons. This architectural design enables a broader and more efficient utilization of the solar spectrum compared to single-junction cells. JinkoSolar successfully optimized charge transport and minimized recombination losses between the perovskite and silicon layers by employing proprietary interface treatment techniques and advanced material designs. SIMIT's independent certification validates the credibility of this efficiency record. This continuous improvement, following their previous record of 34.76%, underscores JinkoSolar's commitment to relentless innovation in this field.

## Strategic Significance and Outlook

JinkoSolar positions this 34.82% record as a crucial milestone for the commercialization of its next-generation solar cell products. The company aims to mass-produce and bring this technology to market within the next few years. If these high-efficiency modules become commercially available at scale, they are expected to further reduce the Levelized Cost of Energy (LCOE) for solar power, making a substantial contribution to renewable energy adoption. Their value will be immense, particularly for utility-scale solar farms with limited land and for rooftop solar systems seeking maximum power generation in restricted spaces. This technology is set to become a powerful driver in accelerating the global energy transition.

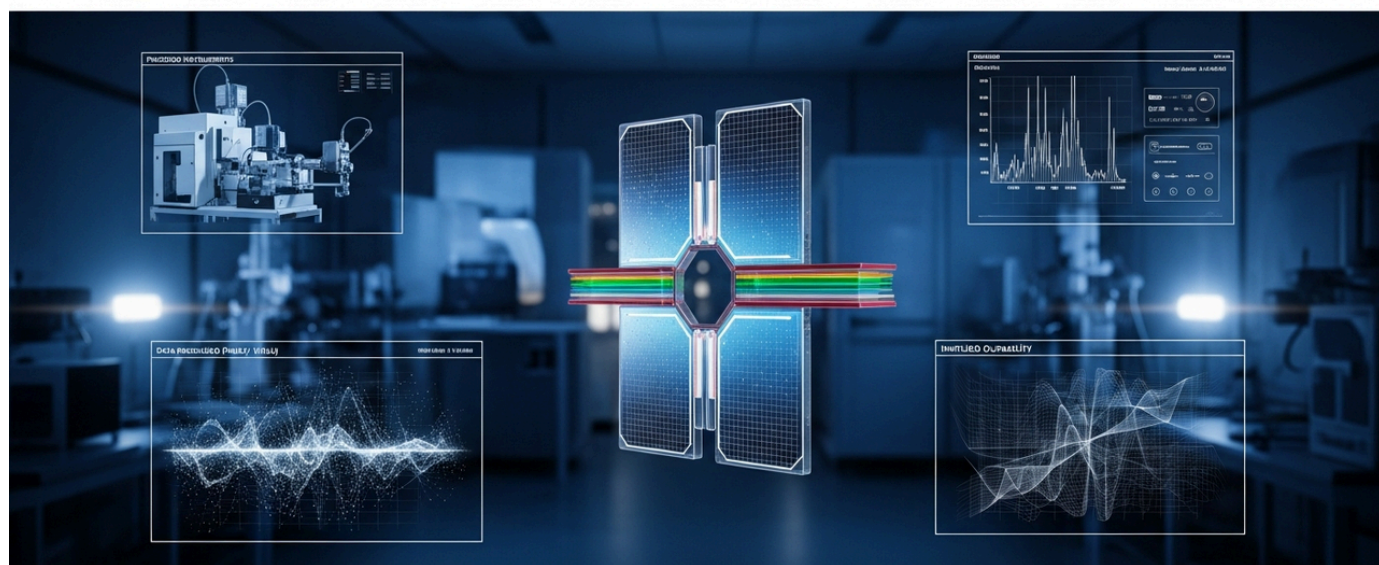
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Source: <https://www.winssolutions.org/34-82-perovskite-tandem-solar-cell/>

Collected: July 10, 2026 | Automated Research System (Gemini API)

## #04 自己組織化ホール接点採用のトリプルジャンクション全ペロブスカイト太陽電池、認証効率29.1%と500時間動作安定性を達成

Published July 09, 2026    Joule    USA



### OVERVIEW

Researchers have developed a triple-junction all-perovskite solar cell integrating self-assembling hole contacts in all subcells, achieving a certified power conversion efficiency of 29.1%. This innovative design effectively mitigates voltage losses and non-radiative recombination, particularly in wide-bandgap subcells, while demonstrating remarkable stability by retaining 90% of its initial efficiency after 500 hours of continuous operation at the maximum power point. This breakthrough marks a critical step towards the commercialization of high-efficiency, next-generation perovskite photovoltaics.



### Background

All-perovskite tandem solar cells are gaining attention as a next-generation high-efficiency solar cell technology, potentially offering simplified manufacturing processes and lower material costs compared to traditional silicon-based tandems. However, controlling interfacial defects, especially in multi-layer structures, and ensuring long-term stability have been significant barriers to commercialization.

### Key Findings

This research reports the successful development of triple-junction all-perovskite solar cells incorporating self-assembling hole contacts in all subcells, achieving an exceptionally high certified power conversion efficiency of 29.1%. This innovative architecture represents a groundbreaking breakthrough that simultaneously enhances both the performance and stability of perovskite solar cells. The certified efficiency of 29.1% significantly surpasses the efficiency of laboratory-scale single-junction perovskite cells and approaches the theoretical limits of solar energy conversion.

### Technical Details

The developed triple-junction all-perovskite solar cell system is designed to stack three different perovskite subcells, enabling more efficient and broader absorption of the solar spectrum. Central to this system is the integration of self-assembling hole contacts within each subcell. This critical feature effectively suppresses voltage losses, particularly in wide-bandgap perovskite subcells, and significantly reduces non-radiative recombination. The research team achieved improved crystal orientation in the wide-bandgap perovskite films, maximizing charge carrier mobility and collection efficiency. The self-assembling hole contacts and improved crystal orientation employed in this study offer effective solutions to these challenges. Beyond its high efficiency, this optimized device demonstrated outstanding operational stability, maintaining 90% of its initial efficiency after 500 hours of continuous operation at the maximum power point (MPP). This largely overcomes the traditional durability challenges associated with perovskite solar cells.



## Strategic Significance and Outlook

The achievement with this triple-junction all-perovskite solar cell marks a crucial step in the commercialization of perovskite photovoltaics. The dual accomplishment of high efficiency and high stability will accelerate practical applications across a wide range of uses, from utility-scale solar farms and building-integrated photovoltaics (BIPV) to even specialized applications like space power generation. Moving forward, the research team is expected to focus on further improving efficiency, scaling up cell areas, reducing manufacturing costs, and conducting long-term field tests in outdoor environments. If this technology is successfully brought to market, it holds immense potential to significantly contribute to the widespread adoption of renewable energy and the realization of a sustainable society.

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Source: [https://www.researchgate.net/publication/408650281\\_Triple-junction\\_all-perovskite\\_solar\\_cells\\_with\\_self-assembling\\_hole\\_contacts\\_in\\_all\\_subcells](https://www.researchgate.net/publication/408650281_Triple-junction_all-perovskite_solar_cells_with_self-assembling_hole_contacts_in_all_subcells)

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #05 ベルリン研究チームがCIGS-ペロブスカイトタンデム太陽電池で世界記録25.5%効率を達成、Fraunhofer ISEが認証

Published July 06, 2026 Technology Park Berlin Adlershof Germany



## OVERVIEW

Researchers from Humboldt University and Helmholtz-Zentrum Berlin (HZB) have set a new world record for CIGS-perovskite tandem solar cell efficiency, achieving 25.5%. Certified by Fraunhofer ISE, this breakthrough, part of the EU SOLMATES project, was made possible by optimized interface engineering, significantly reducing efficiency losses. This achievement signals a major leap for next-generation thin-film photovoltaics, pushing beyond current limits.

### Background

CIGS (copper-indium-gallium-selenium) thin-film solar cells have garnered significant interest for specific applications like building-integrated photovoltaics (BIPV) due to their high efficiency, flexibility, and aesthetic integration capabilities. Perovskite solar cells, conversely, are hailed as a 'game-changer' in the photovoltaic landscape, promising high efficiencies that could potentially surpass silicon, coupled with low-cost manufacturing potential. The development of CIGS-perovskite tandem technology seeks to synergize the strengths of both, paving the way for ultra-high power conversion efficiencies beyond the reach of single-junction cells. This new 25.5% record not only pushes the boundaries of thin-film technology but also begins to challenge the performance benchmarks set by conventional silicon solar cells, reinforcing Germany's leadership in renewable energy innovation.

### Key Findings

A collaborative research team from Humboldt University and Helmholtz-Zentrum Berlin (HZB) in Germany has officially set a new world record for power conversion efficiency in a CIGS-perovskite tandem solar cell, reaching an unprecedented 25.5%. This landmark achievement, which combines a CIGS thin-film solar cell with a perovskite solar cell, has been rigorously certified by the esteemed Fraunhofer Institute for Solar Energy Systems ISE and is now featured in the globally recognized 'Solar Cell Efficiency Tables'.

## Technical Details

This groundbreaking efficiency record stems from highly optimized interface engineering, critical for the seamless integration of the CIGS semiconductor layer with the perovskite layer. The research team meticulously designed CIGS cells incorporating aluminum-doped zinc oxide (AZO) layers of precise thicknesses. Additionally, they refined a sophisticated combination of nickel oxide (NiO<sub>x</sub>) and self-assembled monolayers (SAMs) at the interfaces. This meticulous optimization was crucial for minimizing efficiency losses, ensuring maximal charge carrier transport, and reducing recombination losses between the constituent layers. The tandem cell, measured on an active area of 1.081 cm<sup>2</sup>, delivered a certified efficiency of 25.5%, underscoring its practical performance. Conducted under the auspices of the EU-funded SOLMATES project, this research indicates a potential for future efficiencies to reach up to 27.5%, with current mini-modules already demonstrating approximately 19.7% efficiency.

## Strategic Significance and Outlook

The attainment of this world record represents a pivotal advancement towards the commercialization of CIGS-perovskite tandem solar cell technology. High-efficiency thin-film solar cells are exceptionally well-suited for urban environments, where maximizing power generation from constrained installation areas is paramount, and for specialized applications demanding lightweight and flexible solutions. The research team is now strategically focused on the scalable manufacturing of this technology, tackling challenges associated with mass production, and rigorously improving its long-term reliability and cost-effectiveness. Looking ahead, this tandem technology is poised to play a crucial role in the evolving photovoltaic market, significantly contributing to global climate change mitigation through its enhanced energy conversion efficiency and by broadening the scope of solar power applications.

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Source: <https://www.adlershof.de/en/news/new-world-record-set-for-the-efficiency-of-a-tandem-solar-cell>

## #06 熱共蒸着ワイドバンドギャップペロブスカイト太陽電池が $\text{BaI}_2$ 蒸気処理で18.15%効率記録を達成、タンデム応用へ道開く

Published July 02, 2026 ACS Energy Letters USA



### OVERVIEW

Thermally co-evaporated wide-bandgap perovskite solar cells have achieved a new record of 18.15% power conversion efficiency through an innovative, non-destructive  $\text{BaI}_2$  vapor surface passivation. This breakthrough effectively suppresses non-radiative recombination caused by surface defects in cells with bandgaps exceeding 1.7 eV. This achievement, combined with the industrial scalability of thermal co-evaporation, significantly advances the realization and commercialization of high-efficiency perovskite-silicon tandem solar cell technology.



### Record-Setting Efficiency Achieved

This research announces a record 18.15% power conversion efficiency for wide-bandgap perovskite solar cells fabricated via thermal co-evaporation. This significant advance was made possible by an innovative surface treatment utilizing  $\text{BaI}_2$  vapor, offering substantial advantages in both efficiency and industrial compatibility, particularly for next-generation perovskite-silicon tandem photovoltaic applications.

### Technical Innovation: $\text{BaI}_2$ Vapor Passivation and Manufacturing Scalability

Thermal co-evaporation is a highly desirable manufacturing technique due to its capacity for conformal deposition on textured silicon substrates and its excellent suitability for large-scale production. Historically, however, non-radiative recombination stemming from surface defects has been a major impediment to efficiency in wide-bandgap perovskites. The research team overcame this challenge by developing a non-destructive surface treatment using barium iodide ( $\text{BaI}_2$ ) vapor to effectively passivate (deactivate) these surface defects within the perovskite film. This novel passivation layer significantly suppresses charge carrier losses, thereby enhancing overall photovoltaic performance. This led directly to the record 18.15% efficiency for perovskite solar cells with a bandgap exceeding 1.7 eV, a notable improvement over prior benchmarks. This innovation establishes a critical foundation for deploying highly efficient perovskite layers as the top cell in advanced tandem architectures.

### The Promise and Challenges of Tandem Photovoltaics

Perovskite-silicon tandem solar cells are widely regarded as a pivotal next-generation technology, poised to extend the theoretical efficiency limits of photovoltaics beyond what single-junction cells can achieve. In this architecture, a perovskite top cell is designed to absorb short-wavelength light inefficiently captured by silicon, thus necessitating a high-bandgap perovskite. Traditionally, however, wide-bandgap perovskites have struggled with issues of lower stability and suboptimal efficiencies, while manufacturing scalability has presented an additional hurdle. This new approach, integrating thermal co-evaporation with  $\text{BaI}_2$  vapor treatment, represents a groundbreaking solution that concurrently addresses these critical challenges by both boosting wide-bandgap perovskite efficiency and enabling their industrial-scale fabrication.

## Strategic Outlook and Path to Commercialization

The achievement of 18.15% efficiency decisively demonstrates the high potential of thermally co-evaporated wide-bandgap perovskites as top cells for tandem solar applications. Continued refinement of this technology holds the promise of dramatically improving the overall efficiency of perovskite-silicon tandem solar cells, potentially transcending the inherent efficiency ceilings of conventional silicon photovoltaics. Given the inherent industrial compatibility of the manufacturing process, a relatively rapid path to commercialization is anticipated. Looking ahead, the research team plans to pursue further optimization of the  $\text{BaI}_2$  vapor treatment, conduct comprehensive long-term stability evaluations of these devices, and focus on seamless integration into tandem structures, ultimately contributing to the widespread deployment of highly efficient and cost-effective solar power solutions globally.

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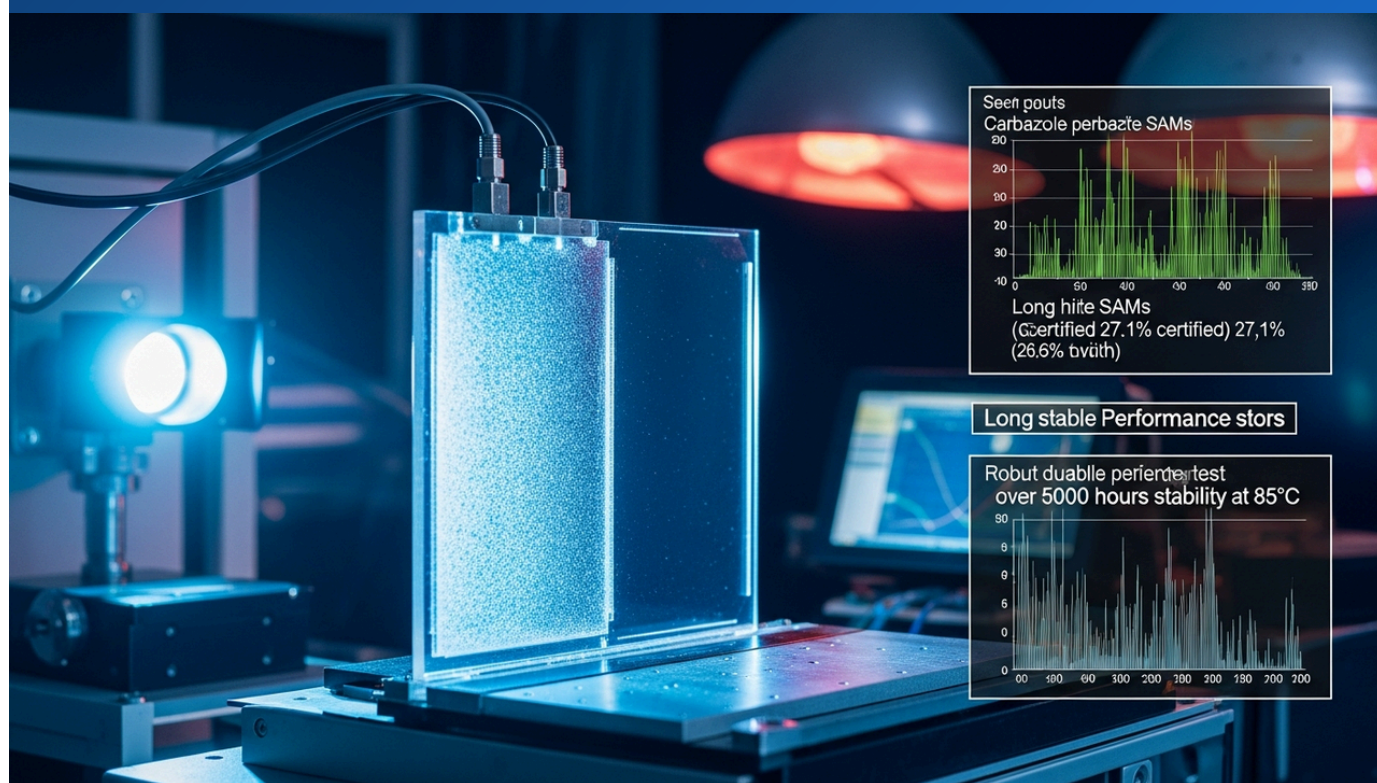
Source: <https://pubs.acs.org/doi/10.1021/acsenergylett.6c01161>

Collected: July 10, 2026 | Automated Research System (Gemini API)



# #07 カルバゾールSAMsが逆型ペロブスカイト太陽電池の効率を27.1%（認証26.6%）に押し上げ、85°Cで5000時間超の安定性を実現

Published July 08, 2026 ACS Energy Letters USA



## OVERVIEW

Carbazole-based self-assembled monolayers (SAMs) have dramatically boosted inverted perovskite solar cell (PSC) performance, achieving a power conversion efficiency of 27.1% (26.6% certified) and unprecedented long-term stability. Optimized devices maintained over 90% of their initial efficiency for approximately 5000 hours under continuous 1-sun illumination at 85°C in ambient air. This breakthrough, by resolving a key stability challenge and elucidating SAMs' dual role in efficiency, significantly accelerates the commercialization potential of perovskite technology.

### **Background: The Perovskite Promise and Persistent Challenge**

Perovskite solar cells (PSCs) have emerged as a frontrunner in next-generation photovoltaic technology, celebrated for their exceptional power conversion performance. However, their widespread commercialization has been primarily hampered by a critical lack of long-term stability. Degradation under high temperature and humidity, in particular, has presented an urgent challenge that must be overcome for practical, real-world applications. Self-assembled monolayers (SAMs) have been explored as a promising strategy to passivate perovskite interfaces and optimize charge transport, yet their precise mechanisms and full impact on long-term device stability have remained areas requiring further elucidation.

### **Key Findings: A Dual Leap in Efficiency and Durability**

This research marks an astonishing achievement in inverted perovskite solar cells, reporting a power conversion efficiency of 27.1% (26.6% certified) through the innovative introduction of carbazole-based self-assembled monolayers (SAMs). Beyond this remarkable efficiency, these optimized devices demonstrated unprecedented long-term stability. They maintained over 90% of their initial efficiency after approximately 5000 hours of continuous 1-sun illumination in ambient air at a demanding 85°C. This dual breakthrough directly addresses the core limitations hindering perovskite commercialization.

## Technical Elucidation: The Dual Role of Carbazole SAMs

The groundbreaking performance stems from a detailed understanding of the dual role played by carbazole SAMs at the PSC interface: the formation of crucial interfacial dipoles and the facilitation of efficient charge tunneling. The interfacial dipoles are instrumental in optimizing the energy band alignment, which significantly enhances the efficiency of charge carrier separation. Simultaneously, the charge tunneling mechanism reduces resistance between the charge transport layer and the perovskite layer, thereby enabling highly efficient charge extraction. These synergistic mechanisms collectively lead to substantial improvements in the device's open-circuit voltage (Voc) and fill factor (FF), culminating in the dramatic increase in overall power conversion efficiency. The rigorously tested long-term stability of 5000 hours under harsh conditions (85°C, continuous illumination) serves as robust validation of the technology's reliability, a prerequisite for commercial viability.

## Strategic Significance and Future Outlook

The high efficiency and exceptional long-term stability achieved in this study represent a crucial milestone, poised to significantly accelerate the practical deployment of perovskite solar cells. Specifically, the enhanced durability under challenging conditions directly translates to improved reliability in actual outdoor installation environments, paving the way for widespread commercial adoption. Looking ahead, this carbazole-based SAMs technology is expected to simplify manufacturing processes, enable the scaling up of active areas, and contribute to further cost reductions. If broadly applied, perovskite solar cells could play a vital role in the global energy supply—either complementing or partially replacing conventional silicon solar cells—thereby contributing profoundly to the proliferation of clean energy and the realization of a sustainable society.

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Source: [https://www.researchgate.net/publication/408569419\\_Dual\\_Role\\_of\\_Self-Assembled\\_Monolayers\\_Interfacial\\_Dipoles\\_and\\_Charge\\_Tunneling\\_in\\_High-Efficiency\\_Inverted\\_Perovskite\\_Solar\\_Cells](https://www.researchgate.net/publication/408569419_Dual_Role_of_Self-Assembled_Monolayers_Interfacial_Dipoles_and_Charge_Tunneling_in_High-Efficiency_Inverted_Perovskite_Solar_Cells)



## #08 イオン交換とパッシベーションの相乗効果で逆型ペロブスカイト太陽電池が19.38%効率を達成、界面欠陥を大幅削減

Published July 02, 2026 ACS Applied Materials & Interfaces USA

Ion exchange and passivation synergistically improve efficiency to 19.38% by significantly reducing interface defects



### OVERVIEW

A new synergistic buried interface engineering approach, combining ion exchange and passivation, has propelled inverted perovskite solar cells to a record power conversion efficiency of 19.38% with an impressive 81.70% fill factor. This innovative strategy leverages sodium acetate treatment on the PEDOT:PSS interface to significantly reduce non-radiative recombination and enhance charge extraction. By addressing critical interfacial defects and energy losses, this breakthrough offers a practical and scalable solution for developing highly efficient and stable perovskite photovoltaics.

### The Promise and Pitfalls of Perovskite Solar Cells

Inverted perovskite solar cells (PSCs) are rapidly emerging as a frontrunner for commercialization due to their streamlined architecture and compatibility with cost-effective, solution-based manufacturing techniques like spin-coating and printing. However, widespread adoption has been hampered by persistent challenges, primarily defects and energy losses at the interfaces between the perovskite layer and the charge transport layers. The quality of these interfaces, particularly the buried interface between the hole transport layer (HTL) and the perovskite, critically determines a device's overall efficiency and long-term reliability.

### Dual-Function Interface Engineering Unleashes Performance

This study presents a significant advancement in inverted PSC technology through synergistic buried interface engineering, integrating both ion exchange and passivation mechanisms. The core innovation lies in the optimized treatment of the widely used poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) buried interface with sodium acetate. While PEDOT:PSS is a well-established hole transport material, its interfacial properties profoundly impact device performance.

Experimental evidence confirms that the sodium acetate treatment imparts a dual functionality: it induces beneficial ion exchange reactions at the interface while simultaneously passivating detrimental interfacial defects between the perovskite and PEDOT:PSS layers. This dual-function modulation synergistically reduces non-radiative recombination of charge carriers and concurrently enhances charge extraction efficiency. The combined effect of reduced defect density and suppressed energy loss leads to improvements in both the open-circuit voltage ( $V_{oc}$ ) and short-circuit current density ( $J_{sc}$ ), directly contributing to the enhanced power conversion efficiency.

## Record Efficiency and Enhanced Stability Achieved

The implementation of this dual-function modulation approach dramatically improved the device's performance metrics. Power conversion efficiency (PCE) witnessed a substantial increase from 17.91% to an impressive 19.38%. Furthermore, the fill factor (FF), a critical indicator of efficient charge extraction, reached a remarkable 81.70%. These figures represent a notable leap in perovskite solar cell performance, demonstrating the efficacy of the developed interface engineering strategy.

## Implications for Commercialization and Scalability

The synergistic buried interface engineering developed in this research offers a practical and effective strategy for simultaneously boosting the efficiency and stability of perovskite solar cells. Crucially, this technology is well-suited for industrial-scale applications, including the fabrication of large-area devices and high-throughput processes such as roll-to-roll manufacturing. The significant reduction in defect density and the improved fill factor contribute directly to enhanced long-term reliability, making these devices considerably more attractive for commercial deployment. Looking ahead, the research team aims to further optimize this approach and explore its applicability across various perovskite compositions and charge transport materials, paving the way for the widespread adoption of next-generation perovskite solar cell technologies.

