

# Bulk heterojunction organic photovoltaic cells

Are organic solar cells based on bulk heterojunction better?

In the last few years, the performance of organic solar cells (OSCs) based on bulk heterojunction (BHJ) structure has remarkably improved. However, for a large scale roll to roll (R2R) manufacturing of this technology and precise device fabrication, further improvements are critical.

Does bulk heterojunction improve photovoltaic performance?

The development of the bulk heterojunction (BHJ) has significantly overcome these issues, resulting in dramatic improvements in organic photovoltaic performance, now exceeding 18% power conversion efficiencies.

Can kinetically bulk heterojunction film morphology be degraded in organic solar cells?

Degradation of kinetically bulk heterojunction film morphology in organic solar cells is a grand challenge for their practical application. Here, the authors design and synthesise multicomponent photoactive material by facile one-pot polymerization and achieve efficiency of 11.8% and T80 of 1000 h.

Can graded bulk-heterojunction surpass classical BHJ in organic solar cells?

Graded bulk-heterojunction (G-BHJ) with well-defined vertical phase separation has potential to surpass classical BHJ in organic solar cells (OSCs). In this work, an effective G-BHJ strategy via nonhalogenated solvent sequential deposition is demonstrated using nonfullerene acceptor (NFA) OSCs.

How efficient are single-junction organic solar cells?

ACS Nano 12, 1473-1481 (2018). Zhu, L. et al. Single-junction organic solar cells with over 19% efficiency enabled by a refined double-fibril network morphology. Nat. Mater. 21, 656-663 (2022). Zhang, C. et al. Comprehensive investigation and analysis of bulk-heterojunction microstructure of high-performance PCE11: PCBM solar cells.

What are organic photovoltaics (OPVs)?

Organic photovoltaics (OPVs) have gained much attention owing to their potential to offer low-cost, high-performance, and flexible devices 1. To cope with the intrinsic strong exciton-binding energy and short carrier diffusion length, OPVs usually employ the bulk heterojunction (BHJ) device structure.

The mechanical properties of bulk-heterojunction (BHJ) films play critical roles in the operational stability of flexible polymer solar cells (PSCs). In this study, the multi-scale mechanical ...

In photovoltaic research, bulk heterojunction organic solar cells have garnered significant interest as light harvesters. This increased attention underscores the importance of advance research in organic solar cell development. The present study considers an organic bulk heterojunction solar cell with P3HT:IC  $_{60}$

60 BA as the active layer. Simulation studies ...

Transient Electron Spin Polarization Imaging of Heterogeneous Charge-Separation Geometries at Bulk-Heterojunction Interfaces in Organic Solar Cells. The Journal of Physical Chemistry C 2019 ... 14.7% Efficiency Organic ...

Exploring photoexcited spin states for fullerene-derivatives based organic bulk heterojunction solar cells using magneto-photocurrent Jiaji Hu. ... 16.7%-efficiency ternary blended organic photovoltaic cells with PCBM as the acceptor additive to increase the open-circuit voltage and phase purity,"

A polymer solar-cell based on a bulk heterojunction design with an internal quantum efficiency of over 90% across the visible spectrum (425&nbsp;nm to 575&nbsp;nm) is reported. The device ...

The surface energy ( $\gamma_s$ ) plays a crucial role in the morphology of the bulk-heterojunction (BHJ) layer of solution-processed organic solar cells (OSCs). The interfacial phase miscibility in BHJ films could be predicted by the intrinsic difference of  $\gamma_s$  between donors and acceptors. 1, 3, 4 The vertical distribution and molecular stacking orientation of BHJs have ...

The development of the bulk heterojunction (BHJ) has significantly overcome these issues, resulting in dramatic improvements in organic photovoltaic performance, now exceeding 18% power conversion efficiencies.

Non-radiative recombination loss suppression is critical for boosting performance of organic solar cells. Here, the authors regulate self-organization of bulk-heterojunction in a non-monotonic ...

Here, the design and engineering strategies used to develop the optimal bulk heterojunction for solar-cell, photodetector, and photocatalytic applications are discussed. Additionally, the thermodynamic driving forces in the creation and stability of the bulk heterojunction are presented, along with underlying photophysics in these blends.

