

# **High-efficiency organic photovoltaics**





## Overview

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Does organic photovoltaic technology have low power conversion efficiency?

Nature Reviews Electrical Engineering 1, 581–596 (2024) Cite this article  
Organic photovoltaic (OPV) technology is flexible, lightweight, semitransparent and ecofriendly, but it has historically suffered from low power conversion efficiency (PCE).

How to improve power conversion efficiency in organic photovoltaics (OPVs)?

Minimizing energy loss to increase open-circuit voltage (VOC) is an essential topic to further improve the power conversion efficiency (PCE) in organic photovoltaics (OPVs). Though various molecular strategies have been developed, simultaneously achieving a VOC beyond 1.0 V and maintaining a high PCE above 15% is a huge challenge.

What is organic photovoltaic (OPV) technology?

Provided by the Springer Nature SharedIt content-sharing initiative Organic photovoltaic (OPV) technology is flexible, lightweight, semitransparent and ecofriendly, but it has historically suffered from low power conversion efficiency (PCE).

How efficient are non-fullerene organic photovoltaic (OPV) cells under indoor conditions?

In this paper, we report high-efficiency non-fullerene organic photovoltaic (OPV) cells with over 30% power conversion efficiency (PCE) under indoor conditions. Our results show that the choice of electron-transporting layer (ETL) is critically important to enable such performance.

Does electron-transporting layer matter in high-efficiency non-fullerene organic photovoltaic (OPV) cells?

In this work, we report high-efficiency non-fullerene organic photovoltaic (OPV) cells with over 30% power conversion efficiency (PCE) in indoor conditions.



Our results show that the choice of electron-transporting layer (ETL) is important to enable such performance.

Do organic photovoltaic cells offer high VOC?

Z. Wang, A. Tang, H. Wang, Q. Guo, Q. Guo, X. Sun, Z. Xiao, L. Ding and E. Zhou, Organic photovoltaic cells offer ultrahigh VOC of  $\sim 1.2$  V under AM 1.5G light and a high efficiency of 21.2% under indoor light, Chem. Eng. J., 2023, 451(4), 1-8, DOI: 10.1016/j.cej.2022.139080.



## High-efficiency organic photovoltaics

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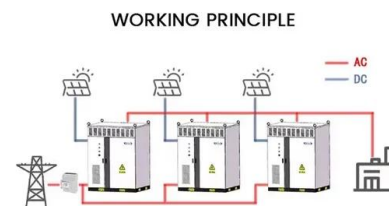


### Toward High Efficiency Water Processed Organic Photovoltaics

Here efficient organic photovoltaic devices fabricated from water-based colloidal dispersions with donor:acceptor composite nanoparticles achieving up to 9.98% power conversion efficiency (PCE) are reported. This high efficiency for water processed organic solar

### Reducing the efficiency-stability-cost gap of organic photovoltaics

Technological deployment of organic photovoltaic modules requires improvements in device light-conversion efficiency and stability while keeping material costs low. Here we demonstrate highly



### Recent advances in organic solar cells: materials, design, and

Organic solar cells have emerged as promising alternatives to traditional inorganic solar cells due to their low cost, flexibility, and tunable properties. This mini review introduces a novel perspective on recent advancements in organic solar cells, providing an overview of the latest developments in materials, device architecture, and performance ...

### Rational tuning of intermolecular and intramolecular interactions

Her research focuses on high-efficient organic photovoltaics. Jinsheng Zhang received his master's degree at Ningbo Institute of Materials



Technology and Engineering, Chinese Academy of Science in 2022.



### Balancing efficiency and transparency in organic transparent photovoltaics

The development of the highly transparent and efficient TPVs strongly relies on the specific transparent materials, and the semiconductors are among the key materials. Organic photovoltaic

### Self-Organized Discotic Liquid Crystals for High-Efficiency Organic

High-efficiency organic photovoltaic devices derive their performance from two basic elements: (i) the dissociation within the active semiconductor layers of the photogenerated electronic excited states (termed excitons), and (ii) the transport of the resulting It is



### Toward High-Efficiency Organic Photovoltaics: Perspectives on ...

These structural characteristics explain the seemingly contradictory high radiative efficiency of low-bandgap nonfullerene molecules, providing promising molecular ...