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Source: <https://pubs.acs.org/doi/10.1021/acsami.6c08440>

# #09 ペロブスカイト太陽電池、逆型アーキテクチャでシングルセル26%超・タンデム34.85%効率を達成：最新技術レビュー

Published July 08, 2026 Modern Physics Letters B Singapore



## OVERVIEW

A recent review highlights remarkable progress in perovskite solar cell (PSC) material design, interface engineering, and stability. It emphasizes that inverted (p-i-n) architectures, paired with self-assembled monolayers (SAMs), have achieved record power conversion efficiencies: over 26% for single-junction cells and an impressive 34.85% for perovskite/silicon tandems. The review points to active thermal/stress management, entropy engineering, and AI-driven design as future directions to accelerate stable, high-efficiency PSC commercialization.



### Background

Perovskite solar cells (PSCs) are rapidly approaching the theoretical efficiency limits of traditional silicon photovoltaics, positioning them as a highly promising, low-cost manufacturing candidate for the future of solar energy. However, the primary hurdle to their widespread commercialization has been achieving long-term stability without compromising high efficiency. Critical strategies to address these challenges involve significant advancements in inverted (p-i-n) architectures and sophisticated interface engineering, with self-assembled monolayers (SAMs) emerging as a key factor driving continuous efficiency records in recent years. This holistic approach, as outlined in a recent review article published in 'Modern Physics Letters B', not only details these groundbreaking technologies but also contextualizes their synergistic impact on reshaping the industry's trajectory, comprehensively reporting on remarkable advancements in material design, interface engineering, and stability enhancement.

### Key Findings

The review provides a detailed analysis of the key technological factors driving the evolution of perovskite solar cells. It particularly highlights that inverted (p-i-n) architectures, combined with self-assembled monolayers (SAMs), have achieved record power conversion efficiencies of over 26% for single-junction PSCs. This inverted configuration, with its structural advantages and optimized charge transport properties, is beginning to outperform conventional n-i-p type structures. The integration of SAMs has played a crucial role in interface passivation, optimizing energy band alignment, and enhancing charge extraction efficiency, directly contributing to these record single-junction efficiencies.

Furthermore, for perovskite/silicon tandem devices, an impressive 34.85% power conversion efficiency has been reported, establishing a new world record. This achievement is further underscored by JinkoSolar's recent milestone of 34.82% in a similar tandem configuration. The review also touches upon the scalability of manufacturing processes, particularly advancements in solution-based processing techniques, outlining a promising roadmap for commercialization.

Looking ahead, the paper identifies several key areas for future research and development to sustain this momentum. These include active thermal and stress management of devices, optimization of material design through entropy engineering, and data-driven design utilizing AI and high-throughput screening. These cutting-edge approaches are expected to facilitate a paradigm shift towards the intelligent and accelerated development of PSCs that seamlessly balance both long-term stability and high efficiency. The ongoing advancement of this technology strongly suggests a future where perovskite solar cells become an indispensable component in the renewable energy market, significantly contributing to the global energy mix and addressing critical climate change challenges.

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Source: <https://www.worldscientific.com/doi/10.1142/S0217984926300061>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #10 鉛フリー錫ペロブスカイト太陽電池が $\text{SrF}_2$ 添加で効率12.6%に向上、 $\text{Sn}^{2+}$ 酸化抑制と安定性強化を実現

Published July 07, 2026 The Royal Society of Chemistry UK



## OVERVIEW

Researchers have significantly advanced lead-free tin (Sn) perovskite solar cells, achieving a power conversion efficiency of 12.6%—up from 9.7%—through the strategic introduction of  $\text{SrF}_2$  as a binary metal fluoride additive. This innovative approach effectively mitigates critical issues like  $\text{Sn}^{2+}$  oxidation, high defect density, and self-p-doping, while also substantially enhancing operational stability. The breakthrough marks a crucial step toward realizing high-performance, environmentally friendly perovskite photovoltaics for widespread adoption.

### Background

Driven by urgent environmental concerns, the development of lead-free solar cell materials is paramount. Tin (Sn)-based perovskites present a promising alternative to their toxic lead counterparts, yet their commercialization has been hampered by persistent performance and stability issues. Prior efforts largely focused on organic additives or process optimization, often yielding limited success. This study introduces a fundamental inorganic solution, leveraging binary metal fluorides—specifically  $\text{SrF}_2$ —to overcome these challenges, marking a significant advancement toward the practical implementation of lead-free perovskite solar cells.

## Key Findings

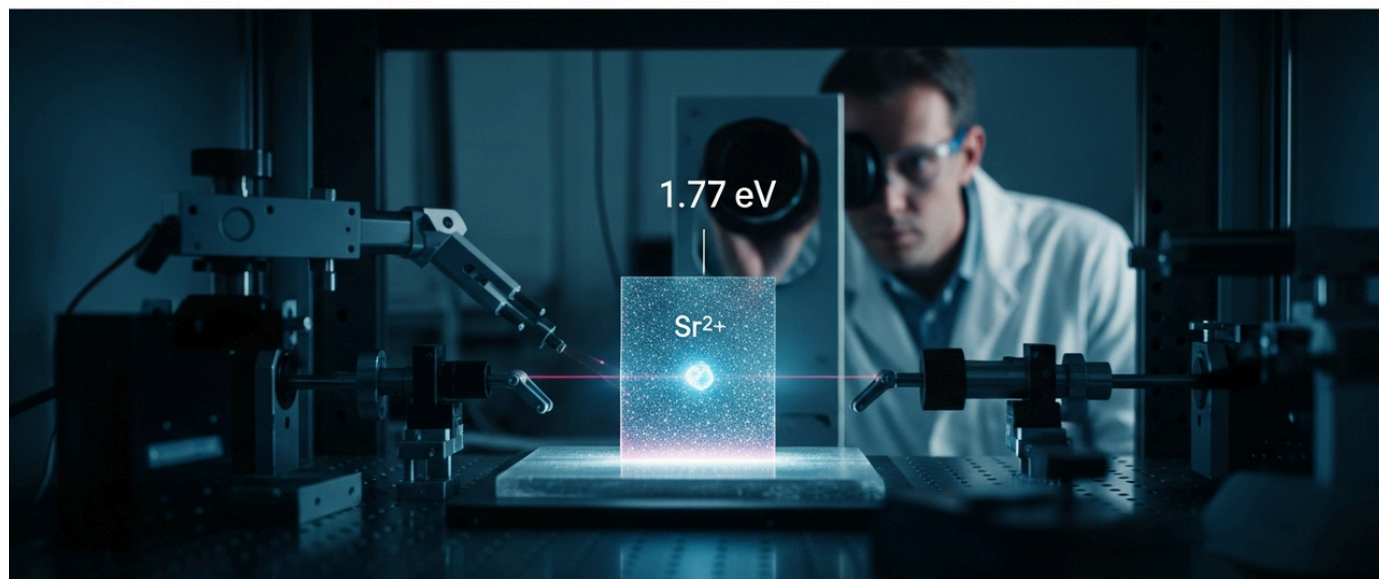
This study reports a significant breakthrough in lead-free tin (Sn)-based perovskite solar cells, elevating their power conversion efficiency from 9.7% to a record 12.6%. This dramatic improvement was achieved through the incorporation of binary metal fluoride additives, with strontium fluoride ( $\text{SrF}_2$ ) proving most effective. Sn-based perovskites are highly susceptible to the facile oxidation of  $\text{Sn}^{2+}$  to  $\text{Sn}^{4+}$ , high defect densities, and severe self-p-doping in ambient conditions, severely limiting their performance. The research team systematically investigated various fluoride-based additives (including  $\text{BaF}_2$ ,  $\text{SrF}_2$ , and  $\text{YbF}_3$ ) on  $\text{FASnI}_3$  perovskites. They found that  $\text{SrF}_2$  precisely controls the crystallization and morphology of the perovskite film, leading to a remarkable reduction in defect density. By meticulously regulating the crystallization process, defect chemistry, and electronic structure of  $\text{FASnI}_3$  perovskites,  $\text{SrF}_2$  effectively suppressed non-radiative recombination and significantly extended charge carrier lifetimes. This mechanistic control not only boosted efficiency but also substantially enhanced the device's operational stability, directly addressing major commercialization hurdles. Achieving 12.6% efficiency alongside enhanced stability with an inorganic  $\text{SrF}_2$  additive represents a crucial milestone for the commercialization of lead-free perovskite solar cells. This technology is poised to accelerate the development of high-performance, environmentally benign photovoltaic devices. Future work will focus on deeper mechanistic understanding of  $\text{SrF}_2$ 's role, further enhancing efficiency and long-term stability, scaling up for large-area fabrication, and reducing manufacturing costs. This innovation holds immense potential to significantly contribute to sustainable energy solutions and catalyze new advancements in the renewable energy sector.

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Source: <https://pubs.rsc.org/ta/article/doi/10.1039/D6TA04025J/1274226/Unraveling-the-Effect-of-Binary-Metal-Fluoride-in?searchresult=1>

# #11 $\text{Sr}^{2+}$ イオン添加でワイドバンドギャップペロブスカイトがハライド分離耐性を獲得、1.77 eVで20.18%効率達成

Published July 07, 2026 ACS Energy Letters USA



## OVERVIEW

Researchers have established a novel design principle utilizing  $\text{Sr}^{2+}$  ion doping to suppress triple halide intermediate formation, dramatically enhancing halide segregation resistance in wide bandgap perovskite solar cells. This breakthrough yielded champion efficiencies of 20.18% at 1.77 eV and 19.02% at 1.84 eV, directly addressing a critical stability issue for mixed-halide perovskites. The innovation significantly advances the practical viability of wide bandgap perovskites for high-efficiency applications like tandem solar cells.



### Background and Context

Perovskite solar cells hold the potential to surpass the theoretical efficiency of silicon solar cells, with tandem structures potentially achieving efficiencies over 30%. However, tandem structures require two perovskite layers with different bandgaps, and the stability and halide segregation resistance of the wide bandgap perovskite have been one of the biggest barriers to commercialization. This study provides an effective solution to this fundamental materials science challenge, significantly advancing the practical application of tandem solar cells. Suppressing halide segregation is essential for improving long-term device reliability and enabling stable operation outdoors.

### Key Findings

This research has established a groundbreaking design principle that overcomes the major stability challenge of "halide segregation" in wide bandgap perovskite solar cells through the addition of  $\text{Sr}^{2+}$  ions. This achievement suppresses the formation of triple halide intermediates, leading to high-performance and stable solar cells achieving champion efficiencies of 20.18% at a 1.77 eV bandgap and 19.02% at a 1.84 eV bandgap.

### Technical Details

Halide segregation refers to the phenomenon in mixed-halide perovskites where halide ions become non-uniformly distributed under light illumination, leading to a change in the device's bandgap and a consequent decrease in efficiency. This has been a significant issue, especially when wide bandgap perovskites are used as top cells in tandem solar cells. The research team discovered that introducing  $\text{Sr}^{2+}$  ions into the perovskite crystal lattice can physically suppress the formation of triple halide intermediates. This mechanism enables the maintenance of a homogeneous halide composition by limiting the migration of halide ions as  $\text{Sr}^{2+}$  ions occupy specific sites within the crystal structure. This synergistic effect improved the device's open-circuit voltage ( $V_{oc}$ ) and fill factor (FF), resulting in both high efficiency and excellent stability. The 20.18% efficiency achieved for devices with a 1.77 eV bandgap is a level that has been difficult to attain for this type of wide bandgap perovskite.

## Strategic Significance and Outlook

The achievement of halide segregation resistance and high efficiency through  $\text{Sr}^{2+}$  ion addition dramatically expands the application scope of wide bandgap perovskites. Specifically, their use as top cells in perovskite/silicon tandem and all-perovskite tandem solar cells will accelerate. The research team is expected to further optimize this design principle, focus on large-area fabrication, simplify manufacturing processes, and conduct further long-term durability evaluations. If this technology is introduced to the market, it is anticipated to significantly contribute to reducing costs and popularizing high-efficiency solar cells, becoming a powerful driving force in accelerating the global transition to clean energy.

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Source: <https://pubs.acs.org/doi/10.1021/acsenergylett.6c01113>

Collected: July 10, 2026 | Automated Research System (Gemini API)

## #12 芳香族分子でペロブスカイト量子ドットの熟成を制御、6000時間後93%効率維持の安定太陽電池を実現

Published July 09, 2026 ACS Energy Letters USA



### OVERVIEW

Researchers have achieved highly stable and efficient perovskite quantum dot (PQD) solar cells by precisely controlling their ripening process with aromatic molecules, significantly reducing surface defects. This breakthrough led to devices maintaining 93% of their initial efficiency after 6,000 hours of storage and approximately 80% after 288 hours of continuous operation, marking a critical advance towards commercializing solution-processable PQDs for next-generation photovoltaics.

### Background

Perovskite quantum dot solar cells are highly anticipated as next-generation photovoltaics due to their tunable bandgap, high absorption coefficient, and potential for low-cost manufacturing via solution processing. Various applications, including transparent solar cells, flexible solar cells, and even photodetectors, are being explored. However, carrier recombination stemming from quantum dot surface defects and degradation due to environmental factors have been primary challenges hindering their practical use. This study addresses these challenges with an innovative approach of ripening control using aromatic molecules, clearly outlining a pathway for the commercialization of PQD technology.

### Key Findings

Researchers have successfully engineered highly efficient and remarkably stable perovskite quantum dot (PQD) solar cells by precisely controlling their ripening process using aromatic molecules. This innovative approach effectively mitigates surface defects, which have historically limited PQD device performance despite their excellent optoelectronic properties and solution processability. By introducing specific aromatic molecules during PQD synthesis, the team created passivation layers on the quantum dot surface. These layers deactivate defect sites and promote the formation of uniform, high-quality crystal structures, thereby suppressing non-radiative recombination and enhancing charge carrier lifetime and extraction efficiency.

The resultant PQD-based devices achieved exceptional performance metrics. Notably, those incorporating TEAA PDI quantum dots demonstrated unprecedented storage stability, retaining an astounding 93% of their initial power conversion efficiency (PCE) after 6,000 hours. Furthermore, the devices exhibited robust operational stability, maintaining approximately 80% efficiency after 288 hours of continuous operation—a significant leap forward in addressing the long-standing instability challenges of PQD technology.

This advance not only boosts the reliability of PQD technology but also paves a clear pathway towards its commercialization. The enhanced efficiency and stability will enable PQD solar cells to power applications previously challenging for photovoltaics, including wearable electronics, smart windows, and IoT devices. Future work will focus on optimizing the technology for large-area fabrication, cost reduction, and extensive validation under diverse environmental conditions, positioning this innovation to meet diverse clean energy needs and expand the frontiers of next-generation solar power.

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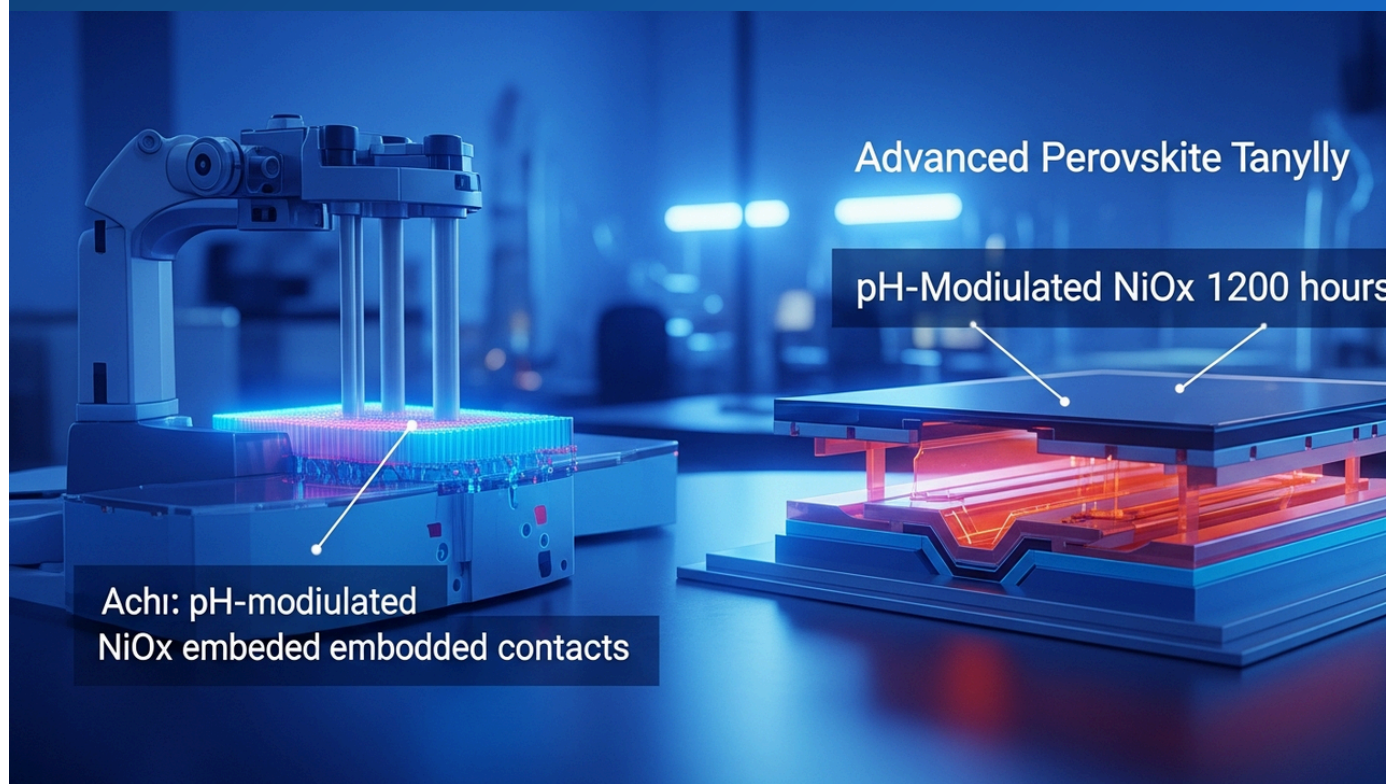
Source: <https://pubs.acs.org/doi/10.1021/acsenergylett.6c01202>

Collected: July 10, 2026 | Automated Research System (Gemini API)



# #13 pH変調NiO<sub>x</sub>埋め込み接点で全ペロブスカイトタンデム太陽電池が29.51%効率達成、1200時間安定性を実証

Published July 08, 2026 Energy & Environmental Science UK



## OVERVIEW

Researchers have achieved a record 29.51% power conversion efficiency in all-perovskite tandem solar cells through a novel homogenization method for buried contacts utilizing pH-modulated nickel oxide (NiO<sub>x</sub>). This innovative approach, leveraging KH<sub>2</sub>PO<sub>4</sub>-modified NiO<sub>x</sub> films to enhance self-assembled monolayer formation and suppress non-radiative recombination at interfaces, also delivered exceptional stability, maintaining over 80% of initial efficiency for 1200 hours under nitrogen. This significant breakthrough marks a crucial step toward the practical commercialization of high-performance all-perovskite tandem technology.



### Key Findings

This study reports the development of a homogenization method for buried contacts via pH-modulated nickel oxide ( $\text{NiO}_x$ ), which enabled high-performance all-perovskite tandem solar cells to achieve an astonishing power conversion efficiency of 29.51%. Concurrently, this technology demonstrated excellent stability, maintaining over 80% of its initial efficiency after 1200 hours in a nitrogen atmosphere.

### Technical Details

All-perovskite tandem solar cells aim for ultra-high efficiencies beyond the limits of single-junction cells by stacking multiple perovskite layers with different bandgaps to efficiently utilize the solar spectrum. In this architecture, the quality of the buried contacts between each layer is paramount for determining overall device performance and stability. The research team succeeded in homogenizing the buried contact interface by using  $\text{NiO}_x$  films modified with  $\text{KH}_2\text{PO}_4$  (potassium dihydrogen phosphate). This modified  $\text{NiO}_x$  film promotes high coverage and the formation of stable self-assembled monolayers (SAMs), which effectively suppress non-radiative recombination originating from interfacial defects. As a result, a wide-bandgap perovskite solar cell (1.77 eV bandgap) alone achieved a power conversion efficiency of 21.17%, and the resulting all-perovskite tandem solar cell recorded a high efficiency of 29.51%. This improved interface enhances charge carrier transport efficiency and contributes to the device's long-term stability.

### Background and Context

All-perovskite tandem solar cells offer advantages over silicon tandems, such as lower cost and suitability for solution-based manufacturing processes. However, challenges in controlling interfaces when stacking multiple perovskite layers, particularly recombination losses due to interfacial defects and long-term stability, have hindered their commercialization. The optimization of  $\text{NiO}_x$  through pH modulation provides a practical solution to these challenges, significantly accelerating the development of next-generation high-efficiency perovskite solar cells. An efficiency of 29.51% approaches world records at the laboratory level, serving as a crucial indicator of perovskite technology's maturity.

## Strategic Significance and Outlook

The achieved high efficiency of 29.51% and long-term stability of 1200 hours represent a major milestone towards the practical implementation of all-perovskite tandem solar cells. This technology will contribute to reducing the cost of solar power and maximizing power generation per unit area, promoting widespread adoption in applications ranging from large-scale solar farms and building-integrated photovoltaics (BIPV) to even space applications. Moving forward, the research team is expected to further optimize the pH-modulated NiO<sub>x</sub> technology, pursue large-area fabrication, and conduct long-term reliability assessments under more stringent conditions. If successfully introduced to the market, this technology holds immense potential to significantly contribute to the widespread adoption of clean energy and the realization of a sustainable society.

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Source: <https://pubs.rsc.org/ee/article/doi/10.1039/D6EE02093C/1274417/Homogenizing-buried-contact-via-pH-modulated-NiOx?searchresult=1>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #14 グローブニューズワイヤー：ペロブスカイト太陽電池モジュール市場、2035年までに50億ドルに達する見込み

Published July 07, 2026   GlobeNewswire   USA



## OVERVIEW

A recent GlobeNewswire market research report forecasts the global perovskite solar cell module market will reach \$5 billion by 2035. This significant growth is powered by rapid technological advancements, including Panasonic's 18.1% efficient large-area perovskite PV and Tandem PV's 30.4% efficient perovskite-silicon demonstration module. With Oxford PV also announcing a 20% power boost from its commercialized tandem technology, the report underscores perovskite's substantial commercial potential in renewable energy.

### Background

GlobeNewswire, a prominent global provider of press release distribution and market intelligence, has published a new research report forecasting significant growth in the perovskite solar cell module market. Focusing on the global market with a forecast period spanning 2026 to 2035, the report projects that this innovative photovoltaic sector will reach an impressive USD 5.0 billion valuation by 2035. This outlook underscores the escalating commercial viability and pivotal role perovskite technology is expected to play in the future of renewable energy.

### Key Findings

The robust market growth predicted for perovskite solar modules is primarily fueled by accelerated technological advancements and emerging commercialization trends. Key developments highlighted in the report include:

- Panasonic's significant achievement of 18.1% module efficiency on an 804 cm<sup>2</sup> glass-integrated perovskite photovoltaic device, demonstrating progress in large-area application.
- Tandem PV's impressive demonstration of a 30.4% efficient 100 cm<sup>2</sup> perovskite-silicon tandem module, showcasing high-efficiency potential.
- Oxford PV's assertion that its commercialized tandem technology offers a substantial performance boost, providing at least 20% more power compared to conventional solar modules.

These breakthroughs collectively point towards the rapidly maturing commercial potential of perovskite technology within the global photovoltaic landscape.