Organic solar cell technology has immense potential owing to lower production cost and flexible characteristics. The latest advancement in the material engineering and sophisticated device structure have significantly improved the solar cells commercial feasibility. ... The fabrication of Bulk heterojunction photovoltaic cell is complex due to ...

**Keywords:** bulk heterojunction, nonfullerene acceptor, organic photovoltaics, organic photodetector, photocatalysis Organic semiconductors require an energetic offset in order to photogenerate free charge carriers efficiently, owing to their inability to ...

The performance of organic solar cells (OSCs) depends on a fine, carefully optimized bulk-heterojunction

(BHJ) microstructure. The understanding and manipulation of BHJ morphology have been the focus of research in optoelectronic devices. In this article, recent advances in understanding and controlling the 2020 Materials Chemistry Frontiers Review-type Articles

strategies used to develop the optimal bulk heterojunction for solar cell, photodetector and photocatalytic applications. Additionally, we discuss the thermodynamic driving forces in the ...

In recent years, there is a huge effort to the development of efficient, flexible, environmentally stable and lightweight organic bulk heterojunction solar cells (BHJ SCs) 1,2,3,4. These devices ...

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Recent efforts in materials and device architecture optimization have pushed the power conversion efficiency of bulk heterojunction organic solar cells (BHJ OSCs) well beyond 10% 1,2,3. All of ...

Recently, organic solar cells have surpassed 17% 1,2 power conversion efficiency (PCE) in single-absorber layer bulk heterojunction (BHJ) devices based upon non-fullerene electron acceptor systems ...

Recent efforts in materials and device architecture optimization have pushed the power conversion efficiency of bulk heterojunction organic solar cells (BHJ OSCs) well beyond 10% 1, 2, 3. All of these devices comprise at least two semiconductor components: an electron donor and an electron acceptor.

A power conversion efficiency (PCE) of sunlight to electricity at the 10% level has been achieved in organic photovoltaics (OPVs) based on the bulk heterojunction 1,2 (BHJ) concept. High ...

Degradation of kinetically bulk heterojunction film morphology in organic solar cells is a grand challenge for their practical application. Here, the authors design and synthesise...

A crosslinking organic silane interfacial layer (IFL) is compared to PEDOT:PSS in bulk-heterojunction photovoltaic devices. The device open-circuit voltage, efficiency, and thermal stability are all ...

**1.1 Introducing Organic Bulk Heterojunction Solar Cells.** In recent years, much of the research effort in the area of novel photovoltaic absorber materials has been directed towards developing solution processable materials consisting of either p-conjugated molecules [1, 2] or inorganic nanoparticles [3-7]. These materials have in common that they are disordered ...

Bulk heterojunction organic solar cells have attracted considerable interest for their promise in cost-effective, lightweight, and flexible photovoltaic applications. This paper specifically examines the production and characterization of organic solar cells. The main objective is to investigate how different weight ratios of the

donor (PCDTBT) and acceptor components affect ...

Bulk heterojunction organic solar cells have attracted considerable interest for their promise in cost-effective, lightweight, and flexible photovoltaic applications. This paper ...

An organic solar cell (also known as OPV) is a type of solar cell where the absorbing layer is based on organic semiconductors (OSCs). Typically, these are either polymers or small molecules. For organic materials to be used in organic electronics, they will need to be semiconducting which will require a high level of conjugation (alternating ...

The bulk-heterojunction blend of an electron donor and an electron acceptor material is the key component in a solution-processed organic photovoltaic device. In the past decades, a p-type conjugated polymer and an n-type fullerene derivative have been the most commonly used electron donor and electron acceptor, respectively. While most advances of ...

Polymer photovoltaic cells have shown great potential as a means to harvest solar energy in a highly processable and cost-effective manner 1,2,3,4,5. Typical organic solar cells consist of a ...

Bulk heterojunction organic photovoltaic cells based on D-A type BODIPY small molecules as non-fullerene acceptors ... The optimized polymer solar cells based on CF 3-BDP-TPA and CF 3-BDP-Cz attained power conversion efficiencies of 9.89% and 13.07%, respectively.

The efficiency of bulk heterojunction (BHJ) based organic solar cells is highly dependent on the morphology of the blend film, which is a result of a fine interplay between donor, acceptor, and solvent during the film drying. ... the film formation process of nonfullerene acceptor blend could also contribute to its reduced energy loss and ...

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