### Highly efficient organic solar cells enabled by suppressing triplet

The high non-radiative energy loss is a bottleneck issue for efficient organic solar cells. Here, the authors regulate the charge transfer state disorder and rate of back charge transfer through a



- TELECOM CABINET
- BRAND NEW ORIGINAL
- HIGH-EFFICIENCY

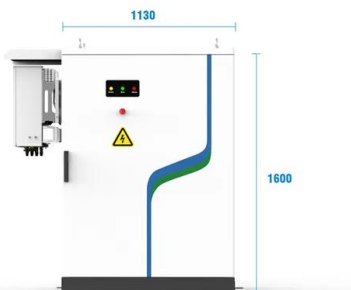


### Molecular interaction induced dual fibrils towards organic solar ...

Xie, Y. et al. High-reproducibility layer-by-layer non-fullerene organic photovoltaics with 19.18% efficiency enabled by vacuum-assisted molecular drift treatment. Adv. Energy Mater. 14, 2400013

### A universal roll-to-roll slot-die coating approach towards high

This work develops a combinational use of solvent additive and in-line drying oven on the flexible organic photovoltaics to improve large-area roll-to-roll (R2R) slot-die coating process. Herein, addition of 1,8-diiodooctane (DIO) in the photoactive layer is conducted to



- PV / DG Application
- APP Intelligent Control
- Multi-Unit Parallel Expansion
- 98.8% Max. Efficiency

### Waterproof and ultraflexible organic photovoltaics with

Jiang, Z. et al. Highly efficient organic photovoltaics with enhanced stability through the formation of doping-induced stable interfaces. Proc. Natl Acad. Sci. USA 117, 6391-6397 (2020).



### Side Connection for High-Efficiency Organic Photovoltaic ...

Indoor photovoltaics has attracted increasing attention because of its potential to power devices of the Internet of Things. The power conversion efficiency (PCE) of organic photovoltaic (OPV) cells has reached values beyond 30% under indoor light, but for OPV



### High-efficiency organic photovoltaic cells processed using a non

In this paper we describe high-performance PM6:BTP-eC9-based organic photovoltaic (OPV) cells prepared using non-halogen solvents, with the goal of minimizing any potential environmental pollution. We investigated three green solvents (toluene, o-xylene, and 1,2,4-trimethylbenzene) as replacements for the commonly used chloroform.

### High-efficiency small-molecule ternary solar cells with a ...

Baran, D. et al. Reducing the efficiency-stability-cost gap of organic photovoltaics with highly efficient and stable small molecule acceptor ternary solar cells. Nat. Mater. 16, 363-369 (2017).



### Intrinsically Stretchable, Semi-transparent Organic Photovoltaics ...

2 Abstract Intrinsically stretchable organic photovoltaic (is-OPV) with high efficiency and transparency remains a grand challenge for wearable applications. Herein, we report a full-solution processed device framework for semi-transparent is-OPV. A ferroconcrete



### Recent progress in solution-processed flexible organic photovoltaics

Lee, J. et al. Slot-die and roll-to-roll processed single junction organic photovoltaic cells with the highest efficiency. Adv. Energy Mater. 9, 1901805 (2019).

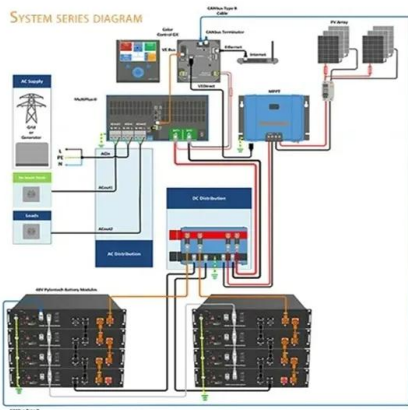


### High-Efficiency Indoor Organic Photovoltaics with a Band

High-Efficiency Indoor Organic Photovoltaics with a Band-Aligned Interlayer Author links open overlay panel Lik-Kuen Ma 1 2 6, Yuzhong Chen 1 2 6, Philip C.Y. Chow 1 2, Guangye Zhang 5, Jiachen Huang 1 2, Chao Ma 4, Jianquan Zhang 1 2, Hang Yin 3, 1 2,

### High-Efficiency Indoor Organic Photovoltaics with a Band

In this work, we report high-efficiency non-fullerene organic photovoltaic (OPV) cells with over 30% power conversion efficiency (PCE) in indoor conditions. Our results show ...