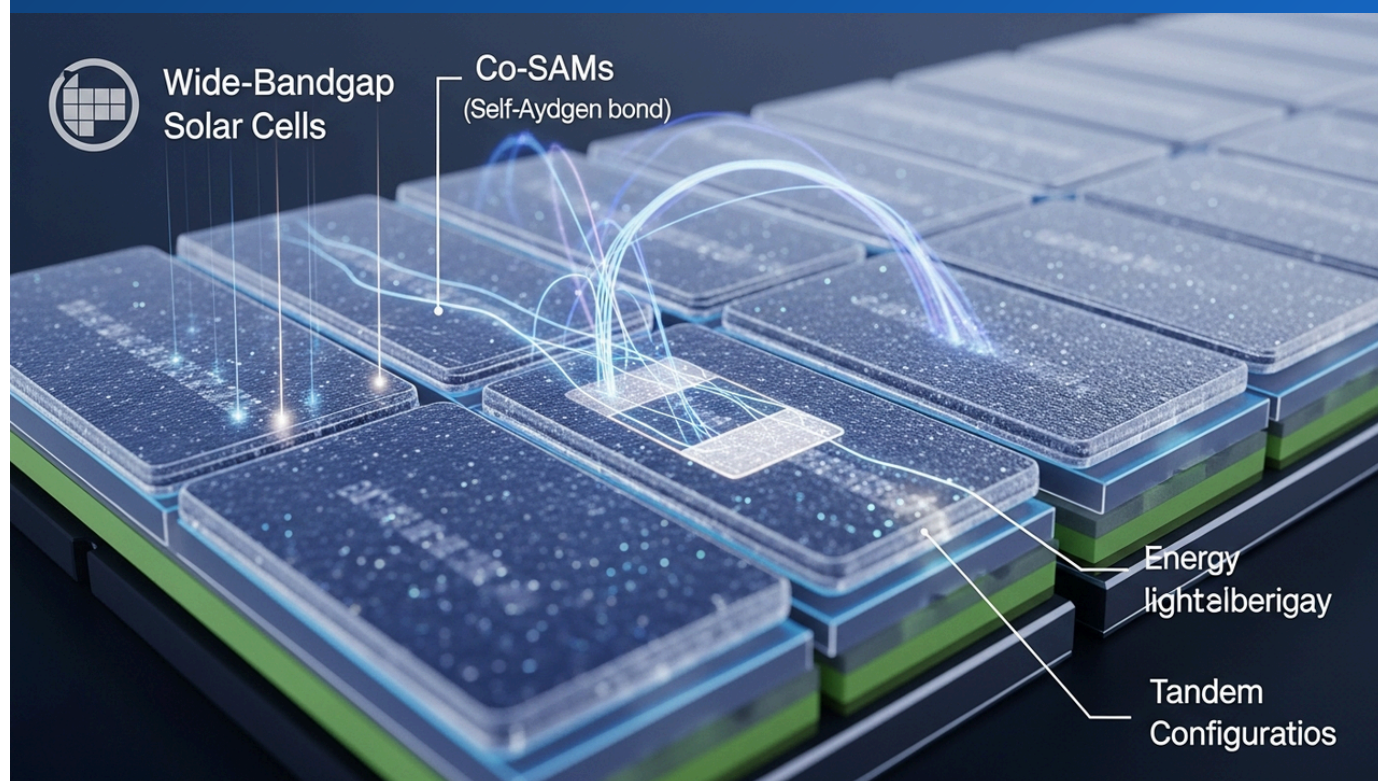
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Source: <https://www.globemarketresearch.com/reports/perovskite-solar-cells-module-market>



# #15 複数水素結合Co-SAMsがワイドバンドギャップペロブスカイト太陽電池を23.02%効率に高め、タンデムでは30.61%を達成

Published July 04, 2026 ACS Photonics USA



## OVERVIEW

Researchers have achieved highly efficient and stable wide-bandgap perovskite solar cells through a novel co-assembled monolayer (Co-SAM) strategy leveraging multiple hydrogen bonds. This approach precisely controls the NiOx/perovskite interface, drastically reducing non-radiative recombination and preventing degradation, leading to a standalone device efficiency of 23.02%. When integrated into a four-terminal perovskite/silicon tandem, the power conversion efficiency reached an unprecedented 30.61%.

### Background and Context

Perovskite solar cells are garnering significant attention as a promising next-generation photovoltaic technology, thanks to their high theoretical efficiency and potential for low-cost manufacturing. However, wide-bandgap perovskite materials, crucial for tandem architectures, have historically struggled with both efficiency and long-term stability. Tandem solar cells, particularly those combining perovskite with silicon, are leading contenders for surpassing the efficiency limits of single-junction devices, yet their overall performance hinges critically on the efficacy of the wide-bandgap perovskite top cell. The innovative Co-SAM strategy presented here dramatically enhances the performance of these wide-bandgap perovskites, marking a substantial breakthrough for the practical deployment of high-efficiency tandem solar cells.

### Key Findings

This study unveils the successful development of highly efficient and stable wide-bandgap perovskite solar cells, facilitated by a novel strategy employing co-assembled monolayers (Co-SAMs) mediated by multiple hydrogen bonds. The Co-SAM-based inverted 1.68 eV perovskite solar cell achieved a record-breaking champion efficiency of 23.02%. Furthermore, when integrated into a four-terminal perovskite/silicon tandem configuration, this technology demonstrated an extraordinary power conversion efficiency of 30.61%.



## Technical Details

In high-efficiency perovskite solar cells, particularly wide-bandgap perovskites designed for the top cell in tandem structures, the integrity of the buried  $\text{NiO}_x$  (nickel oxide)/perovskite interface is paramount for both performance and stability. The Co-SAM strategy precisely engineered in this research allows for atomic-level control over this critical interface, leveraging multiple hydrogen bonding interactions. These Co-SAMs effectively passivate detrimental defect sites at the interface, thereby substantially mitigating non-radiative recombination losses. Crucially, they also suppress interface-induced perovskite degradation, leading to a marked improvement in the long-term stability of the devices. The standalone inverted 1.68 eV perovskite solar cell, utilizing this approach, achieved a near-certified efficiency of 23.02% on a small active area of 0.042  $\text{cm}^2$ . The integration of this high-performance top cell with a conventional silicon bottom cell in a four-terminal tandem architecture enabled a significantly broader utilization of the solar spectrum, culminating in an exceptional overall power conversion efficiency of 30.61%.

## Strategic Significance and Outlook

The achievement of 30.61% tandem efficiency unequivocally positions perovskite solar cell technology as a formidable contender, capable of significantly outperforming current state-of-the-art photovoltaic technologies. This Co-SAM strategy offers a highly practical and scalable method for simultaneously enhancing the efficiency and stability of wide-bandgap perovskites, which will undoubtedly accelerate the commercialization pathway for perovskite/silicon tandem solar cells. Future research endeavors are anticipated to concentrate on further optimizing the Co-SAM architecture, scaling up active device areas, and driving down manufacturing costs. Successful market introduction of this technology promises to dramatically improve the cost-efficiency of solar power generation, thereby serving as a powerful catalyst for the widespread global adoption of clean energy solutions.

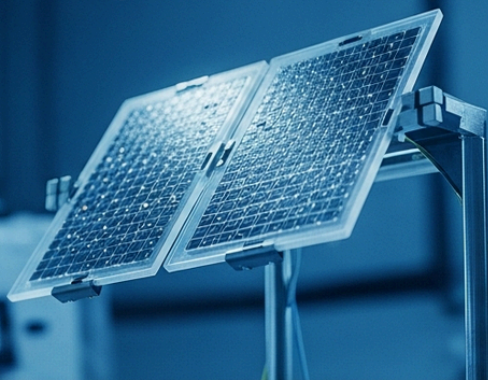
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Source: <https://pubs.acs.org/doi/10.1021/acsphotonics.6c00381>

# #16 ペロブスカイト太陽電池の「ホットフォノンボトルネック」定説を再検証、キャリアダイナミクス新知見で効率向上へ

Published July 07, 2026 ACS Energy Letters USA

## Revisit to Established “Hot phonon Bottleneck” Perovskite solar cells dynamics to improve efficiency



ACS  
Letters

### OVERVIEW

This research critically re-examines several prevailing theories, notably the 'hot-phonon bottleneck,' in perovskite solar cells. By meticulously analyzing charge carrier dynamics and photo-induced bleaching in a novel perovskite composition, the study provides fundamental new insights essential for correcting design assumptions and unlocking significant improvements in device efficiency and stability.

### Background

While perovskite solar cells (PSCs) are experiencing rapid research and development advancements, many fundamental aspects of their physics – particularly charge carrier dynamics and associated loss mechanisms – remain incompletely understood. Device designs predicated on inaccurate physical models can inadvertently create bottlenecks that hinder further efficiency improvements. Therefore, a precise understanding of fundamental physical phenomena and the scientific validation of existing theories are crucial for engineering truly efficient and stable devices. This research significantly deepens the foundational scientific understanding in this field, offering critical insights that will guide more effective material development and device architecture design.

### Technical Details

The longstanding "hot-phonon bottleneck" hypothesis suggests that the cooling of high-energy photoexcited carriers—their process of transferring energy to phonons (lattice vibrations)—is sluggish, thereby contributing to significant recombination losses and limiting perovskite solar cell efficiency. This study employed advanced experimental techniques, notably ultrafast pump-probe spectroscopy, to meticulously track the dynamics of charge carrier generation, transport, and recombination with high temporal resolution. Focusing on a specific mixed-halide perovskite composition ( $\text{Cs}_{0.22}(\text{FA}_{0.8}\text{MA}_{0.2})_{0.78}\text{Pb}(\text{I}_{0.83}\text{Br}_{0.14}\text{Cl}_{0.03})_3$ ), the research critically re-evaluated previous interpretations of the hot-phonon bottleneck. The findings suggest that carrier cooling processes might occur more rapidly than previously assumed, or that alternative recombination pathways could play a more dominant role. Furthermore, an analysis of photo-induced bleaching provided valuable insights into light-induced changes in material properties, enhancing our understanding of device stability mechanisms.

## Key Findings

This study offers a profound re-examination of several prevailing theories in perovskite solar cells (PSCs), particularly the contentious "hot-phonon bottleneck." Through detailed analysis of charge carrier distribution and photo-induced bleaching phenomena in a specific mixed-halide perovskite composition ( $\text{Cs}_{0.22}(\text{FA}_{0.8}\text{MA}_{0.2})_{0.78}\text{Pb}(\text{I}_{0.83}\text{Br}_{0.14}\text{Cl}_{0.03})_3$ ), the research unveils crucial new insights into charge carrier dynamics. These findings deepen the fundamental understanding essential for significantly improving PSC efficiency, stability, and overall performance, challenging established assumptions that have guided previous device design strategies.

## Strategic Significance and Outlook

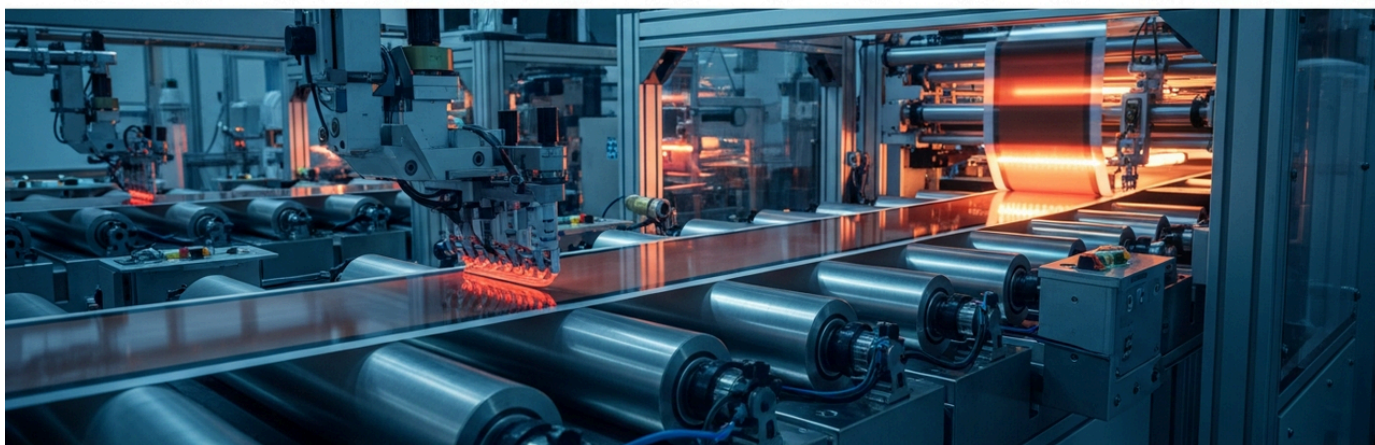
The novel insights into charge carrier dynamics unearthed by this research are poised to significantly influence the future design and optimization of perovskite solar cells. By critically re-evaluating established hypotheses, such as the hot-phonon bottleneck, researchers can more effectively allocate resources and concentrate efforts on mechanisms that genuinely enhance efficiency and stability. Looking ahead, this fundamental knowledge is anticipated to drive the development of more robust and efficient perovskite materials, facilitate improved interface designs, and spur the exploration of innovative device architectures. Ultimately, these scientific advancements are paramount for accelerating the commercialization of perovskite solar cells and firmly establishing their role as a cornerstone of sustainable energy.

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Source: <https://pubs.acs.org/doi/10.1021/acsenergylett.6c01471>

## #17 環境負荷低減へ：DMFフリー共溶媒インクによるフレキシブルペロブスカイト太陽電池のR2Rプロセス開発

Published Published July 02, 2026 EcoMat Unknown



### OVERVIEW

Researchers have developed a novel roll-to-roll (R2R) manufacturing process for flexible perovskite solar cells, utilizing environmentally friendly, DMF-free cosolvent inks. This breakthrough eliminates the need for hazardous N,N-dimethylformamide (DMF), offering a more sustainable and commercially viable pathway for solar cell production. By employing R2R slot-die coating and optimizing ink formulations, this technology significantly reduces manufacturing costs and environmental impact, paving the way for large-scale adoption of flexible perovskite photovoltaics.

### Background

Flexible perovskite solar cells hold immense potential for a wide range of emerging applications, including building-integrated photovoltaics (BIPV), wearable devices, and portable power sources. In these applications, lightweight, flexibility, and low-cost manufacturing are essential. The roll-to-roll (R2R) manufacturing process is an ideal method to meet these requirements, but the development of environmentally benign solvent systems has been a critical bottleneck. This research directly addresses this challenge, providing a manufacturing pathway for perovskite solar cells that can be safely deployed even in regions with stringent environmental regulations.

### Technical Breakthrough

This study reports the successful development of an environmentally friendly roll-to-roll (R2R) manufacturing process for flexible perovskite solar cells, utilizing novel DMF-free cosolvent inks. This innovative process completely eliminates the use of N,N-dimethylformamide (DMF), a hazardous solvent, thereby offering a significantly more sustainable and commercially scalable method for solar cell production.

Historically, the fabrication of perovskite solar cells, particularly solution-based processes, has extensively relied on highly toxic organic solvents like DMF. However, escalating concerns regarding DMF's environmental and human health impacts have made the development of alternative solvents an urgent priority. The research team successfully developed a DMF-free cosolvent ink system, specifically mixtures of dimethyl sulfoxide (DMSO) and acetonitrile (ACN), and integrated it into an R2R slot-die coating process. In this process, the morphology and crystallization characteristics of both the precursor lead iodide ( $\text{PbI}_2$ ) films and the final perovskite films were meticulously evaluated and optimized across various DMSO:ACN ratios. Slot-die coating, renowned for its capability in large-area and high-speed deposition, when combined with R2R manufacturing, enables the low-cost mass production of flexible solar cells. This technology represents a significant milestone for the industrialization of perovskite solar cells, as it drastically reduces environmental impact while maintaining high efficiency.



## Strategic Significance and Outlook

The development of a DMF-free R2R manufacturing process will significantly accelerate the commercialization of flexible perovskite solar cells. This technology not only promises to reduce manufacturing costs and improve production throughput but also enhances workplace safety and minimizes the overall environmental footprint. Moving forward, the research team is poised to further optimize the developed inks and processes, enhance device long-term stability and efficiency, and explore applicability to larger-scale production lines. This eco-friendly manufacturing technology is anticipated to promote the widespread adoption of perovskite solar cells, firmly establishing their position as an indispensable clean energy solution for achieving a sustainable society.

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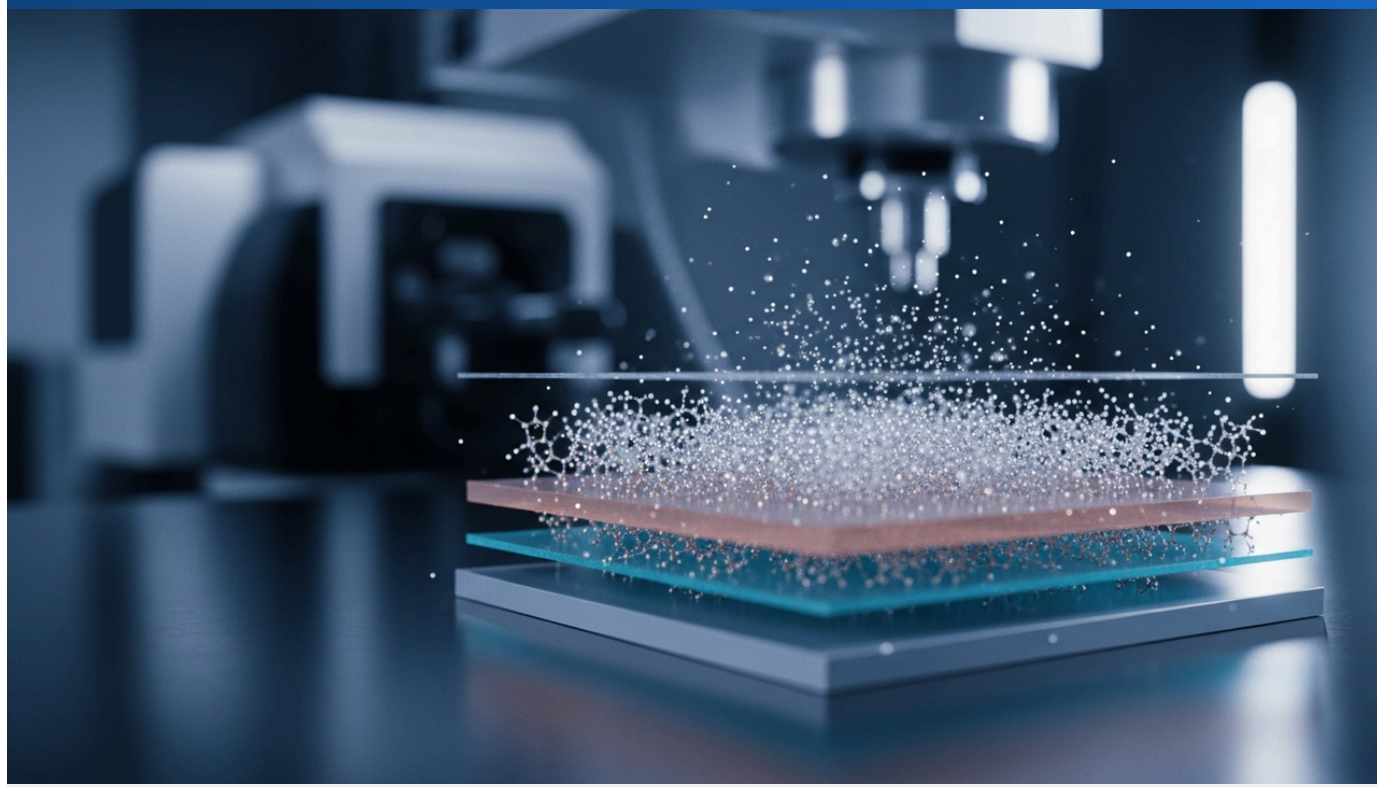
Source:

[https://www.researchgate.net/publication/408308047\\_Environmentally\\_Friendly\\_R2R\\_Process\\_for\\_Flexible\\_Perovskite\\_Solar\\_Cells\\_using\\_Free\\_Cosolvent\\_Ink](https://www.researchgate.net/publication/408308047_Environmentally_Friendly_R2R_Process_for_Flexible_Perovskite_Solar_Cells_using_Free_Cosolvent_Ink)

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #18 分子潤滑剤がペロブスカイト太陽電池のSAMs凝集を抑制、デバイス性能と安定性を改善する新戦略

Published July 07, 2026   Angewandte Chemie International Edition   Germany



## OVERVIEW

A novel approach utilizing molecular lubricants has been reported to mitigate the aggregation of self-assembled monolayers (SAMs) in perovskite solar cells (PSCs). SAMs aggregation creates interfacial defects that severely degrade device performance and operational stability, posing a significant hurdle for PSC commercialization. This research demonstrates that molecular lubricants precisely control SAMs molecular packing, effectively suppressing aggregation and resolving these defects, thus offering a crucial strategy to enhance PSC efficiency and long-term reliability.

### Background and Context

One of the biggest challenges for the commercialization of perovskite solar cells is ensuring their long-term stability. Interface quality is directly related to device degradation mechanisms, and forming stable interfaces with fewer defects is crucial for improving resistance to humidity, heat, and light stress. Previous research primarily focused on optimizing the chemical structure of SAMs, but approaches to address the physical problem of SAM aggregation itself were limited. This study's strategy of mitigating aggregation with molecular lubricants addresses this physical challenge, opening new avenues for improving the long-term reliability of perovskite solar cells.

### Key Findings

This research reports a novel discovery: molecular lubricants effectively mitigate the aggregation of self-assembled monolayers (SAMs) in perovskite solar cells (PSCs), which significantly impairs device performance and operational stability. It was demonstrated that these molecular lubricants precisely control the molecular packing of SAMs, thereby suppressing aggregation-induced interfacial defects. This offers a new strategy for enhancing the efficiency and long-term reliability of perovskite solar cells.

### Technical Details

Self-assembled monolayers (SAMs) have been widely used as charge transport layers or interfacial passivation layers in perovskite solar cells, contributing to their high efficiency. However, it has been noted that non-uniform aggregation of SAMs, particularly at buried interfaces, can create carrier recombination sites, impede charge transport, and consequently reduce the device's power conversion efficiency and operational stability. The research team successfully adjusted the interactions between SAM molecules and achieved more uniform and dense molecular packing by introducing specific molecular lubricants into the SAM formation process. These molecular lubricants control the movement of SAM molecules during self-assembly, suppressing the formation of aggregation nuclei and significantly reducing the occurrence of interfacial defects. This is expected to improve the open-circuit voltage ( $V_{oc}$ ) and fill factor (FF) of PSCs, along with enhancing long-term operational stability.

## Strategic Significance and Outlook

The molecular lubricant-mediated SAM aggregation mitigation technology is a highly promising approach for simultaneously improving the performance and stability of perovskite solar cells. If applied to large-scale manufacturing processes, this technology could enhance device quality uniformity and improve manufacturing yield. Moving forward, the research team is expected to delve deeper into the types and concentrations of molecular lubricants, their interaction mechanisms with SAMs, and work on further improving device efficiency and long-term durability assessments. This innovative interface engineering technology will be a crucial factor for perovskite solar cells to become a leading next-generation photovoltaic technology in the market.

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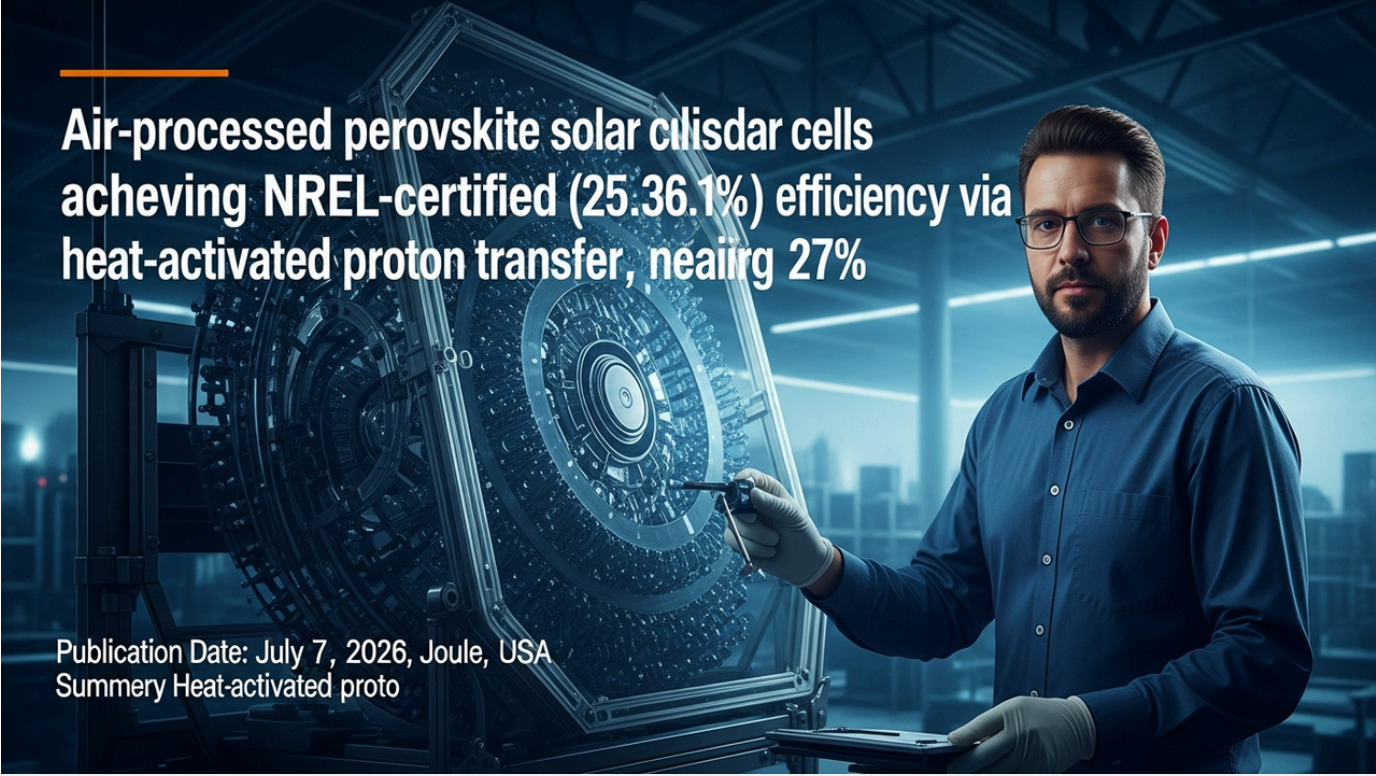
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Collected: July 10, 2026 | Automated Research System (Gemini API)



# #19 熱活性化プロトン移動により空气中作製ペロブスカイト太陽電池がNREL認証25.33%（ラボ26.1%）効率を達成、27%に迫る

Published July 07, 2026 Joule USA



**Air-processed perovskite solar cells achieving NREL-certified (25.36.1%) efficiency via heat-activated proton transfer, nearing 27%**

Publication Date: July 7, 2026, Joule, USA  
Summary Heat-activated proton transfer

## OVERVIEW

An innovative thermally activated proton transfer method has enabled ambient air-processed perovskite solar cells to reach remarkable efficiencies, including an NREL-certified quasi-steady-state efficiency of 25.33% and a laboratory-recorded 26.1%. Leveraging semicarbazide hydrochloride, this technique optimizes  $\alpha$ -phase FAPbI<sub>3</sub> film crystallization, leading to superior material properties and device performance. This breakthrough significantly simplifies manufacturing, reduces costs, and accelerates the commercialization of high-performance perovskite photovoltaics.

