

# Photophysics of organic photovoltaic devices a review

How do photophysical mechanisms affect optoelectronic properties of photovoltaic devices?

The understanding of the photophysical mechanisms in photovoltaic devices plays a significant role in determining the optoelectronic properties of high-performance OSCs. This review gives a fundamental description of the photophysical mechanisms in OSCs, with the main emphasis on the exciton transfer and charge-transfer mechanisms.

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).

Are organic photovoltaics a viable technology?

Over the past 25 years, the field of organic photovoltaics has grown from scientific curiosity to viable technology as organic photovoltaic (OPV) devices have demonstrated a significant potential for stable, low-cost solar power generation.

How can organic photovoltaics improve the operational life of solar modules?

A high water and oxygen barrier and stable encapsulation process can increase the operational lifetime of module devices. 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.

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).

What are organic photovoltaic cells?

Organic photovoltaic (OPV) cells have attracted a significant amount of attention due to their advantages such as cost-effectiveness, low weight, compatibility with high-throughput technology, and huge potential for large area fabrication by roll-to-roll processing .

This chapter covers physics of the basic device operation of organic photovoltaic cells and review of recent progress in the field of organic photovoltaics. The organic solar cell characteristics, parameters, and various device architectures to optimize the power conversion efficiency of OPV cells for a given set of photoactive donor and ...

This paper provides a comprehensive overview of organic photovoltaic (OPV) cells, including their materials,

technologies, and performance. In this context, the historical evolution of PV cell technology is explored, and the classification of PV production technologies is presented, along with a comparative analysis of first, second, and third-generation solar cells.

In this Review, recent advances in device architectures and operation mechanisms of phototransistor, photoconductor, and photodiode based OPDs are reviewed with a focus on the strategies aiming at performance improvement. ... The photodiodes can operate in two detection modes: photovoltaic (PV) mode and photoconductive (PC) mode, which is ...

This review volume provides in-depth discussion of the fundamental photophysical processes as well as the state-of-the-art device engineering of various emerging photovoltaic technologies, including organic (fullerene, non-fullerene, and ternary), dye-sensitized (ruthenium, iron, and quantum dot), and hybrid metal-halide perovskite solar cells ...

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Photo-initiated, oxygen-mediated degradation of the molecules in the active layer of organic photovoltaic, OPV, devices currently limits advances in the development of solar cells. To address this problem systematically and at a molecular level, it is informative to quantify the kinetics of the pertinent processes, both in solution phase and in ...

Solar cells based on organic photovoltaic, OPV, devices continue to provide a promising alternative to devices based on inorganic materials []. However, further progress in the development of OPVs is now limited by the stability of the active material against photoinitiated oxygen-dependent degradation [2-4]. Many of the issues involved in the degradation of such ...

In this review, we systematically discussed the recent progress in the understanding of photophysical mechanisms and characterization in organic photovoltaic devices. The contribution of this review is first intended to discuss the exciton transfer process.

Photophysics of organic photovoltaic devices : a review. Research output: Journal Publications and Reviews (RGC: 21, 22, 62) > 21\_Publication in refereed journal > peer-review. Overview; 8 Scopus Citations. Scopus

Metrics View graph of relations. Author(s) Rugeng Liu; Chun Hong Mak; Hsien-Yi Hsu; And 5 others ...

1 Introduction. Since the development of nonfullerene acceptors, organic solar cells (OSCs) have made strides toward reaching to 20% power conversion efficiency (PCE) in just a few years. [] Their potential in applications such as the Internet of Things, [] building integrated photovoltaics, [] and agrivoltaics, [] has pushed researchers to make significant progress in terms of ...

We discussed the fundamental photophysics of MAPbI<sub>3</sub>, MAPbBr<sub>3</sub>, and MAPbCl<sub>3</sub>, the model materials of lead halide perovskites, and their solar cell devices. In the first half of this review, we explained that these solution-processed materials possess superior optoelectronic properties such as extremely high luminescence efficiencies, no ...

A better understanding will enable more efficient and photostable solar cells and optoelectronic devices in the future. This special issue collects the latest cutting-edge research in the photophysics of PSCs and OSCs, contributed by experts on spectroscopy, theory, device physics, and materials science.

npj Flexible Electronics 6, Article number: 89 ( 2022 ) Cite this article The certified power conversion efficiency (PCE) of organic photovoltaics (OPV) fabricated in laboratories has improved dramatically to over 19% owing to the rapid development of narrow-bandgap small-molecule acceptors and wide bandgap polymer donor materials.

Organic photovoltaic (OPV) cells, also known as organic solar cells, are a type of solar cell that converts sunlight into electricity using organic materials such as polymers and small molecules. 83,84 These materials are carbon-based and can be synthesized in a laboratory, unlike inorganic materials like silicon that require extensive mining ...

Photophysics of 2D Organic-Inorganic Hybrid Lead Halide Perovskites: Progress, Debates, and Challenges ... 5 Australian Centre for Advanced Photovoltaics School of Photovoltaic and Renewable Energy ... of room to improve the performances of photoelectronic devices based on 2D RPPs by enhancing knowledge on fundamental photophysics. This ...

This review summarizes the recent progress in the stability and lifetime of organic photovoltaics (OPVs). In particular, recently proposed solutions to failure mechanisms in different layers of the device stack are discussed comprising both structural and chemical modifications.

As discussed above, access to the soft x-ray spectral range is necessary for the study of the organic semiconductors used in OPV devices. At the K edges of C, N and O, x-ray absorption excited dipole allowed 1s to 2p transitions, where the 1s orbital is strongly localized on the absorbing atom.

Photophysics of metal-organic frameworks: A brief overview. Qingshuo Liu ... such as photocatalysis,

photovoltaic devices, light-emitting diodes, and nonlinear optical devices. ... [49,50] and solar energy conversion, [51,52] has received significant attention. The principle of photocatalysis involves the excitation of electrons in materials by ...

Organic photovoltaic cells (OPVs) have been a hot topic for research during the last decade due to their promising application in relieving energy pressure and environmental problems caused by the increasing combustion of fossil fuels. Much effort has been made toward understanding the photovoltaic mechanism, including evolving chemical structural motifs and ...

The development of new hierarchical materials capable of efficient energy transfer along a predesigned pathway will boost various applications, ranging from organic photovoltaics to catalytic systems. Due to their exceptional tunability and structural diversity, metal-organic frameworks (MOFs) offer a unique platform to study and model directional energy-transfer ...

Australian Centre for Advanced Photovoltaics, School of Photovoltaic and Renewable Energy Engineering, UNSW Sydney, Kensington, NSW, 2052 Australia ... of room to improve the performances of photoelectronic devices based on 2D RPPs by enhancing knowledge on fundamental photophysics. This review highlights the special photophysics of ...

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