### Phase separation and domain crystallinity control enable open-air

Phase separation and domain crystallinity control enable open-air-printable highly efficient and sustainable organic photovoltaics Jie Lv, Jie Lv Hoffmann Institute of Advanced Materials,



## Physical insights into non-fullerene organic photovoltaics

Price, M. B. et al. Free charge photogeneration in a single component high photovoltaic efficiency organic semiconductor. Nat. Commun. 13, 2827 (2022). Article ADS Google Scholar



## Thermally stable, highly efficient, ultraflexible organic photovoltaics

An ultraflexible organic photovoltaic (OPV) is developed that achieves sufficient thermal stability of up to 120 °C and a high power conversion efficiency of 10% with a total thickness of 3 um by combining an inherently stable donor:acceptor blend as the active layer and ultrathin substrate and barriers with excellent thermal capability to overcome the trade-offs ...

## High-Efficiency Indoor Organic Photovoltaics with a Band-Aligned

In this paper, we report high-efficiency non-fullerene organic photovoltaic (OPV) cells with over 30% power conversion efficiency (PCE) under indoor conditions. Our results show that the choice of electron-transporting layer (ETL) is critically important to enable such performance.

### ESS



## Free charge photogeneration in a single component high photovoltaic

When light hits organic semiconductors, bound charge pairs, called excitons, are usually produced. Here, the authors show that in the best performing organic solar material to date, free charges



### Advances in organic photovoltaic cells: a comprehensive review ...

The working principles and device structures of OPV cells are examined, and a brief comparison between device structures is made, highlighting their advantages, ...



### Shamrock-shaped non-fullerene acceptors enable ...

Minimizing energy loss to increase open-circuit voltage (VOC) is an essential topic to further improve the power conversion efficiency (PCE) in organic photovoltaics (OPVs). Though various molecular strategies have been ...

### High-Efficiency ITO-Free Organic Photovoltaics with ...

This work provides insight into device structure design and optimization for OPVs with high efficiency, low cost, superior flexibility, and upscaling capacity, indicating the potential for the future commercialization of OPVs.





### Toward High Efficiency Water Processed Organic ...

Here efficient organic photovoltaic devices fabricated from water-based colloidal dispersions with donor:acceptor composite nanoparticles achieving up to 9.98% power conversion efficiency (PCE) are reported. This ...

### Interlayer surface energy control for high-efficiency printed organic

The surface properties of the substrate play a crucial role in regulating the morphology of active layers coated atop and the resulting photoelectronic properties in solution-processed organic photovoltaic (OPV) cells. However, current studies on the relationship between the surface free energy ( $\gamma_s$ ) of the s



### Intrinsically stretchable, semi-transparent organic photovoltaics ...

Intrinsically stretchable organic photovoltaics (is-OPVs) with high efficiency and transparency are a great challenge for wearable applications. Herein, we report a full-solution-processed device framework for semi-transparent is-OPVs. A ferroconcrete-like AZO@silver

### Key molecular perspectives for high stability in organic photovoltaics

Organic photovoltaics (OPVs) have rapidly improved in efficiency, with single-junction cells now exceeding 18% efficiency. These improvements have been driven by the adoption of





### High-Efficiency Organic Photovoltaics using Eutectic Acceptor ...

Material wise, aligned cascading energy levels with much larger driving force, and suppressed recombination channels confirm efficient charge transfer and transport, enabling an improved power conversion efficiency (PCE) of 17.84%.



### High-Efficiency ITO-Free Organic Photovoltaics with ...

Developing indium-tin-oxide (ITO)-free flexible organic photovoltaics (OPVs) with upscaling capacity is of great significance for practical applications of OPVs. Unfortunately, the efficiencies of the corresponding devices lag far behind ...



### Progress of organic photovoltaics towards 20% efficiency

Organic photovoltaics (OPVs) are an emerging solar cell technology that is cost-effective 1,2,3, lightweight 4,5 and flexible 4,6,7,8. Moreover, owing to their energy-efficient production and non



### Efficient and stable organic solar cells enabled by

Ma, R. et al. Achieving high efficiency and well-kept ductility in ternary all-polymer organic photovoltaic blends thanks to two well miscible donors. Matter 5, 725-734 (2022). Article CAS

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### ENERGY STORAGE SYSTEM

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HJ-ESS-215A(100KW/215KWh)  
HJ-ESS-115A(50KW 115KWh)

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1600\*1200\*2000mm

**Rated Battery Capacity**  
215KWH/115KWH

**Battery Cooling Method**  
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