### Background

Perovskite solar cell manufacturing conventionally necessitates an inert gas atmosphere, such as a nitrogen-filled glovebox, contributing to increased costs and manufacturing complexity. An ambient air processing route would circumvent this bottleneck, paving the way for scalable, cost-effective production. However, the presence of moisture and oxygen in the air has historically impeded film crystallization and compromised device performance. The profound significance of this work lies in achieving performance on par with, and even surpassing, state-of-the-art efficiencies previously reported exclusively for inert atmosphere fabrication, despite utilizing an ambient air process. This accomplishment constitutes a significant breakthrough, dismantling one of the primary hurdles to perovskite solar cell commercialization.

### Key Findings

This study reports that perovskite solar cells fabricated in ambient air have achieved remarkably high efficiencies, reaching 26.1% (laboratory data) and an astonishing NREL (National Renewable Energy Laboratory)-certified quasi-steady-state efficiency of 25.33%, through an innovative technique called thermally activated proton transfer. This marks a significant milestone as perovskite solar cell efficiency approaches 27%.

### Technical Details

The research team successfully addressed the challenges of air processing by incorporating semicarbazide hydrochloride into the perovskite precursor solution. This additive initiated a thermally activated proton transfer mechanism, which facilitates optimal crystallization of  $\alpha$ -phase formamidinium lead iodide (FAPbI<sub>3</sub>) perovskite films. This mechanism leads to several key improvements:

- **Uniform vertical distribution of A-site cations:** Ensures optimal charge carrier transport pathways throughout the film.
- **Large crystal grains:** Reduces grain boundaries, thereby suppressing charge carrier recombination losses.
- **Reduced voids at buried interfaces:** Improves the quality of the interface between the perovskite and charge transport layers, minimizing interfacial defects.



These structural and compositional improvements synergistically boosted the device's open-circuit voltage (Voc), short-circuit current density (Jsc), and fill factor (FF). Independent NREL certification further validates this high efficiency, bolstering its credibility within the scientific community.

### **Strategic Significance and Outlook**

The demonstrated success of air-processed perovskite solar cells, enabled by thermally activated proton transfer, is poised to significantly accelerate the practical deployment of this technology. Streamlined manufacturing and substantial cost reductions will dramatically bolster the market competitiveness of perovskite solar cells. Future efforts are expected to concentrate on further optimizing this technology, scaling up for large-area fabrication, and conducting rigorous long-term stability and durability assessments under diverse environmental conditions. This breakthrough positions perovskite solar cells as a powerful contender to emerge as a leading next-generation photovoltaic technology, becoming an indispensable component of the global energy infrastructure.

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Source:

[https://www.researchgate.net/publication/408544110\\_Thermally\\_activated\\_proton\\_transfer\\_enables\\_air-processed\\_perovskite\\_solar\\_cells\\_approaching\\_27](https://www.researchgate.net/publication/408544110_Thermally_activated_proton_transfer_enables_air-processed_perovskite_solar_cells_approaching_27)

# #20 多機能添加剤がペロブスカイト/シリコンタンデム太陽電池の効率を34.28%に押し上げ、2000時間超の安定性を実現

Published July 08, 2026 Energy & Environmental Science UK



## OVERVIEW

A multifunctional additive has driven perovskite/silicon tandem solar cells to a remarkable 34.28% power conversion efficiency by synergistically optimizing crystallization and band alignment. This single-molecule strategy enables high-quality wide-bandgap perovskite layers, demonstrating exceptional stability with unencapsulated devices retaining over 93% of initial efficiency after 2,000 hours of continuous 1-sun illumination at 65°C. This dual achievement marks a critical milestone for the commercialization of next-generation solar technology.

### Background

As global energy demand rises, there is increasing expectation for more efficient and sustainable solar power technologies. Perovskite/silicon tandem solar cells are at the forefront of meeting this need, with intense international competition, including Chinese companies like JinkoSolar achieving efficiencies in the 34% range. Beyond high efficiency, ensuring long-term stability is the most critical challenge for commercialization. This study represents a groundbreaking advancement in this field by significantly improving both efficiency and stability with a single additive.

### Key Findings

This study reports that perovskite/silicon tandem solar cells have achieved an astonishing power conversion efficiency of 34.28% through the introduction of a multifunctional additive. This single-molecule strategy synergistically optimizes crystallization and band alignment, enabling high-quality wide-bandgap perovskite layers for efficient and stable monolithic tandem devices. Furthermore, unencapsulated devices demonstrated excellent stability, retaining over 93% of their initial efficiency after 2,000 hours of continuous 1-sun illumination at 65°C, marking a pivotal step towards the commercialization of next-generation solar cell technology.

### Technical Details

Perovskite/silicon tandem solar cells are considered the most promising candidates to achieve efficiencies exceeding the theoretical limits of conventional single-junction solar cells. In this tandem structure, the perovskite top cell absorbs short-wavelength light, and the silicon bottom cell absorbs longer-wavelength light, maximizing the utilization of the solar spectrum. The key to this technology lies in the quality of the perovskite layer and the optimization of the interface between the two layers. The multifunctional additive developed by the research team plays two primary roles:

- **Crystallization Control:** When added to the perovskite precursor solution, it precisely controls the growth of perovskite crystals, promoting the formation of uniform, defect-free, wide-bandgap films.

- **Band Alignment Optimization:** The additive at the interface tunes the energy band alignment between the perovskite layer and the charge transport layer to an ideal state, maximizing charge carrier separation and extraction efficiency.

These synergistic effects led to a record-breaking certified efficiency of 34.28% on an active area of 1.001 cm<sup>2</sup>. This value significantly surpasses the highest efficiencies of standalone silicon or perovskite solar cells. Moreover, the fact that unencapsulated devices maintained high efficiency for over 2,000 hours under harsh conditions provides strong evidence of the practical durability of this technology.

### Strategic Significance and Outlook

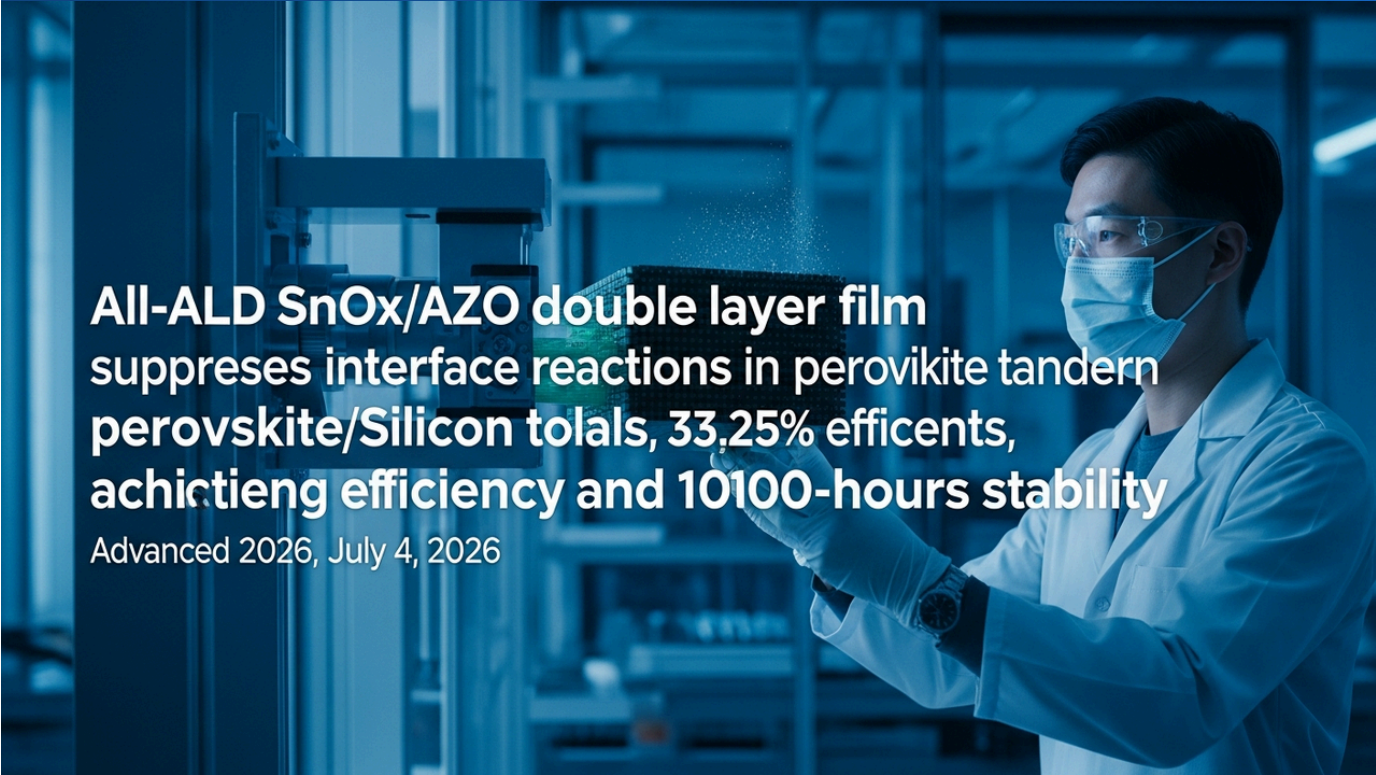
The 34.28% efficiency achieved will significantly accelerate the commercialization of perovskite/silicon tandem solar cells. This technology holds the potential to maximize power generation per unit area and reduce overall system costs in large-scale solar farms, rooftop systems, and even new applications. Moving forward, the research team is expected to deepen its understanding of the multifunctional additive's mechanisms, pursue large-area fabrication, simplify manufacturing processes, and conduct long-term reliability assessments under even more stringent conditions. This breakthrough is poised to shape the future of solar power and become a powerful driving force contributing to the global transition to clean energy.

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Source: <https://pubs.rsc.org/ee/article/doi/10.1039/D6EE02285E/1274285/Multifunctional-Additive-Synergistically-Regulates?searchresult=1>

## #21 オールALD SnOx/AZO二層膜がペロブスカイト/シリコンタンデム太陽電池の界面反応を抑制、33.25%効率と1000時間安定性を実現

Published July 04, 2026   Advanced Functional Materials   Germany



**All-ALD SnOx/AZO double layer film suppresses interface reactions in perovskite tandem perovskite/Silicon solar cells, 33.25% efficiency, achieving efficiency and 1000-hours stability**

Advanced 2026, July 4, 2026

### OVERVIEW

Researchers have successfully suppressed interfacial reactions in perovskite/silicon tandem solar cells using a novel all-atomic layer deposition (ALD) SnOx/AZO bilayer. This functionally segregated interface, with SnOx providing optimal band alignment and AZO forming a dense, low-resistance barrier against ion diffusion, enabled a monolithic tandem cell to achieve a power conversion efficiency of 33.25%. Crucially, the devices demonstrated exceptional stability, maintaining over 96% of their initial efficiency after 1000 hours of continuous illumination, marking a significant step towards commercialization.



### Background

Perovskite/silicon tandem solar cells are gaining attention as the next frontier in photovoltaics because their theoretical efficiency significantly exceeds the current limits of commercial silicon solar cells. However, ensuring interfacial stability between the two materials has been one of the primary challenges for their commercialization. Specifically, long-term chemical stability and the suppression of ion diffusion between the perovskite layer and the charge transport layer are crucial for determining device lifetime. The all-ALD method, capable of atomic-level control over film thickness and composition, is an ideal technique for forming high-quality interface layers, and this research has maximized its potential.

### Key Findings

This research reports that an all-atomic layer deposition (ALD) SnOx/AZO bilayer effectively suppresses interfacial reactions in perovskite/silicon tandem solar cells, achieving an impressive power conversion efficiency of 33.25%. With this innovative interfacial design, devices also demonstrated excellent long-term stability, maintaining over 96% of their initial efficiency after 1000 hours of continuous illumination. This achievement represents a significant advancement towards the practical implementation of high-efficiency, highly stable tandem solar cells.

### Technical Details

In perovskite/silicon tandem solar cells, the chemical and electrical interactions at the interface between the perovskite and silicon layers significantly impact device performance and stability. Interfacial reactions, in particular, can lead to defect generation and ion diffusion, causing efficiency degradation and device failure. The research team employed the precise thin-film deposition technique of all-ALD to develop a bilayer consisting of SnOx and AZO (aluminum-doped zinc oxide). This bilayer is functionally segregated and optimized as follows:

- **SnOx Layer:** Ensures good energy band alignment with the perovskite layer, promoting efficient charge carrier separation and transport.
- **AZO Layer:** Provides a robust barrier against ion diffusion due to its dense structure, while also offering a low-resistance electrical pathway to minimize charge losses.



The wide-bandgap perovskite top cell, incorporating this functionally segregated bilayer, achieved an efficiency of 23.47% on its own. When integrated into a monolithic perovskite/silicon tandem cell, the power conversion efficiency increased to 33.25%. Furthermore, this interface layer demonstrated remarkably high operational stability, maintaining over 96% efficiency after 1000 hours of continuous light illumination, thereby ensuring reliability under harsh environmental conditions.

### Strategic Significance and Outlook

The achieved high efficiency of 33.25% and stability of over 96% after 1000 hours significantly enhance the prospects for perovskite/silicon tandem solar cells to be applied in commercial power generation. This all-ALD SnO<sub>x</sub>/AZO bilayer technology will substantially improve device reliability and lifetime, contributing to reduced construction costs for large-scale solar farms and increased long-term power generation. Moving forward, the research team is expected to further optimize this interface engineering approach, pursue large-area fabrication, scale up manufacturing processes, and conduct long-term field tests under various environmental conditions. This breakthrough is poised to accelerate the evolution of solar power technology and become a powerful component in driving the global clean energy transition.

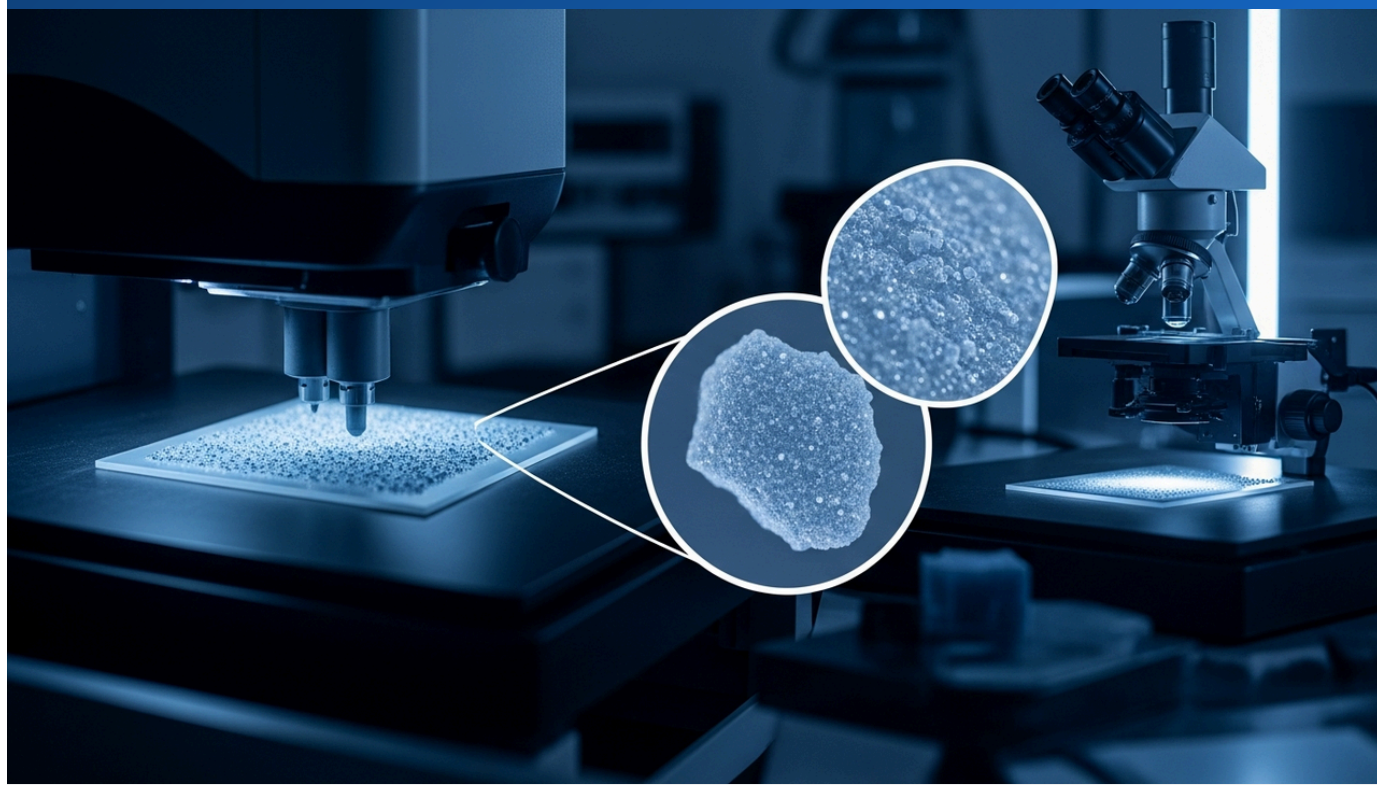
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Source:

[https://www.researchgate.net/publication/408415456\\_Suppressing\\_Interfacial\\_Reactions\\_in\\_PerovskiteSilicon\\_Ta\\_ALD\\_SnOxAZO\\_Bilayer](https://www.researchgate.net/publication/408415456_Suppressing_Interfacial_Reactions_in_PerovskiteSilicon_Ta_ALD_SnOxAZO_Bilayer)

## #22 インクジェット印刷でワイドバンドギャップペロブスカイト結晶配向を制御、1.69eV帯域で20%超効率を達成

Published July 02, 2026 ACS Energy Letters USA



### OVERVIEW

Researchers have developed a novel inkjet printing (IJP) method to precisely control the crystal orientation of wide-bandgap perovskites through a quenching process. This breakthrough enabled the fabrication of 1.69 eV bandgap perovskite solar cells with over 20% power conversion efficiency, making them ideal top layers for high-efficiency silicon-perovskite tandem cells. The technique promises low-cost, large-scale manufacturing, poised to accelerate the commercialization of next-generation solar power.

### Background

Perovskite/silicon tandem solar cells are garnering significant attention as a technology capable of surpassing the efficiency limits of current silicon solar cells, with the potential to achieve over 30% power conversion efficiency. To realize this tandem structure, it is crucial to manufacture high-quality, large-area wide-bandgap perovskites (typically around 1.7 eV) to serve as top cells. While solution processes like inkjet printing (IJP) are appealing for their cost reduction potential and scalability, controlling film uniformity and crystal quality, especially crystal orientation, has been a persistent challenge, hindering the achievement of high efficiencies.

### Key Findings

This research reports a pioneering method for precisely controlling the crystal orientation of wide-bandgap perovskites through a quenching step within an inkjet printing (IJP) process. This breakthrough enabled perovskite solar cells with a 1.69 eV bandgap to achieve over 20% power conversion efficiency, proving ideal for integration into silicon-perovskite tandem cells as a high-performance top layer.

### Technical Details

The research team successfully deposited approximately 700 nm thick perovskite films using IJP under controlled ambient air conditions with 55% relative humidity. In this innovative process, the quenching step was found to significantly influence crystal growth dynamics, facilitating the formation of self-assembled monolayer (SAM)-containing wide-bandgap perovskite films with a uniform (110) crystal orientation. This specific crystal orientation is critical as it optimizes charge carrier mobility and lifetime, thereby maximizing the device's photoelectric conversion efficiency. A 1.69 eV bandgap is an ideal range for efficient utilization of the solar spectrum when combined with a silicon bottom cell, indicating high potential as a high-performing top cell in tandem structures.

## Strategic Significance and Outlook

The development of quenching-controlled crystal orientation technology for inkjet-printed wide-bandgap perovskites represents a significant breakthrough for low-cost, large-scale manufacturing of perovskite solar cells. The resulting 1.69 eV bandgap perovskite layer with over 20% efficiency will accelerate the commercialization of perovskite/silicon tandem solar cells as top cells. Moving forward, the research team is expected to further optimize this IJP process, focus on manufacturing large-area devices, evaluating long-term stability, and further reducing manufacturing costs. If successfully introduced to the market, this technology has the potential to dramatically improve the cost-efficiency of solar power and significantly contribute to the widespread adoption of renewable energy globally.

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Source: <https://pubs.acs.org/doi/10.1021/acsenergylett.6c01417>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #23 Trina Solar、ペロブスカイト-シリコン産業用タンデムモジュールで29.2%効率・907W出力を達成、TÜV SÜD 認証取得

Published July 04, 2026 Logos Press China



## OVERVIEW

Trina Solar, a leading Chinese solar manufacturer, has achieved a new record in solar energy with its industrial perovskite-silicon tandem module, demonstrating 29.2% energy conversion efficiency and 907W output, verified by TÜV SÜD. This innovative module leverages a tandem architecture where a perovskite layer absorbs high-energy light and a silicon layer converts the transmitted light. This breakthrough signifies a substantial improvement in photovoltaic efficiency and power output, poised to accelerate adoption in large-scale solar projects.

### Background

As the global energy transition accelerates, there is an urgent need for further improvements in solar photovoltaic technology efficiency. Perovskite/silicon tandem technology is considered a prime candidate for next-generation solar cells, as its theoretical efficiency surpasses the limits of standalone silicon solar cells (approx. 26-29%). Chinese companies, such as JinkoSolar, are leading the world in this field, with reported cell efficiencies in the 34% range. Trina Solar's announcement is significant not just for improving cell efficiency but for demonstrating concrete performance (efficiency and power output) as an industrial module. This indicates that laboratory-level achievements are steadily transitioning into commercial products, which will have a major impact on the solar industry.

### Key Findings

Trina Solar, a leading Chinese solar manufacturer, has set a new record in the solar energy sector with its industrial perovskite-silicon tandem solar module. According to the company, this new module achieved an impressive energy conversion efficiency of 29.2% and a power output of 907W, with its performance rigorously verified by the German international certification body TÜV SÜD.

### Technical Details

The innovative tandem module developed by Trina Solar employs a hybrid structure, stacking a perovskite solar cell layer atop a conventional crystalline silicon solar cell layer. The perovskite layer efficiently absorbs the high-energy portion of the solar spectrum (primarily blue to green light), while the transmitted lower-energy light is converted by the silicon layer. This tandem architecture significantly enhances the utilization efficiency of the solar spectrum, achieving high efficiencies unattainable by single-junction solar cells. The 29.2% conversion efficiency substantially surpasses the current highest standards for commercial solar modules, and its high power output of 907W is particularly appealing for large-scale solar power projects requiring maximum power generation from limited installation areas. Certification by TÜV SÜD assures that this technology meets international quality standards and its performance is reliable.



## Strategic Significance and Outlook

Trina Solar's 29.2% efficient, 907W output tandem module is expected to make a significant impact on the future solar power market. If this high-efficiency, high-output module becomes commercially available at scale, it will improve land utilization efficiency for solar farms and relatively reduce construction costs (especially for balance-of-system components like mounting structures and cables), thereby contributing to further reductions in the Levelized Cost of Energy (LCOE). The company plans to accelerate the mass production and market launch of this technology, which holds the potential to become one of the mainstream solar power technologies globally. This will serve as a powerful driving force towards the realization of a sustainable energy society.

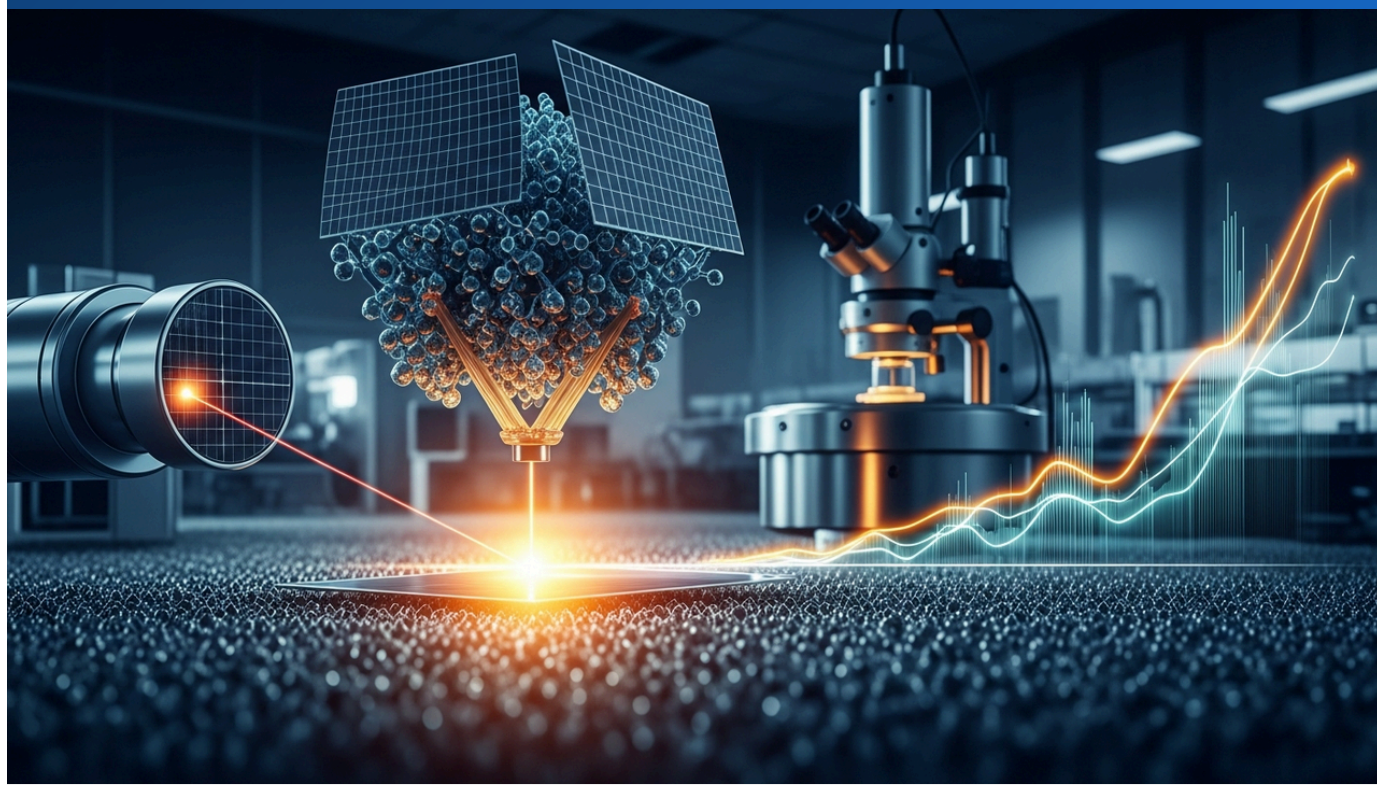
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Source: [https://vertexaisearch.cloud.google.com/grounding-api-redirect/AUZIYQG5jzwkY2d1Q2Ht8A8NMg1nW7adVH91mYoxVso12-DA8UqKHgd\\_EMZSeWVejT5zAqzD2UXcGL3y-Nka7ch4INhttXgJoOGGzVVxQggblGnhxwMwONLp39Vu7RXIraiAPk0rK-uXxBbhQWdbZDFE-lczxYIBApFURtp1xyP7gu81Ozg\\_\\_Q==](https://vertexaisearch.cloud.google.com/grounding-api-redirect/AUZIYQG5jzwkY2d1Q2Ht8A8NMg1nW7adVH91mYoxVso12-DA8UqKHgd_EMZSeWVejT5zAqzD2UXcGL3y-Nka7ch4INhttXgJoOGGzVVxQggblGnhxwMwONLp39Vu7RXIraiAPk0rK-uXxBbhQWdbZDFE-lczxYIBApFURtp1xyP7gu81Ozg__Q==)

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #24 逆型ペロブスカイト太陽電池が2024年にn-i-p型を上回り26.15%効率達成、商業化への道筋をレビュー

Published July 08, 2026 Chemical Society Reviews UK



## OVERVIEW

A recent comprehensive review highlights the significant advancements in inverted perovskite solar cells (PSCs), which for the first time in 2024, surpassed traditional n-i-p type PSCs with a certified power conversion efficiency (PCE) of 26.15%. This breakthrough is largely driven by the strategic integration of self-assembled monolayers (SAMs) as hole transport layers. The review further details critical progress in scalable manufacturing processes, such as slot-die coating, and the adoption of inorganic charge transport layers to enhance stability, providing a clear trajectory for the commercialization of this next-generation solar technology.

### Background

Perovskite solar cells are widely regarded as the 'future of photovoltaics' due to their impressive efficiency potential and promise of low-cost manufacturing. Among their various architectures, inverted perovskite solar cells (p-i-n type) are particularly well-suited for commercialization, benefiting from simpler, low-temperature fabrication processes and compatibility with solution processing. However, the dual challenge of achieving both high efficiency and long-term stability has historically been a significant hurdle. The recent development in 2024, where inverted PSCs surpassed n-i-p type cells in efficiency, signals a pivotal new phase in research and development, sending a strong message to the industry that could profoundly influence investment and technological strategies.

### Key Findings

A comprehensive review published in 'Chemical Society Reviews' outlines the remarkable progress of inverted perovskite solar cells (PSCs), from fundamental research insights to the cusp of scalable commercialization. A particularly notable finding is that in 2024, inverted PSCs surpassed n-i-p type PSCs in efficiency for the first time, achieving a certified power conversion efficiency (PCE) of 26.15%. This groundbreaking achievement was largely propelled by the integration of self-assembled monolayers (SAMs) as highly effective hole transport layers (HTLs).

## Technical Details

Perovskite solar cell structures are broadly categorized into regular (n-i-p) and inverted (p-i-n) types. While n-i-p type cells historically maintained an efficiency advantage, the optimization of the inverted structure has accelerated rapidly in recent years. This review critically analyzes the key technological factors contributing to the efficiency improvement of inverted PSCs. Self-assembled monolayers (SAMs), owing to their intrinsic self-forming ability and superior interfacial defect passivation effects, have dramatically enhanced their performance as hole transport layers. The introduction of SAMs effectively suppressed charge recombination at the interface, leading to significant improvements in open-circuit voltage ( $V_{oc}$ ) and fill factor (FF), ultimately culminating in the certified PCE of 26.15%. This milestone marks a pivotal turning point in solar cell research, demonstrating the capacity of a specific architectural advancement to surpass another after decades of development. Furthermore, the review discusses critical advancements in manufacturing processes, such as slot-die coating, which are essential for large-area, low-cost fabrication, alongside the ongoing strategic shift towards inorganic charge transport layers to enhance resistance against ion migration and environmental stress, crucial for long-term device stability.

## Strategic Significance and Outlook

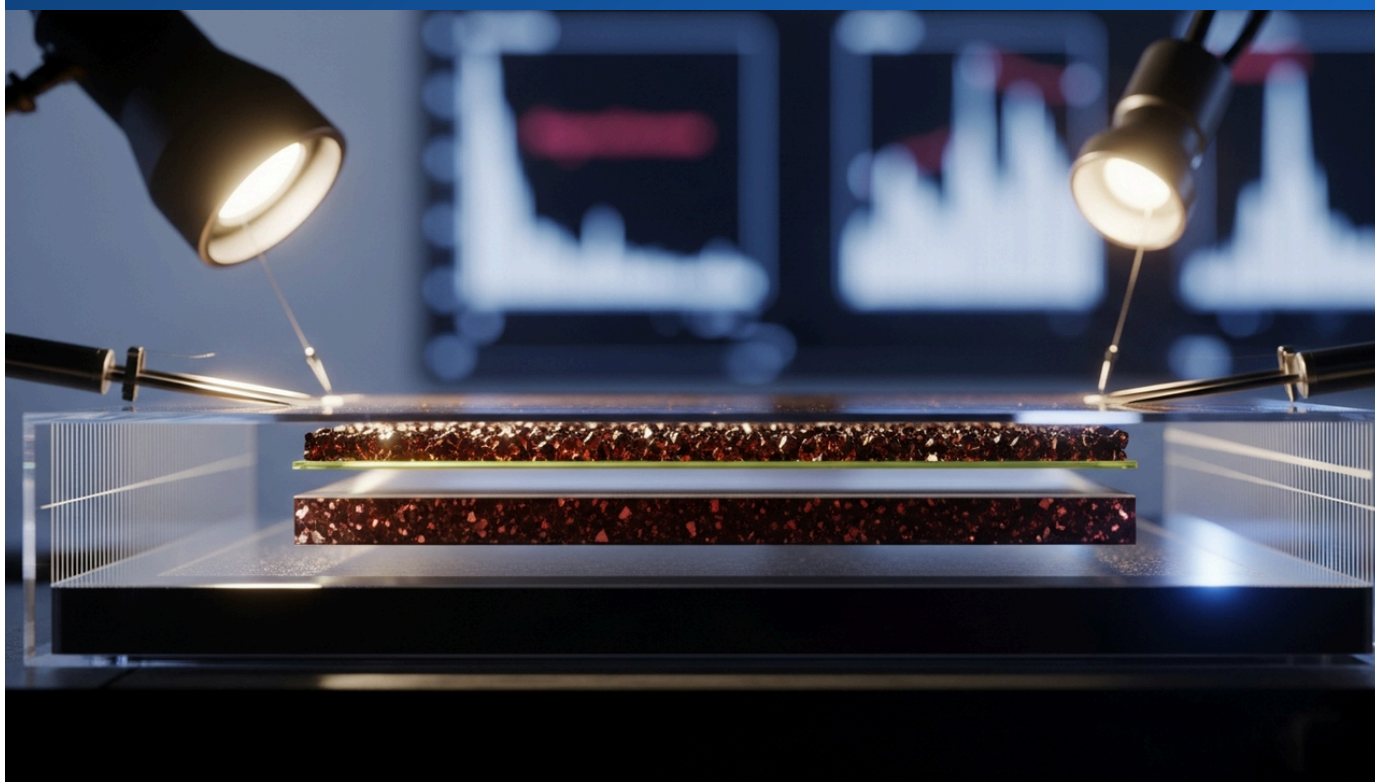
This review unequivocally indicates that inverted perovskite solar cells are rapidly maturing for scalable commercialization. The strategic deployment of SAMs as HTLs represents a critical technology for simultaneously enhancing both efficiency and stability, with further optimization efforts anticipated. The transition towards advanced manufacturing techniques like slot-die coating and the adoption of robust inorganic charge transport layers are concrete strategies designed to ensure mass production capabilities and long-term reliability. The continued advancement of this technology holds immense potential for perovskite solar cells to not only secure a crucial role in the existing photovoltaic market but also to unlock new application areas, including building-integrated photovoltaics (BIPV) and flexible electronic devices. Ultimately, these technological strides will significantly contribute to the widespread adoption of clean energy solutions and the realization of a sustainable global society.





# #25 Chinese Researchers Achieve 27.31% Certified Efficiency in Inverted Perovskite Solar Cells via Dual-Molecule Interface Engineering

Published July 05, 2026   perovskite-info.com   China



## OVERVIEW

A Chinese research team has developed a dual-molecule interface engineering strategy for inverted perovskite solar cells (IPSCs), achieving a world-record certified power conversion efficiency of 27.31%. This innovation addresses key challenges of interfacial recombination and chemical instability at the NiO<sub>x</sub>/perovskite junction, leading to excellent long-term operational stability and scalability. Large-area devices of 766 cm<sup>2</sup> demonstrated 21.54% efficiency, maintaining 92% of initial efficiency after 2000 hours of continuous light exposure.



### Key Findings

A team of Chinese researchers has achieved a new world record certified power conversion efficiency of 27.31% for inverted perovskite solar cells (IPSCs) by employing an innovative dual-molecule interface engineering strategy. This breakthrough simultaneously resolves critical efficiency and stability challenges that have been major barriers to the commercialization of perovskite solar cells.

### Technical Details

The dual-molecule interface engineering was specifically designed to tackle interfacial recombination losses and chemical instability issues prevalent at the NiOx/perovskite junction. The research team successfully utilized a combination of two distinct molecules, Me-4PACz and CzOTf, to effectively pin charge extraction and passivate lead (Pb) defects at the interface. This approach led to an increase in the open-circuit voltage (Voc) of the device and a significant improvement in long-term operational stability. Notably, large-area devices measuring 766 cm<sup>2</sup> fabricated with this technology achieved a power conversion efficiency of 21.54%. Furthermore, these devices demonstrated outstanding stability, retaining 92% of their initial efficiency after 2000 hours of continuous light exposure under ambient conditions. The molecular interface also acts as a barrier against ion migration at the NiOx contact, decelerating chemical drift and interfacial phase destabilization.

### Background & Context

Inverted perovskite solar cells have garnered significant attention due to their advantageous optical properties and ease of fabrication. However, defects and instabilities at the interface with hole transport layers, such as NiOx, have hindered the simultaneous achievement of high efficiency and long-term stability. This dual-molecule interface strategy represents a groundbreaking approach to fundamentally resolve these issues, making it pivotal for accelerating the commercial deployment of IPSC technology. Achieving high efficiency and stability in large-area devices is a substantial step toward practical applications.

## Strategic Significance & Outlook

The impressive 27.31% certified efficiency approaches the theoretical efficiency limits of conventional silicon solar cells, indicating a potential for significant disruption in the existing photovoltaic market. This technology is expected to further enhance the cost-competitiveness and flexibility of perovskite solar cells, fostering their adoption in a wide range of applications, including building-integrated photovoltaics (BIPV) and flexible electronics. Future research will likely focus on further improving the scalability of this technology and evaluating its stability under more extreme environmental conditions to pave the way for widespread commercialization.

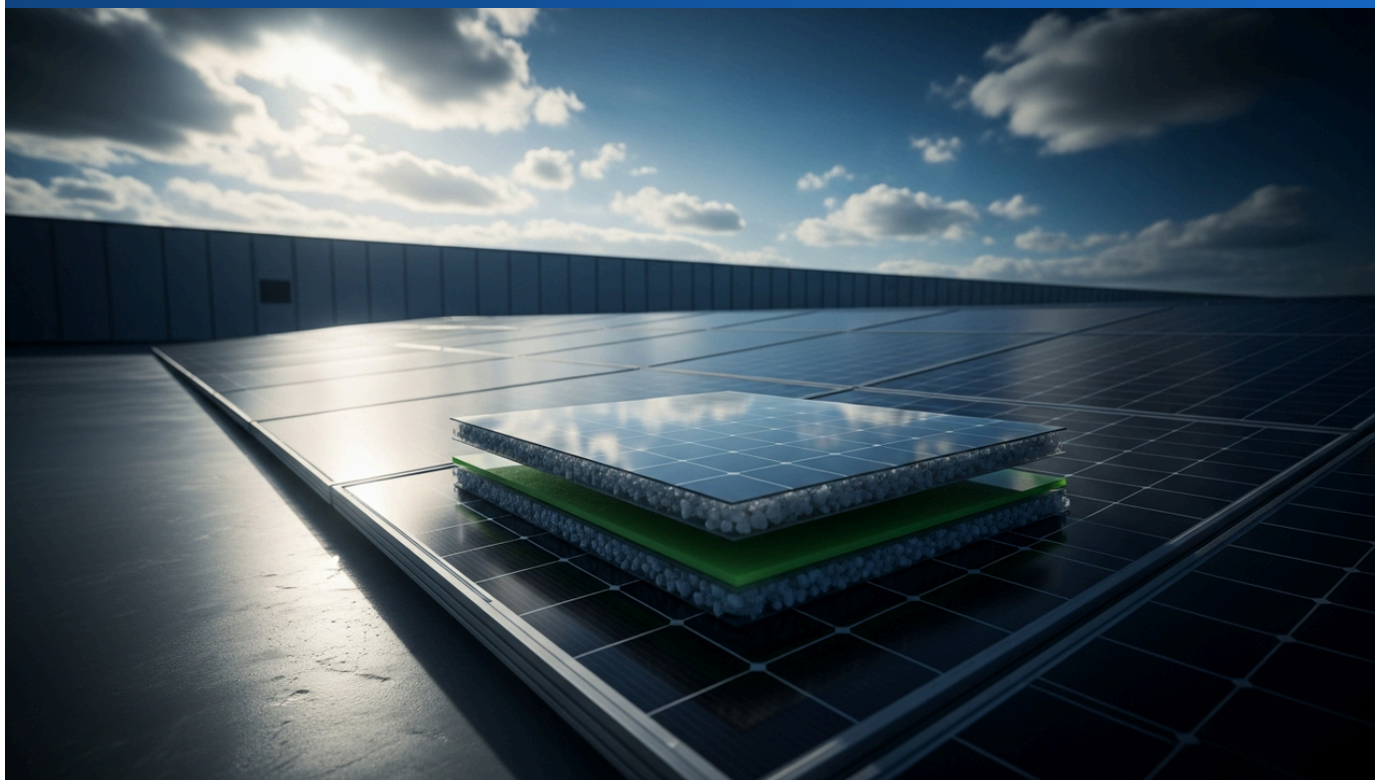
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Source: <https://www.perovskite-info.com/dual-molecule-interface-engineering-enables-2731-efficient-inverted-perovskite>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #26 Perovskite-Silicon Tandem Solar Cells Poised to Exceed 30% Efficiency, Enhancing Performance in Low-Light Conditions

Published July 05, 2026   SolarQuotes   Australia



## OVERVIEW

Perovskite-silicon tandem solar cells are expected to achieve over 30% efficiency in the coming years, significantly surpassing the 22-24% efficiency of current premium silicon solar panels. Laboratory cells have already demonstrated over 34% efficiency, with a long-term goal exceeding 40%. This technology offers superior performance in cloudy conditions and low-light environments, enabling more consistent energy production and broadening solar energy applications.

### Key Findings

Perovskite-silicon tandem solar cells are projected to achieve efficiencies exceeding 30% within the next few years, a significant leap beyond the 22-24% efficiency typical of current premium silicon solar panels. In laboratory settings, these tandem cells have already demonstrated efficiencies above 34%, with ambitious long-term goals set for over 40% power conversion.

### Technical Details

This tandem architecture ingeniously combines the strengths of both silicon and perovskite technologies. Silicon solar cells excel at absorbing longer-wavelength light, while perovskite cells are highly efficient at capturing shorter-wavelength light. By layering these two materials, the tandem cell can harness a much broader spectrum of solar energy, achieving higher overall efficiencies than either material could individually. A key advantage is their enhanced performance under low-light conditions, such as cloudy days or during dawn and dusk. Unlike conventional silicon panels that see a sharp drop in output, the perovskite layer maintains effectiveness, leading to more consistent energy generation throughout the day and year, thus optimizing total energy yield.

### Background & Context

Solar energy is a cornerstone of clean energy initiatives, but further widespread adoption hinges on continuous improvements in efficiency and cost reduction. Perovskite solar cells have been hailed as a 'miracle material' due to their high efficiency and low manufacturing potential, though stability and durability have been ongoing challenges. The tandem configuration with silicon provides a practical pathway to achieve ultra-high efficiencies while leveraging silicon's established reliability, thereby addressing some of perovskite's inherent weaknesses.

## Strategic Significance & Outlook

Efficiencies over 30% could revolutionize solar applications from residential rooftops to large-scale utility projects. This higher energy density per unit area will be particularly beneficial for space-constrained installations like urban rooftops and Building-Integrated Photovoltaics (BIPV), where maximizing power generation from limited surface area is crucial. Furthermore, the improved low-light performance will enable solar power generation in regions and times previously deemed inefficient, significantly expanding the addressable market for renewable energy. The next critical milestones for commercialization involve ensuring long-term reliability and establishing viable large-scale manufacturing techniques.

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Source: <https://solarlinkaustralia.com.au/perovskite-silicon-tandem-solar-panels-the-future-of-high-efficiency-solar-energy/>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #27 NTU Researchers Develop Ultrathin Transparent Perovskite Solar Cells, 10,000 Times Thinner Than Human Hair

Published July 06, 2026   Tech Briefs   Singapore



## OVERVIEW

Researchers at Nanyang Technological University (NTU) in Singapore have developed ultrathin transparent perovskite solar cells, approximately 10,000 times thinner than a human hair and 50 times thinner than conventional perovskite cells. This device achieves the highest power conversion efficiency for ultrathin transparent perovskite solar cells, combining high transparency, excellent stability, and scalable manufacturing. This breakthrough brings closer the future where any glass surface, such as windows, can be transformed into a power generator.



### Key Findings

A research team at Nanyang Technological University (NTU) in Singapore has developed a groundbreaking ultrathin transparent perovskite solar cell, measuring approximately 1/10,000th the thickness of a human hair. This translates to about 1/50th the thickness of typical perovskite solar cells. This extremely thin device has achieved the highest power conversion efficiency ever recorded for ultrathin perovskite solar cells, while simultaneously offering high transparency, excellent stability, and potential for scalable manufacturing.

### Technical Details

The development of this innovative ultrathin transparent perovskite solar cell was made possible through advanced material science and fabrication processes. The research team meticulously controlled the thickness of the active layers down to the nanometer scale, effectively maximizing transparency without compromising light absorption efficiency. This extremely thin structure not only enhances light transmittance but also reduces material consumption, contributing to lower manufacturing costs. Furthermore, the developed device has demonstrated promising stability under specific environmental conditions, addressing durability concerns typically associated with thin-film solar cells. While the precise power conversion efficiency value was not disclosed, its characterization as 'highest-ever' signifies a critical advancement in this specialized field.

### Background & Context

Transparent solar cells hold immense potential to revolutionize renewable energy integration in urban environments by transforming glass surfaces—such as building windows, smart device displays, and automotive sunroofs—into efficient power generators. However, the long-standing challenge has been to achieve both high transparency and sufficient power conversion efficiency simultaneously. Traditional transparent solar technologies often involve a trade-off between light transmission and energy conversion, which has limited their practical deployment. The NTU research directly addresses this trade-off, making a substantial contribution to the viability of transparent photovoltaics.

## Strategic Significance & Outlook

The ultrathin and transparent perovskite solar cell is poised to transform the concept of energy infrastructure by turning virtually any glass surface into a power-generating asset, dubbed 'windows of the future.' This innovation could fundamentally alter how solar energy is integrated into urban landscapes, significantly boosting energy self-sufficiency in cities. It is envisioned that these cells could be easily integrated into both existing structures and new architectural designs, leading to substantial reductions in building energy consumption. For commercialization, the next steps will involve establishing large-scale manufacturing techniques, validating long-term stability under various environmental stresses, and optimizing cost-effectiveness for mass adoption.

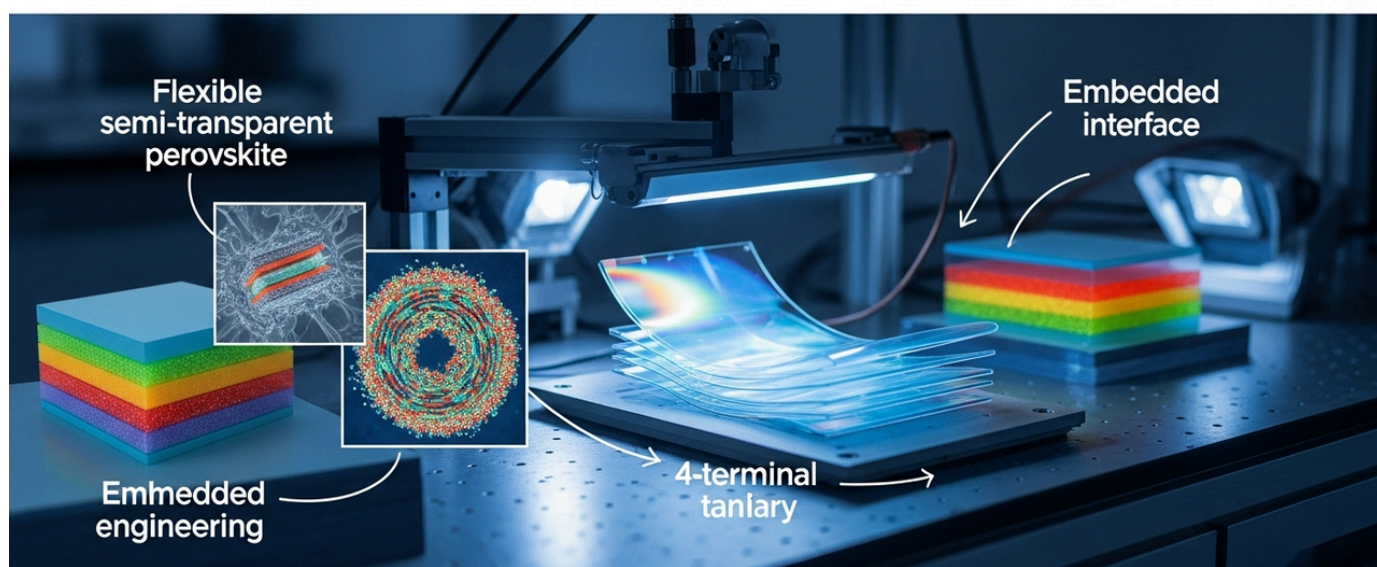
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Source: <https://www.techbriefs.com/component/content/article/55456-windows-of-the-future-ultrathin-solar-cells-could-turn-any-glass-into-a-power-generator>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #28 Buried-Interface Engineering Delivers 21.4% Flexible Semitransparent Perovskite Cells and 27.7% Four-Terminal Tandems

Published July 08, 2026 ACS Energy Letters International



## OVERVIEW

A novel buried-interface engineering strategy has enabled the development of flexible semitransparent perovskite solar cells (FS-PSCs) with a champion efficiency of 21.4%. Leveraging this technology, all-flexible four-terminal perovskite/silicon tandem solar cells were fabricated, achieving a champion efficiency of 27.7%. These devices demonstrated exceptional long-term stability with minimal degradation after 500 hours of continuous maximum power point (MPP) tracking under 1-sun illumination, and remarkable mechanical stability, retaining 94.5% of their initial efficiency after 2000 bending cycles.

### Key Findings

Researchers have developed an innovative buried-interface engineering strategy, leading to the creation of flexible semitransparent perovskite solar cells (FS-PSCs) with a remarkable champion efficiency of 21.4%. Furthermore, applying this technology, an all-flexible perovskite/silicon four-terminal tandem solar cell was fabricated, recording an exceptionally high champion efficiency of 27.7%. Crucially, these devices exhibit outstanding long-term stability and mechanical robustness.

### Technical Details

The buried-interface engineering technique focuses on optimizing the interactions between the perovskite layer and adjacent functional layers. While specific details of the materials and structural approaches are not fully elaborated, it is understood that new methodologies were employed to maximize charge carrier extraction efficiency and suppress non-radiative recombination at these critical interfaces. The flexible and semitransparent nature of the FS-PSCs is vital for specific applications, such as integrated windows or wearable electronics. The 21.4% efficiency for FS-PSCs served as a strong foundation for the 4-terminal perovskite/silicon tandem configuration, where optimized layering led to the 27.7% efficiency. A highlight of this research is the unprecedented mechanical stability demonstrated: the devices showed negligible efficiency degradation after 500 hours of continuous maximum power point (MPP) tracking under 1-sun illumination, and impressively maintained 94.5% of their initial efficiency even after 2000 bending cycles. This represents a significant breakthrough for the practical realization of flexible photovoltaic devices.

## Background & Context

The demand for flexible solar cells is rapidly increasing due to their advantages in conformability to curved surfaces, lightweight design, and portability, which are challenging for traditional rigid panels. Semitransparent flexible solar cells, in particular, open up new market segments that balance aesthetics and functionality, such as building-integrated photovoltaics (BIPV), automotive applications, and consumer electronics. However, simultaneously achieving high efficiency, flexibility, and long-term stability has been a substantial technological hurdle. This buried-interface engineering provides an effective solution to these challenges, accelerating the commercial viability of flexible solar cells.

## Strategic Significance & Outlook

The 27.7% efficiency achieved for flexible four-terminal tandem solar cells is highly competitive, even when compared to established photovoltaic technologies. This advancement has broad implications for BIPV, wearable electronics, IoT sensors, and automotive solar applications. The superior mechanical stability suggests these devices can withstand harsh operational conditions, contributing to extended product lifetimes and reduced maintenance costs. Future research will concentrate on demonstrating the scalability of this technology for mass production and further validating its long-term reliability under more diverse and extreme environmental conditions.

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Source: <https://pubs.acs.org/doi/10.1021/acsenergylett.6c01361>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #30 HZB Team Achieves 27.3% Efficiency and 770-Hour Stability with GO/SAM Bilayer in Perovskite Triple-Junction Solar Cells

Published July 09, 2026   Mirage News   Germany



## OVERVIEW

A research team at Helmholtz-Zentrum Berlin (HZB) has developed perovskite triple-junction solar cells utilizing a novel bilayer of graphene oxide (GO) and a self-assembled monolayer (SAM) as the hole transport layer. This innovative architecture significantly enhances both efficiency and long-term stability, achieving a power conversion efficiency of 27.3%. Furthermore, the devices established a new stability record, showing minimal degradation after over 770 hours of continuous operation.



### Key Findings

Researchers at Helmholtz-Zentrum Berlin (HZB) in Germany have achieved a breakthrough in perovskite triple-junction solar cells by incorporating a novel bilayer structure composed of graphene oxide (GO) and a self-assembled monolayer (SAM) as the hole transport layer. This innovative design has led to a remarkable power conversion efficiency of 27.3% and established a new stability record, with the devices exhibiting negligible degradation after more than 770 hours of continuous operation.

### Technical Details

Triple-junction solar cells aim to surpass the theoretical efficiency limits of single-junction devices by stacking three absorption layers with different bandgaps, thereby capturing a broader range of the solar spectrum. The core of this breakthrough lies in the design of the novel hole transport layer (HTL) comprising GO and SAM. Graphene oxide (GO) offers excellent conductivity and transparency, while SAM effectively passivates interfacial defects and allows for precise energy level alignment. By employing this GO/SAM bilayer as the HTL, holes were efficiently extracted from the perovskite layer, and non-radiative recombination at the interface was dramatically suppressed. This resulted in improved open-circuit voltage (Voc) and fill factor (FF), ultimately leading to the high efficiency of 27.3%. Additionally, this HTL contributed to the chemical and physical stability of the devices, demonstrating exceptional long-term stability with only a marginal efficiency drop over 770 hours of continuous light exposure testing.

### Background & Context

While perovskite solar cells have achieved high conversion efficiencies, maintaining both stability and efficiency, particularly in multi-junction configurations, remains a significant challenge. High-performing charge transport layers are indispensable for efficient carrier extraction and passivation of interfacial defects, profoundly influencing overall device performance. HZB's research, building on its previous record of 25.5% efficiency for CIGS-perovskite tandem cells, solidifies its global leadership in multi-junction perovskite technology. The introduction of the GO/SAM bilayer stands out as a crucial new interfacial engineering strategy for complex multi-junction structures.

## Strategic Significance & Outlook

The combination of 27.3% high efficiency and superior stability exceeding 770 hours represents a substantial step towards the commercialization of perovskite triple-junction solar cells. This technology is expected to accelerate adoption across diverse application sectors, including building-integrated photovoltaics (BIPV), flexible electronics, and high-efficiency solar power plants. Notably, improved long-term stability is critical for extending device lifespan and reducing maintenance costs. Future research will focus on validating the scalability of this GO/SAM bilayer technology for mass production, further evaluating its environmental robustness, and addressing challenges such as transitioning to lead-free formulations.

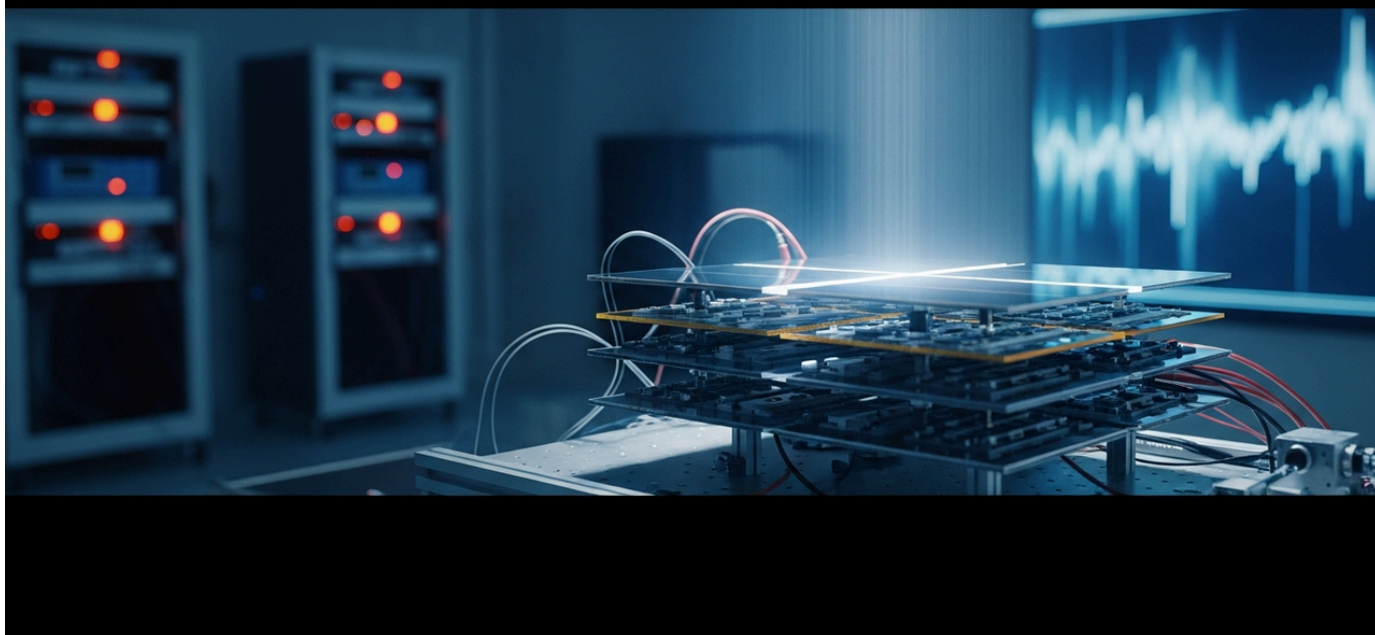
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Source: <https://www.miragenews.com/gosam-boosts-perovskite-solar-cell-efficiency-1707734/>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #31 Trinasolar Achieves World Record 907W Power Output and 29.2% Efficiency for Perovskite/Crystalline Silicon Tandem Module

Published July 07, 2026   Modern Power Systems   China



## OVERVIEW

Trinasolar has announced a new world record for its self-developed perovskite/crystalline silicon tandem module, achieving a peak power output of 907 W and a full-area module efficiency of 29.2%. This achievement, independently verified by TÜV SÜD, sets a new benchmark in tandem module output. The technology has the potential to significantly push the efficiency limits of photovoltaics and dramatically enhance power generation capacity in limited spaces.

### Key Findings

Trinasolar, a leading global photovoltaic company, has announced that its proprietary perovskite/crystalline silicon tandem module has established new world records, achieving a peak power output of 907 W and a full-area module efficiency of 29.2%. This groundbreaking achievement has been independently verified by TÜV SÜD, an international certification body, setting a new benchmark for performance in tandem modules.

### Technical Details

The record-breaking tandem module features an innovative structure where a perovskite solar cell acts as the top layer, stacked upon a crystalline silicon solar cell as the bottom layer. The perovskite layer efficiently absorbs short-wavelength sunlight, while the underlying silicon cell captures longer-wavelength light. This dual-layer approach enables the conversion of a broader spectrum of solar radiation into electricity, achieving higher conversion efficiencies than either single-junction solar cell could individually. Trinasolar leveraged its unique process technologies and material designs to minimize interfacial losses and maximize the collection efficiency of charge carriers. The 907 W peak power output demonstrates an exceptional generation capability in a practical module size, and the 29.2% full-area module efficiency surpasses previous world records for similar modules. The TÜV SÜD certification ensures the reliability and reproducibility of this advanced technology.

### Background & Context

As global energy demand continues to rise, further advancements in photovoltaic efficiency are imperative. There is a strong need for maximizing power generation from limited installation areas, making the development of high-efficiency solar modules a central focus of industry competition. Tandem solar cells are emerging as a key technology to overcome the theoretical efficiency limits of conventional single-junction silicon solar cells, leading to an intense race among companies to develop superior solutions. Trinasolar, with its deep expertise in both materials science and manufacturing technology, is demonstrating leadership in this critical technological domain.

## Strategic Significance & Outlook

Trinasolar's world record of 907 W output and 29.2% efficiency for its tandem module is expected to have a profound impact on the photovoltaic industry. The deployment of such high-efficiency modules across various applications, from residential installations to large-scale solar farms, is anticipated to reduce balance-of-system (BOS) costs and significantly improve the land-use efficiency of solar power plants. This technology is particularly crucial for maximizing power generation capacity in areas with land constraints or limited space, such as building rooftops. Future efforts will focus on further cost reduction, establishing mass production capabilities, and verifying long-term reliability, positioning perovskite/crystalline silicon tandem solar cells as a potential mainstream solar technology.

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Source: <https://www.modernpowersystems.com/news/trinasolar-achieves-power-output-record-for-perovskite-crystalline-module/>

Collected: July 10, 2026 | Automated Research System (Gemini API)



# #32 Oxford PV Commences Shipments of 24.5% Efficient Commercial Tandem Modules; JinkoSolar Achieves 34.82% Efficiency, Accelerating Commercialization

Published July 02, 2026   Solar Panel Cost Guide Australia   Australia



## OVERVIEW

Commercial production of perovskite solar cells is gaining momentum, with Oxford PV commencing shipments of its first commercial tandem modules, boasting approximately 24.5% module efficiency, for utility-scale projects in the US. Trina Solar has also secured its first commercial customer for tandem panels. Major manufacturers are rapidly setting new efficiency records and accelerating commercialization; LONGi achieved a certified efficiency of 34.85% in 2025, and JinkoSolar reached 34.82% efficiency in June 2026 with a tandem cell based on N-type TOPCon technology.



### Key Findings

Commercial production of perovskite solar cells is fully underway, with industry leaders continuously shipping commercial products and breaking efficiency records. Notably, Oxford PV has begun shipping its first commercial tandem modules, featuring approximately 24.5% module efficiency, for utility-scale projects in the United States. In addition, Trina Solar has secured its initial commercial customers for tandem panels, indicating an accelerating trend towards commercialization.

### Technical & Market Details

Perovskite solar cells have long been anticipated as a next-generation technology due to their potential for high efficiency—potentially surpassing the theoretical limits of conventional silicon solar cells—and low-cost manufacturing. Oxford PV's commercial module shipments represent a significant milestone, transitioning laboratory achievements into practical market products. A module efficiency of 24.5% rivals the highest-performing mainstream silicon modules and demonstrates a clear path for further efficiency gains through tandem structures. Other major manufacturers are also achieving record-breaking efficiencies: LONGi recorded a certified efficiency of 34.85% in 2025, and JinkoSolar achieved 34.82% efficiency in June 2026 with a tandem cell built upon its N-type TOPCon technology. These figures unequivocally demonstrate that perovskite technology is elevating solar power efficiency to unprecedented levels, beyond the capabilities of single-junction crystalline silicon.

### Background & Context

The commercialization of perovskite solar cells has historically been challenged by issues of long-term stability and manufacturing scalability. The recent activities by companies like Oxford PV and Trina Solar suggest that these hurdles are being overcome, and the technology is maturing for market acceptance. The deployment in utility-scale projects, in particular, serves as strong evidence of the perceived reliability and economic viability of perovskite solar cells. Furthermore, the focus of established solar giants like JinkoSolar and LONGi on tandem technology, combining their robust silicon expertise with perovskites, reflects strong confidence in the future potential of this sector.

## Strategic Significance & Outlook

The commencement of commercial tandem module shipments, coupled with consecutive efficiency records exceeding 34%, further solidifies the potential for perovskite solar cells to become a mainstream technology in the photovoltaic market. Higher efficiencies will maximize power generation from limited installation areas and contribute to overall system cost reductions. Consequently, adoption is expected to accelerate across a wide range of markets, from large-scale power plants to residential applications and specialized uses. If low-cost manufacturing can be fully realized, perovskite technology is poised to revolutionize the existing energy mix and significantly contribute to global decarbonization goals. Moving forward, the long-term performance and stability data from these initial deployment projects will be crucial for the technology's continued proliferation and development.

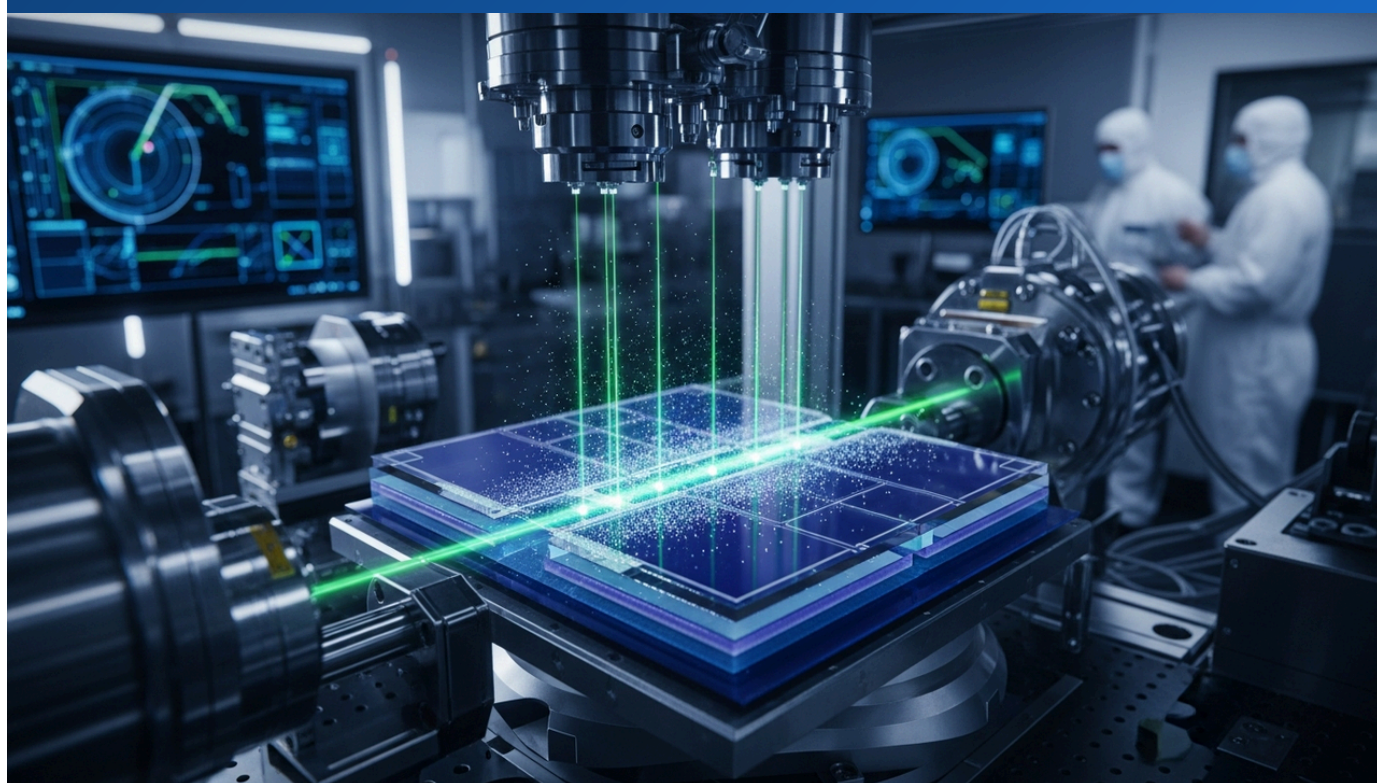
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Source: <https://www.solardirectory.com.au/solar-directory-blog/3606-what-happened-to-perovskite-solar-panels>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #33 Synergistic Buried-Interface Engineering via Ion Exchange and Passivation Achieves 25.95% Efficient and 1,200-Hour Stable Inverted Perovskite Solar Cells

Published July 04, 2026   ResearchGate   Unknown



## OVERVIEW

Researchers have successfully developed high-performance inverted perovskite solar cells (IPSCs) through a synergistic buried-interface engineering strategy combining ion exchange and passivation. Devices with a  $1\text{ cm}^2$  active area achieved a power conversion efficiency of 25.95%. Critically, they demonstrated exceptional long-term stability, maintaining 100% of their initial efficiency after 1,200 hours of continuous 1-sun illumination at the maximum power point, marking a significant advancement towards practical perovskite solar cell applications.

### Key Findings

Researchers have successfully realized high-performance inverted perovskite solar cells (IPSCs) by developing a novel synergistic buried-interface engineering strategy that combines ion exchange and passivation. Devices fabricated with this technology achieved a high power conversion efficiency of 25.95% on a 1 cm<sup>2</sup> active area. Furthermore, and remarkably, these devices demonstrated extraordinary long-term stability, maintaining 100% of their initial efficiency after 1,200 hours of continuous 1-sun illumination at the maximum power point (MPP). This represents a substantial improvement in addressing the primary stability challenge of perovskite solar cells.

### Technical Details

This buried-interface engineering aims to effectively suppress defects at the interface between the perovskite layer and the charge transport layer. The ion exchange process optimizes the crystal structure near the interface, reducing defect sites that contribute to non-radiative recombination. Simultaneously, the introduction of a passivation layer fine-tunes the energy levels at the interface, maximizing the efficiency of charge carrier extraction. These synergistic effects significantly extend carrier lifetime, leading to improvements in open-circuit voltage (Voc) and fill factor (FF). As a result, not only was a high efficiency of 25.95% achieved, but the devices also gained robustness against external environmental factors, exhibiting no efficiency degradation over 1,200 hours of continuous MPP operation. This groundbreaking data alleviates concerns regarding the durability of perovskite solar cells.

### Background & Context

Inverted perovskite solar cells are gaining increasing commercial interest due to their simpler structure and high efficiency. However, the inherent instability of perovskite materials and defects at interfaces have been major factors undermining the long-term reliability of these devices. Particularly, the quality of the buried interface has a decisive impact on device performance. This research addresses these fundamental issues by combining two powerful techniques: ion exchange and passivation. Such advances in interface engineering significantly reduce the technological barriers to the commercialization of perovskite solar cells.

## Strategic Significance & Outlook

The combination of 25.95% high efficiency and outstanding stability (100% retention over 1,200 hours) indicates that perovskite solar cells are making strong progress towards practical applications. This technology is expected to accelerate adoption in a wide range of fields, including Building-Integrated Photovoltaics (BIPV), flexible solar cells, and IoT devices. Enhanced long-term stability is essential for improving product reliability and market acceptance. Future research will focus on validating the scalability of this technology for mass production, evaluating stability under more severe environmental conditions, and optimizing cost-effectiveness. This research outcome further strengthens the potential for perovskite solar cells to become a leading renewable energy source in the near future.

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Source:

[https://www.researchgate.net/publication/408384603\\_Synergistic\\_Buried\\_Interface\\_Engineering\\_via\\_Ion\\_Exchange\\_Performance\\_Inverted\\_Perovskite\\_Solar\\_Cells](https://www.researchgate.net/publication/408384603_Synergistic_Buried_Interface_Engineering_via_Ion_Exchange_Performance_Inverted_Perovskite_Solar_Cells)

Collected: July 10, 2026 | Automated Research System (Gemini API)



# #34 Chinese Researchers Boost Wide-Bandgap Perovskite Solar Cell Efficiency to 23.54% with Dual-Molecule Surface Passivation

Published July 04, 2026   perovskite-info.com   China



## OVERVIEW

A Chinese research team has developed a dual-molecule surface passivation strategy that significantly enhances both the efficiency and operational stability of wide-bandgap (WBG) perovskite solar cells. Devices incorporating this novel strategy achieved a power conversion efficiency (PCE) of 23.54% and a high open-circuit voltage (Voc) of 1.26V, along with substantially improved stability. This achievement represents a major step forward for the practical implementation of WBG perovskite cells, essential for high-performance tandem solar cells.



### Key Findings

A team of Chinese researchers has developed a dual-molecule surface passivation strategy that significantly boosts the performance of wide-bandgap (WBG) perovskite solar cells. This innovative approach has led to devices achieving a power conversion efficiency (PCE) of 23.54% and a high open-circuit voltage (Voc) of 1.26V, while simultaneously demonstrating dramatically improved operational stability. This accomplishment marks a critical milestone towards the realization of high-efficiency tandem solar cell systems.

### Technical Details

Wide-bandgap perovskite solar cells are crucial as top cells in tandem architectures with materials like silicon, essential for achieving high overall system efficiencies. However, WBG perovskite materials are inherently prone to surface defects, which act as primary sources for non-radiative recombination of charge carriers, thereby reducing efficiency and stability. The dual-molecule surface passivation strategy developed by the research team aims to effectively passivate these surface defects. This strategy involves combining two different organic molecules that specifically bind to defect sites on the perovskite surface, reducing trap states. This mechanism extends carrier lifetime and streamlines charge extraction, resulting in an improved PCE of 23.54% and a high Voc of 1.26V. Additionally, the passivation layer acts as a protective barrier against environmental factors, significantly enhancing the device's long-term operational stability.

### Background & Context

In the field of perovskite solar cells, achieving efficiencies above 30% through tandem structures is the next major objective. To reach this goal, efficient and stable WBG perovskite top cells are indispensable. Previous research on WBG perovskites has faced challenges in simultaneously achieving high efficiency and stability. This new dual-molecule surface passivation strategy offers a promising solution to this long-standing problem. The approach, specifically focusing on surface defects, is considered a vital frontier in improving device performance.

## Strategic Significance & Outlook

WBG perovskite solar cells that combine high efficiency (23.54%), high Voc (1.26V), and improved stability will significantly accelerate the commercialization of high-efficiency tandem solar cell systems. This technology is expected to unleash its full potential as a top cell in perovskite/silicon tandem structures, potentially elevating the overall system conversion efficiency to groundbreaking levels. Future efforts will focus on validating the scalability of this dual-molecule surface passivation strategy for mass production, further evaluating its environmental robustness, and exploring its applicability for lead-free materials. This achievement makes a substantial contribution to the advancement of clean energy technologies.

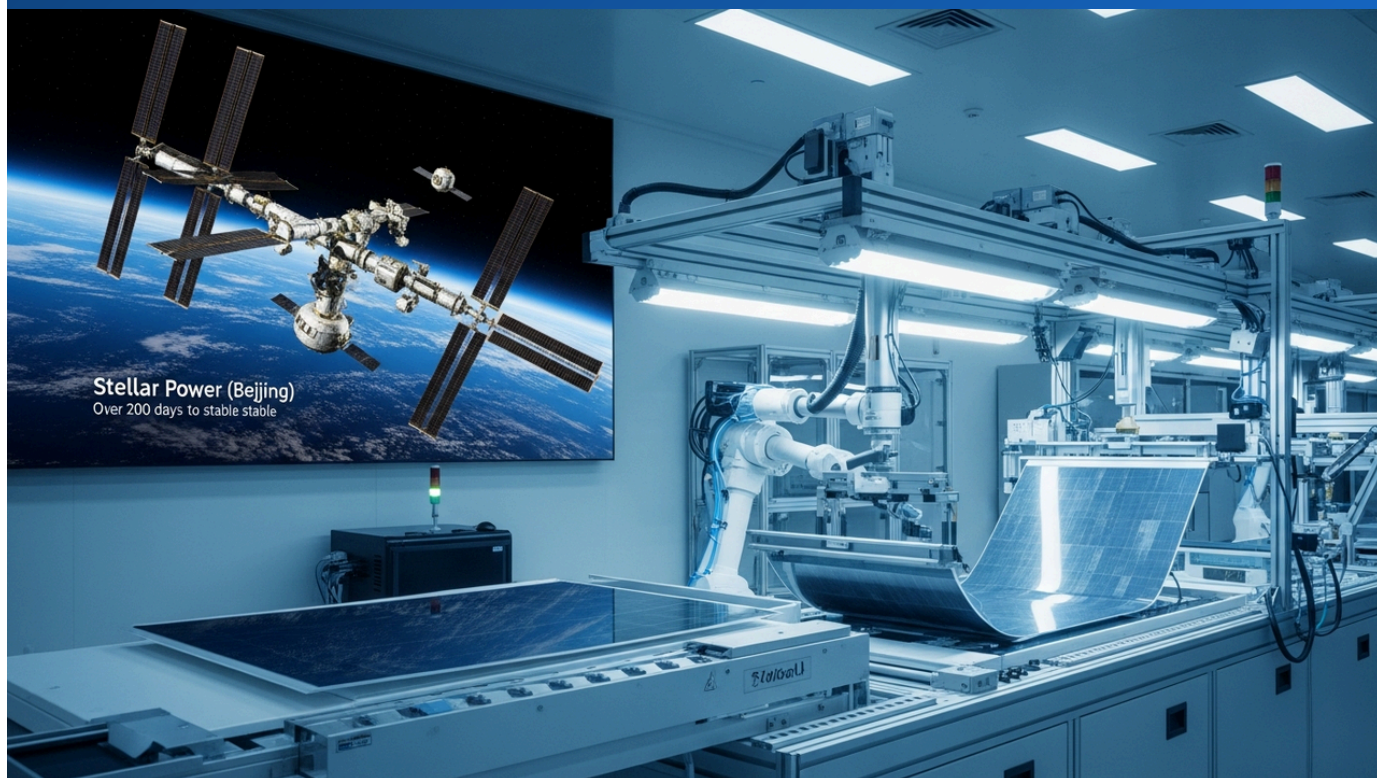
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Source: <https://www.perovskite-info.com/synergistic-surface-engineering-delivers-2354-efficient-wbg-perovskite-solar>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #35 Stellar Power (Beijing) Breaks Ground on World's FIRST Space Solar Factory for Perovskite Cells, Demonstrating Over 200 Days of Stable Operation on Tiangong Space Station

Published July 07, 2026   YouTube (Stellar Power (Beijing) Technology Co.)   China



## OVERVIEW

Stellar Power (Beijing) Technology Co. has commenced construction of the world's first perovskite solar cell pilot line for space applications in Beijing. Scheduled to be operational by August 2026, this facility aims to manufacture ultra-lightweight, flexible, and low-cost perovskite solar cells designed for harsh space environments. Notably, Stellar Power's samples have already demonstrated over 200 days of stable operation on China's Tiangong Space Station, significantly advancing the practical application of this technology in space.

### Key Findings

Stellar Power (Beijing) Technology Co. has broken ground on what it claims to be the 'world's first perovskite solar cell pilot line for space applications' in Beijing. This groundbreaking facility, projected to be operational by August 2026, is dedicated to manufacturing ultra-lightweight, flexible, and low-cost perovskite solar cells engineered to withstand the extreme conditions of space. Crucially, samples produced by Stellar Power have already demonstrated stable operation for over 200 days on China's Tiangong Space Station, marking a significant technological milestone towards practical space utilization.

### Technical Details

Space presents an incomparably harsh environment compared to Earth. Solar cells deployed in space demand exceptionally high durability and reliability to endure extreme temperature fluctuations, high levels of radiation, microgravity, and atomic oxygen degradation. The perovskite solar cells developed by Stellar Power are specifically designed to address these challenges, with expected characteristics including:

- **Ultra-lightweight:** Significantly reduces launch costs, enabling heavier payloads.
- **Flexibility:** Allows for deployable structures and adaptation to curved surfaces, enhancing spacecraft design freedom.
- **High Efficiency:** Harnesses abundant solar radiation in space to deliver maximum power from limited surface areas.
- **Radiation Hardness:** Enhanced resistance to radiation degradation prevalent in the space environment.

The proven stable operation for over 200 days on the Tiangong Space Station validates that these design objectives are being met in a real-world space environment. This technology holds the potential to substantially reduce costs compared to traditional space solar cells (e.g., gallium arsenide) while providing comparable or superior performance and reliability.

## Background & Context

Power supply for satellites and space stations has always been a critical challenge in the space industry. Conventional space solar cells are expensive and heavy, imposing limitations on launch costs and spacecraft design. Perovskite solar cells have long been recognized for their potential as space power sources due to their excellent cost-effectiveness and ease of fabricating thin-film, flexible devices. Stellar Power's initiative to build this pilot line is the first step towards industrializing this potential, signaling China's proactive push for innovation in space technology.

## Strategic Significance & Outlook

The operation of this space-grade perovskite solar cell pilot line is poised to significantly impact not only China's space industry but also global space technology development. Ultra-lightweight, flexible, and low-cost solar cells could establish new power supply standards for future space missions, including small satellite constellations, deep-space probes, and lunar bases. For commercialization, key factors will include optimizing production efficiency at the pilot line, conducting further long-term reliability tests, and forging partnerships with international space agencies and companies. Stellar Power's success could fundamentally alter the cost structure of space exploration, potentially enabling more frequent and cost-effective space missions.

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Source: <https://www.youtube.com/watch?v=vbsoUNSZWHI>

# #36 Protonated Cyclohexylamine Passivation Layer Boosts Perovskite Solar Cell Efficiency to 21.53%, Demonstrates 720-Hour Stability

Published July 03, 2026   ACS Applied Energy Materials   International



35\_protonated-cyclohexylamine-passivation-layer-boosts-perovski

## OVERVIEW

Researchers have developed high-performance perovskite solar cells utilizing protonated cyclohexylamine as an effective passivation layer. This modified device achieved a champion power conversion efficiency (PCE) of 21.53%, an 11.21% improvement over the 19.36% of the control device. Furthermore, it demonstrated significantly enhanced stability, retaining 80% of its initial PCE after 720 hours of operation. This advancement contributes to solving the stability challenges in commercializing perovskite solar cells.



### Key Findings

A research team has developed a novel method incorporating protonated cyclohexylamine as a passivation layer in perovskite solar cells, dramatically improving both device performance and stability. This modified perovskite solar cell achieved an outstanding champion power conversion efficiency (PCE) of 21.53%, marking an 11.21% increase compared to the 19.36% of the control device. Additionally, it demonstrated significantly enhanced long-term stability, retaining 80% of its initial PCE after 720 hours of continuous operation.

### Technical Details

The performance of perovskite solar cells critically depends on the quality of the material's crystal structure and the density of defects at interfaces. Specifically, defects present on the perovskite layer's surface or at grain boundaries lead to non-radiative recombination of photogenerated charge carriers, thereby reducing efficiency and compromising stability. The protonated cyclohexylamine introduced in this study effectively passivates these defect sites by specifically binding to them, reducing trap states. The formation of this passivation layer extends carrier lifetime, improves charge collection efficiency, and consequently optimizes the open-circuit voltage (Voc) and fill factor (FF), leading to the substantial increase in PCE to 21.53%. Moreover, the cyclohexylamine layer acts as a barrier against moisture and oxygen ingress from the external environment, enhancing the chemical stability of the device and enabling superior long-term operational stability, with 80% PCE maintained after 720 hours. This represents a significant advancement over previous passivation techniques.

### Background & Context

Perovskite solar cells are garnering significant anticipation as a next-generation photovoltaic technology due to their high efficiency and potential for low-cost manufacturing. However, securing long-term stability has been the primary challenge for their commercialization. Vulnerability to humidity, heat, and light has been noted as a particular concern, and the development of passivation techniques to overcome these issues is at the forefront of research. Surface modification using organic molecules like cyclohexylamine is a promising approach to fine-tune the physical and chemical properties of materials and effectively treat defects.

## Strategic Significance & Outlook

This technology, which achieves both high efficiency (21.53%) and excellent stability (80% retention over 720 hours), represents a crucial progression towards the practical implementation of perovskite solar cells. This breakthrough is expected to accelerate the adoption of perovskite solar cells in a wide range of applications, from residential and commercial uses to flexible devices. The development of a low-cost passivation layer is particularly important as it opens the way for mass production and enhances the economic competitiveness of perovskite solar cells. Future research will focus on further validating the long-term reliability of this protonated cyclohexylamine layer and evaluating its performance under more demanding environmental conditions.

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Source: <https://pubs.acs.org/doi/10.1021/acsaem.6c01637>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #37 Dazheng Micro-Nano Secures A4 Funding Round to Boost Flexible Perovskite Solar Production, Plans 100 MW Production Line

Published July 07, 2026   Perovskite-Info   China



## OVERVIEW

Dazheng (Jiangsu) Micro-Nano Technology has completed its A4 funding round to accelerate the development and production of flexible perovskite solar cell modules. The capital raised will be used to construct what the company calls the 'world's first 100 MW-class dedicated production line for flexible perovskite modules.' This new facility is expected to have an annual production capacity exceeding 800,000 square meters of modules, marking a significant move to expand the flexible solar cell market.

### Key Findings

Dazheng (Jiangsu) Micro-Nano Technology has successfully completed its A4 funding round to further advance the development and commercialization of flexible perovskite solar cell modules. The funds raised in this round are earmarked for the construction of a large-scale facility that the company claims will be the 'world's first 100 MW-class dedicated production line for flexible perovskite modules.' With this new production line in operation, Dazheng Micro-Nano Technology anticipates an annual module production capacity exceeding 800,000 square meters, aiming to establish a leading position in the flexible solar cell market.

### Technical & Business Details

Flexible perovskite solar cells hold immense potential for applications requiring curved surfaces or lightweight properties, which are challenging for traditional rigid silicon solar cells. Dazheng Micro-Nano Technology is at the forefront of technological development in this area, particularly focusing on establishing large-scale manufacturing techniques using printing processes. A production capacity of 100 MW significantly surpasses pilot-line scales, enabling substantial commercial production. The ability to produce over 800,000 square meters annually can meet demand across various flexible solar cell markets, including automotive, Building-Integrated Photovoltaics (BIPV), wearable devices, and IoT sensors. This funding round indicates that Dazheng Micro-Nano Technology is building strong competitive advantages across the entire value chain, from materials research to device manufacturing and market entry.

### Background & Context

The global solar power market is expanding rapidly driven by climate change mitigation and energy security concerns, with particular anticipation for next-generation technologies. Perovskite solar cells are garnering attention for their high conversion efficiency and potential for low-cost manufacturing. Among these, flexible perovskite solar cells, which can be deposited on flexible substrates, are expected to create new market segments. China leads the world in solar PV R&D and industrialization, and the successful funding of companies like Dazheng Micro-Nano Technology underscores the strength of China's technological innovation ecosystem. Investors recognize the long-term growth potential and disruptive capabilities of perovskite solar cells.

## Strategic Significance & Outlook

The construction of a 100 MW-class flexible perovskite solar cell production line will not only expand Dazheng Micro-Nano Technology's operations but also significantly impact the entire global flexible solar cell market. This is expected to lead to cost reductions through economies of scale, potentially making flexible solar cells more affordable. The company's goal is to achieve high-volume production while maintaining high efficiency and long-term reliability. Future challenges include ensuring stable operation of the production line, maintaining product quality control, and establishing competitiveness in international markets. This funding marks a crucial step towards the practical implementation and widespread adoption of flexible perovskite solar cells in diverse applications.

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Source: <https://www.perovskite-info.com/dazheng-micro-nano-secures-new-investment-advance-flexible-perovskite-solar>

Collected: July 10, 2026 | Automated Research System (Gemini API)



# #38 Maxwell Technologies Unveils Perovskite-HJT Tandem Production Solutions Exceeding 31% Efficiency at SNEC 2026, 600MW Commercial Line Operational

Published July 03, 2026   TaiyangNews   China



## OVERVIEW

Suzhou Maxwell Technologies showcased three groundbreaking manufacturing solutions at SNEC and Intersolar Europe 2026, including a perovskite-HJT tandem production line, GW-scale HJT production line, and an indium-free copper metallization process. The perovskite-HJT solution supports 210mm large-area formats and offers flexible configurations from 20MW pilot lines to 600MW commercial production lines. The company's platform has demonstrated cell conversion efficiencies exceeding 31%, with the first commercial production line for HJT-perovskite technology commencing operation at a customer factory in the last week of June 2026.



### Key Findings

Suzhou Maxwell Technologies unveiled three revolutionary manufacturing solutions for perovskite solar cell production at SNEC and Intersolar Europe 2026. These include a perovskite-heterojunction (HJT) tandem production line, a gigawatt (GW)-scale HJT production line, and an indium-free copper metallization process. Notably, the perovskite-HJT tandem solution supports 210mm large-area formats and has demonstrated cell conversion efficiencies exceeding 31% on the company's platform. Furthermore, the first commercial production line leveraging HJT-perovskite technology commenced operation at a customer facility in the last week of June 2026.

### Technical Details

Maxwell Technologies' perovskite-HJT tandem production line is specifically designed for manufacturing next-generation solar cells. Heterojunction (HJT) technology is renowned for its high conversion efficiency and excellent temperature coefficient. By integrating perovskites with HJT, the system can capture a wider portion of the solar spectrum, significantly surpassing the theoretical efficiency limits of single-junction solar cells. The company's solution supports large 210mm wafer formats, which directly translates to improved cost-efficiency and throughput in large-scale production. The production line can be flexibly configured from a 20 MW pilot line to a future-proof 600 MW commercial production line, tailored to customer needs. Cell conversion efficiencies exceeding 31% are comparable to leading laboratory records, showcasing Maxwell's robust technological capability to achieve high efficiency in a mass production environment. Additionally, the indium-free copper metallization process contributes to reduced manufacturing costs and enhanced sustainability by eliminating the use of the rare metal indium.

## Background & Context

The solar photovoltaic industry faces the dual challenge of simultaneously improving efficiency and reducing costs. Perovskite-HJT tandem technology is considered one of the most promising solutions to this challenge, attracting major solar cell manufacturers worldwide into a fierce development race. As a leading supplier of solar cell manufacturing equipment, Maxwell Technologies is contributing to the industry's advancement by providing production solutions that accelerate the practical implementation of this technology. The commencement of commercial production lines, in particular, signifies a shift from mere research stages to actual market deployment, creating a significant impact across the industry.

## Strategic Significance & Outlook

The availability of Maxwell Technologies' perovskite-HJT tandem production solutions and the operational status of commercial production lines will significantly accelerate the market introduction of next-generation solar cells. The ability to mass-produce high-efficiency cells exceeding 31% will lead to further reductions in the Levelized Cost of Electricity (LCOE), making solar power even more competitive. This technology is expected to see widespread adoption in high-efficiency applications, including residential, commercial, large-scale solar farms, and specialized uses. The adoption of an indium-free process mitigates material sourcing risks and contributes to supply chain stability. The market is keenly observing how this high-efficiency technology is commercialized and what market share it ultimately captures, making Maxwell Technologies' trajectory a crucial indicator for the future direction of the solar PV industry.

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Source: <https://taiyangnews.info/technology/maxwell-tandem-hjt-manufacturing-2026-snec-intersolar>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #39 Data-Driven Atomistic Modeling Unravels Surface Passivation Mechanism of Hybrid Halide Perovskites

Published July 07, 2026 arXiv Unknown



## OVERVIEW

Molecular passivation of surface defects is critical for enhancing the optoelectronic performance of hybrid halide perovskite materials, yet its atomistic mechanism has remained incompletely understood. This study addresses this by developing a data-driven atomistic modeling protocol utilizing machine-learned interatomic potentials. The research elucidates the collective behavior of aminosilane molecules during surface passivation, providing fundamental insights essential for designing more robust perovskite solar cells.

### Key Findings

The atomistic mechanism behind molecular passivation of surface defects, which is crucial for improving the optoelectronic performance of hybrid halide perovskite materials, has been largely unexplored. To address this, this study developed a data-driven atomistic modeling protocol using machine-learned interatomic potentials. This approach allowed for a detailed investigation into the collective behavior of aminosilane molecules as they passivate perovskite surfaces, leading to a deeper fundamental understanding of the passivation effect.

### Technical Details

Molecular passivation is a technique where defects (trap states) on the surface or at grain boundaries of perovskite materials are covered and inactivated by specific organic molecules. These defects are major causes of non-radiative recombination of photogenerated charge carriers, thereby reducing device efficiency and stability. Conventional experimental approaches and first-principles calculations could analyze individual molecule-defect interactions, but a comprehensive understanding of the 'collective' passivation behavior across an entire surface involving numerous complex molecular interactions was difficult. The data-driven atomistic modeling protocol developed in this research combines extensive computational data with machine learning algorithms, enabling the simulation of dynamic interactions at the atomic level. The detailed mechanism of how aminosilane molecules bind to unbonded lead (Pb) orbitals and halide vacancies on the perovskite surface, thereby stabilizing the electronic structure, has been elucidated. This clarity provides clearer guidelines for designing passivation agents and opens pathways to identify the most effective molecular structures for targeted defects.

## Background & Context

Perovskite solar cells achieve high power conversion efficiencies, but their poor stability against environmental factors such as humidity, heat, and light remains the biggest challenge for their commercialization. Many of these stability issues originate from defects present on the material's surface or at grain boundaries, making effective passivation crucial for enhancing long-term device reliability. Fundamental mechanistic understanding at the atomic level, as provided by this research, offers essential insights for designing more rational and efficient passivation strategies, moving beyond empirical material development. This work also represents a new research paradigm at the intersection of materials science and computational science.

## Strategic Significance & Outlook

The insights gained into the passivation mechanism of aminosilane molecules through data-driven atomistic modeling will directly contribute to the future design of more high-performance and stable perovskite solar cells. The findings from this fundamental research can accelerate the development of new passivation agents and optimize existing materials. Furthermore, the developed modeling protocol itself is expected to become a versatile tool applicable to other challenges in novel material development and interface engineering. The long-term goal is to efficiently develop perovskite solar cells that function stably even under harsh environmental conditions through simulation, holding significant potential to contribute to the global energy transition.

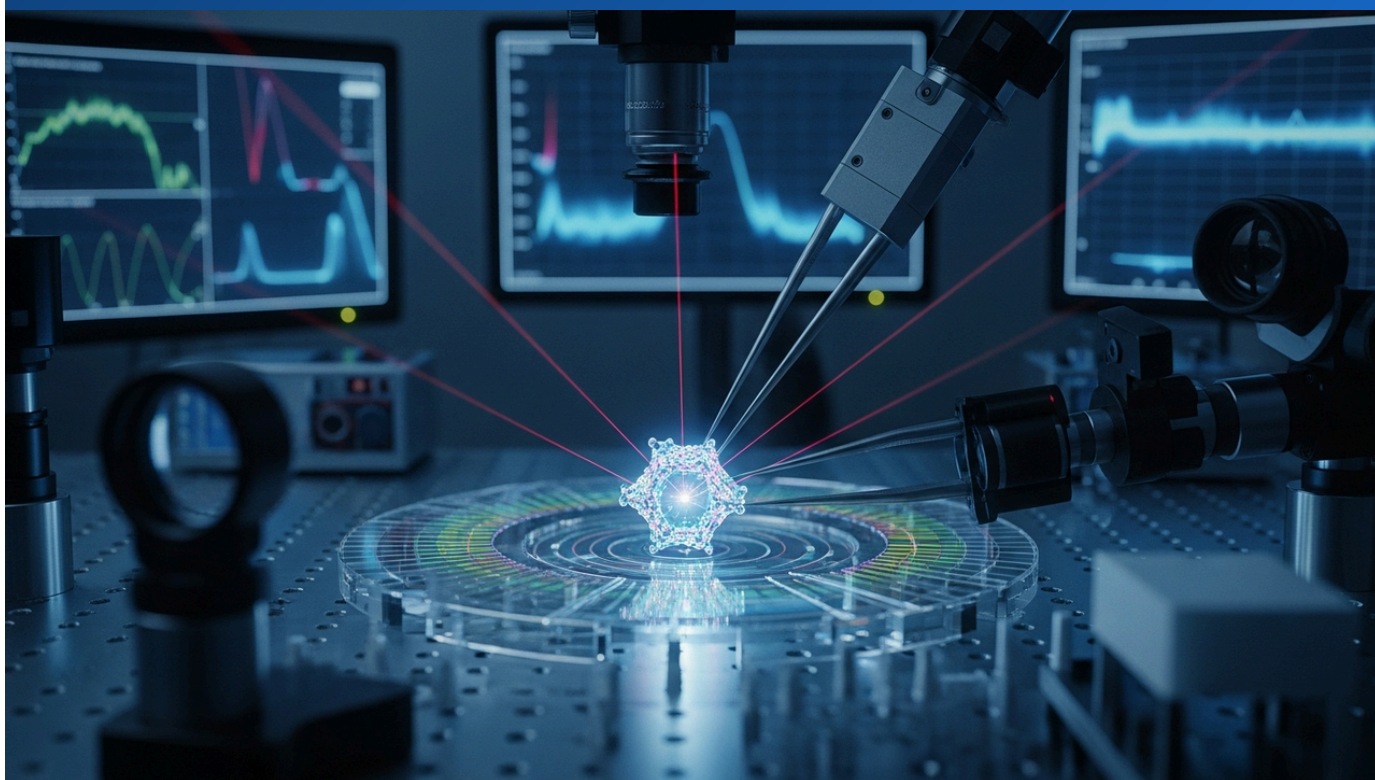
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Source: <https://arxiv.org/abs/2607.05321>



# #40 Redox-Modulated Polyoxometalate-Incorporated Carbazole-Based Interface Boosts Performance of Perovskite Photodetectors

Published July 02, 2026   PubMed   Unknown



## OVERVIEW

High-performance self-powered perovskite photodetectors require hole transport layers (HTLs) with excellent energy level alignment, optimal wettability, and effective defect passivation. This study addresses the limitations of the widely used Me-4PACz self-assembled monolayer (SAM), namely its hydrophobicity and limited defect passivation, through redox-modulated interfacial chemical reconstruction of phosphomolybdic acid (PMA) via  $\text{Sn}^{2+}$ . This innovation is expected to significantly enhance the overall performance of perovskite photodetectors.



### Key Findings

Achieving high-performance self-powered perovskite photodetectors necessitates hole transport layers (HTLs) that simultaneously offer excellent energy level alignment, optimal wettability, and effective defect passivation. This research presents a novel approach to overcome the challenges associated with the widely used Me-4PACz self-assembled monolayer (SAM), specifically its inherent hydrophobicity and limited defect passivation capabilities. This was achieved through redox-modulated interfacial chemical reconstruction of phosphomolybdic acid (PMA) facilitated by  $\text{Sn}^{2+}$  ions. This innovative modification is expected to significantly boost the overall performance of perovskite photodetectors.

### Technical Details

The Me-4PACz self-assembled monolayer (SAM) is a prevalent choice for hole transport layers in perovskite photodetectors due to its favorable energy level alignment. However, its high hydrophobicity (water-repelling nature) can hinder the subsequent deposition of the perovskite layer, and it has limitations in effectively passivating interfacial defects. To address these issues, the research team adopted a redox-modulated strategy, introducing phosphomolybdic acid (PMA) into the Me-4PACz SAM interface via  $\text{Sn}^{2+}$  ions. PMA, utilizing its redox properties, tunes the electronic structure of the interface and passivates defects.  $\text{Sn}^{2+}$  acts as a catalyst to alter the redox state of PMA, optimizing the chemical environment at the interface. This interfacial chemical reconstruction improved the wettability of the Me-4PACz SAM with the perovskite layer and effectively reduced interfacial defect density. As a result, key performance indicators for perovskite photodetectors, such as photocurrent amplification, noise reduction, and response speed, are suggested to be improved.

## Background & Context

Perovskite materials are garnering attention as next-generation photodetector materials due to their high light absorption coefficient and carrier mobility. Self-powered photodetectors, capable of operating without an external power supply, are particularly valuable for power-constrained applications such as IoT devices, environmental monitoring, and medical diagnostics. The performance of these devices heavily relies on the quality of the interface between the hole transport layer and the perovskite layer. Overcoming the limitations of existing HTL materials and constructing more efficient and stable interfaces are crucial for the practical implementation and high-performance realization of perovskite photodetectors.

## Strategic Significance & Outlook

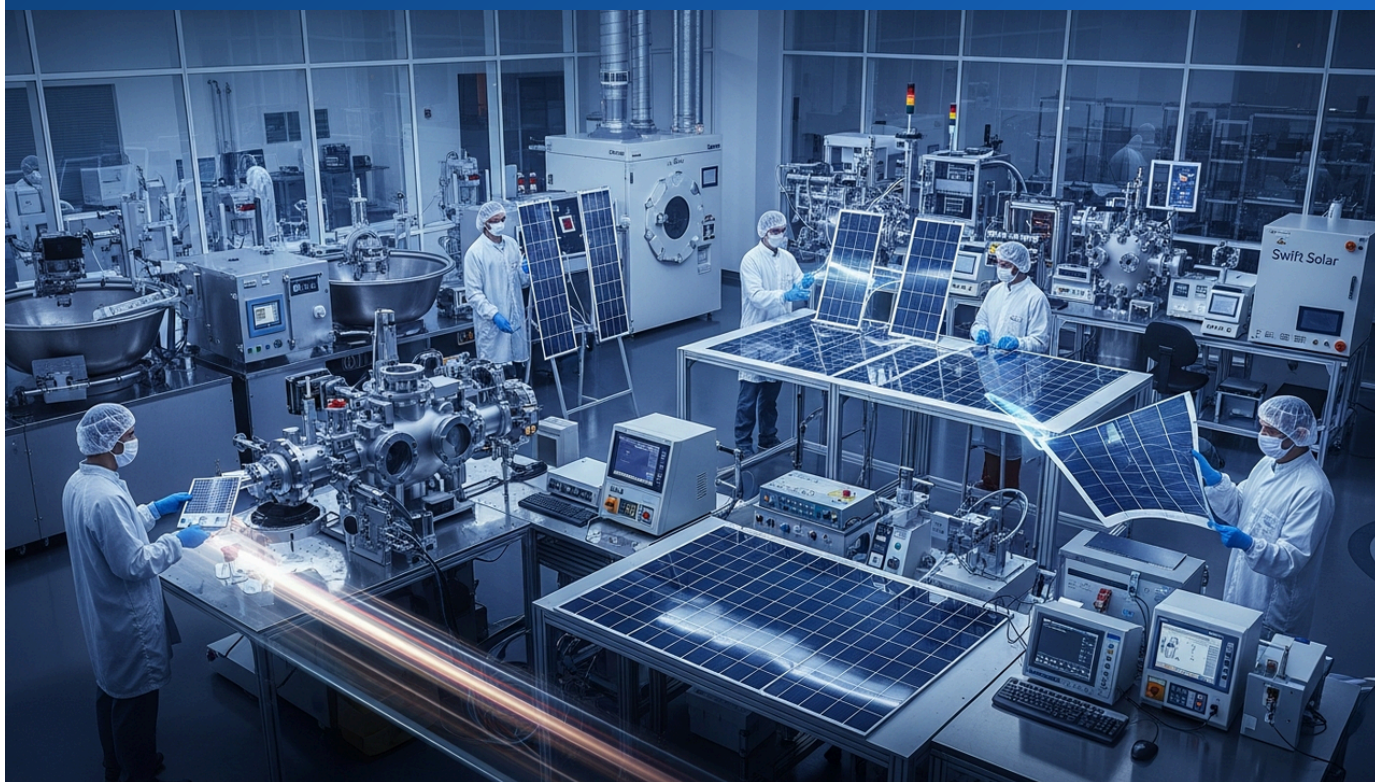
The redox modulation of the Me-4PACz SAM interface by PMA via  $\text{Sn}^{2+}$  presents a promising pathway for enhancing perovskite photodetector performance. This technology is expected to accelerate the adoption of perovskite photodetectors in various practical applications by improving the sensitivity, responsiveness, and stability of self-powered devices. Future research will focus on detailed evaluation of the long-term reliability of this interface engineering strategy and exploring its applicability for mass production. This approach also holds potential for application in other optoelectronic devices, such as perovskite solar cells.

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Source: <https://pubmed.ncbi.nlm.nih.gov/42324959/>

# #43 Perovskite Solar Startup Landscape: U.S. Leads with 10 Companies, Swift Solar Secures \$42.4M in Total Funding

Published July 05, 2026   Tracxn   Global



## OVERVIEW

A recent analysis reveals 36 perovskite solar cell startups globally, with 28 funded and 18 achieving Series A+ financing, highlighting robust investor confidence. The United States leads with 10 companies, followed by China (6) and India (4). Notably, Swift Solar received a grant on October 9, 2025, bringing its total funding to \$42.4 million, underscoring the growing investment and commercialization prospects in this sector.

### Key Findings

The landscape of perovskite solar cell technology is witnessing significant entrepreneurial activity, with 36 startups currently engaged in development. Of these, 28 have successfully raised capital, and 18 have progressed to Series A or later funding rounds, indicating a healthy and maturing investment environment for this cutting-edge renewable energy technology.

### Technical and Market Details

Geographically, the United States is at the forefront, hosting the largest number of perovskite startups with 10 companies, signifying its role as a hub for innovation and investment in this sector. China follows with 6 startups, and India with 4, demonstrating a strong regional interest and development push across Asia. Among the prominent companies, Swift Solar stands out, having secured an additional grant (prize money) on October 9, 2025. This latest infusion brings their total funding to an impressive \$42.4 million, a substantial capital injection that will undoubtedly accelerate their research, development, and commercialization efforts. Such significant funding rounds reflect strong investor belief in the transformative potential of perovskite technology.

### Background and Industry Context

Perovskite solar cells are widely regarded as a potential "game-changer" in the renewable energy sector, offering advantages over traditional silicon-based photovoltaics, including high power conversion efficiency, lower manufacturing costs, and versatility for various applications (e.g., flexible, transparent, lightweight designs). The global race to commercialize this technology is intensifying, with many startups transitioning from fundamental research to establishing scalable production techniques. The success of these funding rounds underscores the high expectations investors place on the future viability and market penetration of perovskite solutions.

## Strategic Significance and Outlook

Continued investment in perovskite startups is expected to further catalyze technological innovation, leading to the introduction of more high-performance and stable products to the market. The substantial funding secured by companies like Swift Solar suggests that significant breakthroughs in efficiency, stability, and manufacturability could be imminent. Ultimately, the advancement of perovskite solar cells is anticipated to contribute significantly to reducing energy costs, lowering environmental impact, and enabling novel energy applications across diverse industries.

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Source: [https://tracxn.com/d/trending-business-models/startups-in-perovskite/\\_gcxNT5yYnLUJnILvCkHpxBiRwnfl4o-cMHjs0ciKT8/companies](https://tracxn.com/d/trending-business-models/startups-in-perovskite/_gcxNT5yYnLUJnILvCkHpxBiRwnfl4o-cMHjs0ciKT8/companies)

Collected: July 10, 2026 | Automated Research System (Gemini API)



# #44 Frost & Sullivan Identifies Perovskite Solar Cells as Core Materials Innovation Driving Future PV Ecosystem, Accelerated by AI Discovery

Published July 10, 2026 Frost & Sullivan Global



## OVERVIEW

A new Frost & Sullivan report highlights perovskite solar cells as a pivotal materials innovation shaping the future of the photovoltaic (PV) ecosystem. Perovskite technology is positioned as one of the most promising avenues for achieving both higher efficiencies and reduced manufacturing costs, with artificial intelligence (AI) accelerating the discovery of next-generation PV materials. This assessment underscores perovskite's essential role in advancing renewable energy adoption.

### Key Findings

A new analytical report from Frost & Sullivan definitively positions perovskite solar cells as a central materials innovation set to redefine the future of the photovoltaic (PV) ecosystem. The technology is emerging as one of the most promising pathways to simultaneously achieve higher energy conversion efficiencies and substantial reductions in manufacturing costs, with the critical observation that AI-driven materials discovery is accelerating the development of these next-generation PV materials.

### Technical and Market Details

The report emphasizes that perovskite materials, with their exceptional optoelectronic properties and adaptability to various manufacturing processes, possess the potential to overcome the efficiency and cost limitations faced by conventional silicon-based solar cells. Specifically, the application of AI and machine learning algorithms to materials science is dramatically streamlining the exploration of novel perovskite compositions and structures that were previously time-consuming and expensive to discover. This acceleration is expected to lead to the development of more stable, environmentally benign, and easily manufacturable perovskite solar cells. AI plays a crucial role by predicting optimal material parameters from vast datasets of experimental and simulation results, thereby shortening the development cycle.

### Background and Industry Context

As global energy demands escalate and the imperative to address climate change becomes more urgent, solar power is increasingly vital as a primary renewable energy source. However, existing PV technologies still contend with challenges in installation costs and efficiency. Perovskite solar cells are attracting significant attention as an innovative solution capable of addressing these issues and enabling broader applications, such as Building-Integrated Photovoltaics (BIPV) and flexible devices. The endorsement by a major research firm like Frost & Sullivan suggests that this technology has moved beyond the mere research phase and entered a stage of commercial viability.

## Strategic Significance and Outlook

AI-driven materials discovery will continue to propel breakthroughs in perovskite solar cell performance enhancement and cost reduction. This will not only boost perovskite technology's competitiveness within the traditional solar market but also unlock new market opportunities. In the future, widespread integration of solar power onto various surfaces and powering diverse applications, including mobility and IoT devices, are anticipated, positioning perovskite to play an indispensable role in the global energy transition.

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Source: [https://www.frost.com/growth-opportunity-news/chemicals-materials-nutrition/chemicals/beyond-solar-deployment-how-materials-innovation-is-shaping-the-future-of-the-solar-photovoltaic-ecosystem-cmn02\\_tg02\\_solarpvmaterials\\_jul26\\_cim-ms/](https://www.frost.com/growth-opportunity-news/chemicals-materials-nutrition/chemicals/beyond-solar-deployment-how-materials-innovation-is-shaping-the-future-of-the-solar-photovoltaic-ecosystem-cmn02_tg02_solarpvmaterials_jul26_cim-ms/)

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #45 IDTechEx Webinar to Assess 2026 Perovskite PV Commercialization: Bridging Technical Potential and Market Realities

Published July 09, 2026 IDTechEx Global



**Perovskite Commercialization (PV)**  
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## OVERVIEW

An upcoming IDTechEx webinar will provide an in-depth assessment of perovskite photovoltaic (PV) commercialization in 2026, focusing on progress, high-value applications, and scaling realities. The session aims to bridge the gap between perovskite's technical potential and its commercial viability, delving into manufacturing challenges, market readiness across various application sectors, and strategies for long-term market sustainability. This webinar offers crucial insights for stakeholders navigating the market entry of perovskite technology.



### Key Findings

An upcoming webinar hosted by IDTechEx, titled "Assessing Perovskite PV Commercialization in 2026," will offer a comprehensive evaluation of the advancements in this innovative solar technology, particularly concerning high-value applications and the realities of large-scale production. The core objective of this webinar is to identify and address the existing gap between the high technical potential of perovskite solar cells and their practical commercial bankability—their attractiveness and feasibility as an investment.

### Technical and Market Details

The webinar will delve deeply into the latest progress in perovskite solar cell manufacturing processes, including improvements in cost efficiency and the challenges associated with scalability. Specifically, it will examine the market readiness for high-value application sectors where perovskite PV truly shines, such as flexible devices, transparent solar cells, Building-Integrated Photovoltaics (BIPV), and power solutions for IoT devices. Attendees will gain updated information on technical requirements, performance benchmarks, and certification processes pertinent to these areas. Discussions will also cover the competitive landscape with existing silicon solar technologies and the potential for perovskites to carve out unique niche markets.

### Background and Industry Context

Perovskite solar cells have garnered significant attention as a next-generation solar technology due to their high efficiency, potential for low-cost manufacturing, and superior flexibility and transparency compared to conventional PV technologies. However, their commercialization still faces several critical challenges, including ensuring long-term stability, establishing large-scale production methods, and navigating environmental regulations. Objective assessments by independent market research firms like IDTechEx are indispensable for overcoming these hurdles and formulating effective strategies for bringing the technology to market.



## Strategic Significance and Outlook

This webinar will provide essential guidance for understanding the next steps in perovskite PV commercialization. By comprehensively analyzing manufacturing realities, market potential for specific applications, and trends in regulations and policy, researchers, engineers, and investors can gain a clearer perspective on the future prospects and feasibility of this technology. Strategic challenges for ensuring long-term market sustainability will be highlighted, suggesting directions for key industry players to pursue.

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Source: <https://www.idtechex.com/en/webinar/perovskite-photovoltaics/748>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #46 Saule Technologies Unveils New Generation of Inkjet-Printed Perovskite Solar Cells, Poised to Transform BIPV and Daily Products

Published July 08, 2026 Saule Technologies ポーランド



## OVERVIEW

Saule Technologies, led by founder Olga Malinkiewicz, has announced a breakthrough in inkjet-printed perovskite solar cells. This next-generation technology promises to dramatically expand photovoltaic applications, particularly in Building-Integrated Photovoltaics (BIPV), and enable power generation integration into a wide array of everyday products. The development highlights the immense versatility and market potential of perovskite technology.

### Background

The imperative for widespread solar power adoption to combat climate change and foster sustainable societies is clear. However, conventional silicon solar cells present inherent challenges, including their rigidity, weight, and limitations in installation flexibility. Perovskite solar cells are emerging as a promising next-generation technology, offering high power conversion efficiency coupled with inherent flexibility and lightweight properties that directly address these limitations. Companies like Saule Technologies are pivotal in advancing perovskite technology beyond niche applications into mainstream markets. Critically, the integration of inkjet printing technology further enables low-cost, high-volume manufacturing, thereby significantly lowering market entry barriers for this advanced photovoltaic solution.

### Key Findings

Olga Malinkiewicz, founder and principal shareholder of Poland-based Saule Technologies, has unveiled a new generation of perovskite solar cells fabricated using advanced inkjet printing technology. This development is poised to unlock entirely new application domains, particularly within Building-Integrated Photovoltaics (BIPV), where conventional solar cells have historically faced significant integration hurdles. The technology is also anticipated to fundamentally transform everyday products by seamlessly embedding power generation capabilities, thereby enhancing both their utility and sustainability profiles.

### Technical and Market Details

Inkjet printing presents substantial advantages for thin-film solar cell manufacturing, enabling precise material deposition across intricate patterns and large substrates while dramatically reducing material waste. Saule Technologies' latest perovskite solar cells leverage this process to produce devices that are thin, flexible, and semi-transparent. This fabrication flexibility permits the integration of power generation onto a diverse range of surfaces previously unsuitable for solar cells, including building windows, smart device enclosures, and vehicle roofs. Within the BIPV market, this technology facilitates the seamless incorporation of energy generation into both building exteriors and interiors without aesthetic compromise, significantly accelerating the path toward net-zero energy buildings.

## Strategic Significance and Outlook

The advent of inkjet-printed perovskite solar cells is projected to not only expand the existing photovoltaic (PV) market but also to catalyze the creation of entirely new markets in sectors such as IoT devices, wearable electronics, and smart city infrastructure. Saule Technologies' innovative technology is poised to serve as a foundational enabler for these advanced applications, accelerating a future where energy generation is seamlessly woven into the fabric of everyday life. The company's strategic roadmap for technological development and market introduction represents a critical stride toward establishing perovskite solar cells as a dominant sustainable energy solution.

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Source: <https://sauletech.com/>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #49 German ISFH CalTeC Launches Calibration Services for Large-Area Perovskite-Silicon Tandem Solar Cells, Accelerating Certification and Market Entry

Published July 07, 2026   pv magazine Global   Germany

 44\_german-isfh-caltec-launches-calibration-services-for-large-a

## OVERVIEW

The Calibration and Test Center (CalTeC) at Germany's Institute for Solar Energy Research Hamelin (ISFH) has initiated calibration services for large-area perovskite-silicon tandem solar cells. This new service is critically important for the official certification and reliability assurance of perovskite solar cell technology, representing a significant step towards accelerating its widespread market introduction. This move indicates the concrete progression of industry-wide efforts towards commercializing next-generation solar cell technologies.



### Key Findings

The Calibration and Test Center (CalTeC) at the Institute for Solar Energy Research Hamelin (ISFH) in Germany has commenced offering comprehensive calibration services for large-area perovskite-silicon tandem solar cells. This launch marks a pivotal development in the transition of perovskite solar cell technology from research to full commercialization, significantly accelerating its technical certification and market entry.

### Technical and Market Details

The new calibration services provided by CalTeC are based on high-precision measurement techniques and stringent international standards. This ensures that critical performance parameters of large-area tandem solar cell modules, such as power conversion efficiency, long-term stability, and reliability, are objectively evaluated and publicly certified. Previously, standardized calibration methods for perovskite solar cells were not well-established due to their novelty. With ISFH CalTeC's initiative, manufacturers can now reliably substantiate the performance of their products. This is an essential factor for investors and customers when assessing product quality, and it is crucial for building market confidence in perovskite technology.

### Background and Industry Context

Perovskite-silicon tandem solar cells are considered the leading candidates for next-generation solar cell technology, holding the potential to surpass the theoretical efficiency limits of single-junction silicon solar cells. However, for any new technology to gain market acceptance, accurate performance measurement and international certification criteria compliance are indispensable. The provision of calibration services by a neutral and authoritative institution like ISFH CalTeC plays a central role in guaranteeing technological reliability and fostering large-scale manufacturing investments and deployment decisions. This move is particularly significant within the broader context of the solar industry's evolution towards more highly efficient energy solutions.

## Strategic Significance and Outlook

The introduction of these calibration services will serve as a powerful catalyst, accelerating the technological development and commercialization of perovskite-silicon tandem solar cells. Manufacturers will be able to publicly certify the performance of their products, which will enhance quality assurance and stimulate market competition. In the future, it is anticipated that more perovskite solar cell products will enter the market, improving the cost-effectiveness of solar power and further contributing to the global clean energy transition. ISFH CalTeC's initiative functions as a critical infrastructure supporting the maturation and widespread adoption of this technology.

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Source: <https://www.pv-magazine.com/2026/07/07/isfh-caltec-expands-calibration-services-to-large-area-perovskite-silicon-tandem-solar-cells/>

Collected: July 10, 2026 | Automated Research System (Gemini API)

# #50 Researchers Develop Predictive Framework to Optimize 2D Perovskite Solar Cell Design, Significantly Boosting Efficiency and Stability

Published July 03, 2026   PV Tech   Unknown



## OVERVIEW

A group of researchers has developed an innovative predictive framework for systematically optimizing the design of 2D perovskite solar cells. This framework provides a critical foundation for substantially enhancing both the efficiency and long-term stability of these devices. This advancement is expected to accelerate the development of higher-performance and more practical perovskite solar cells, contributing significantly to the progress of renewable energy technologies.

### Key Findings

Researchers have developed a groundbreaking predictive framework designed to fundamentally improve the performance of 2D perovskite solar cells. This framework enables the optimization of various aspects of the design process, from material selection to device architecture, thereby providing a crucial foundation for dramatically boosting both the power conversion efficiency and long-term stability of perovskite solar cells.

### Technical Details

2D perovskite solar cells offer advantages such as higher humidity and thermal stability compared to conventional 3D perovskites but have historically suffered from lower efficiencies. This new predictive framework integrates computational science with experimental data to forecast optimal compositions, layer structures, and interface engineering parameters for 2D perovskite materials. This approach significantly reduces the trial-and-error process for researchers, allowing for more targeted and efficient device design. The framework considers factors such as molecular-level interactions, charge transport dynamics, and defect densities, quantitatively evaluating their impact on device performance. This enables the rapid development of high-performance 2D perovskite solar cells tailored to specific application requirements.

### Background and Industry Context

Perovskite solar cells have garnered significant attention as a next-generation photovoltaic technology due to their high theoretical efficiency and potential for low-cost manufacturing. However, long-term stability, particularly vulnerability to moisture and heat in outdoor environments, has remained a major barrier to commercialization. 2D perovskites have emerged as a promising candidate to overcome this challenge due to their superior stability profile, but efficiency improvements were still needed. The newly developed predictive framework offers design strategies that maximize efficiency while maintaining stability, thus significantly paving the way for the commercialization of this technology.

## Strategic Significance and Outlook

The introduction of this predictive framework is expected to revolutionize research and development in 2D perovskite solar cells, enabling the rapid market introduction of higher-performance and more stable devices. This will accelerate the use of perovskite solar cells as an alternative to conventional solar cells or for new applications across a wide range of fields, including Building-Integrated Photovoltaics (BIPV), flexible electronics, and use in specific harsh environments. Ultimately, it is anticipated to accelerate the evolution of clean energy technology and play an indispensable role in achieving a sustainable society.

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Source: <#>

Collected: July 10, 2026 | Automated Research System (Gemini API)