Why is bimolecular recombination important in organic solar cells?

In organic solar cells,bimolecular recombination is a key factor limiting the device performanceand creating the need for characterization. Light-intensity-dependent short-circuit current density measurements are a frequently used tool to qualitatively analyze bimolecular recombination in a device.

Does bimolecular recombination exist in bulk heterojunction organic photovoltaic devices?

We review scientific literature on bimolecular recombination (BR) in bulk heterojunction organic photovoltaic devices to bring forward existing ideas on the origin and nature of BR and highlight both experimental and theoretical work done to quantify its extent.

Are solar cells based on non-fullerene acceptors bimolecular recombination?

However,the bimolecular recombination rate in solar cells based on novel non-fullerene acceptors is mostly unclear. Moreover,the origin of the reduced-Langevin recombination rate in bulk heterojunction solar cells in general is still poorly understood.

Why is bimolecular recombination limited in OPV?

In a disordered semiconductor with localized charge carriers,bimolecular recombination is limited by the rate at which oppositely charged carriers find one another. The faster charge carriers move,the faster they will find each other; consequently,the rate of bimolecular recombination in OPV is proportional to the charge carrier mobilities.

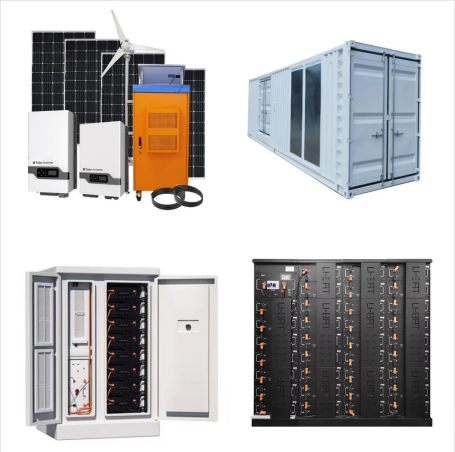
Does spin control recombination in organic photovoltaics?

Rao, A. et al. The role of spin in the kinetic control of recombination in organic photovoltaics. Nature 500, 435-439 (2013). Gillett, A. J. et al. The role of charge recombination to triplet excitons in organic solar cells.

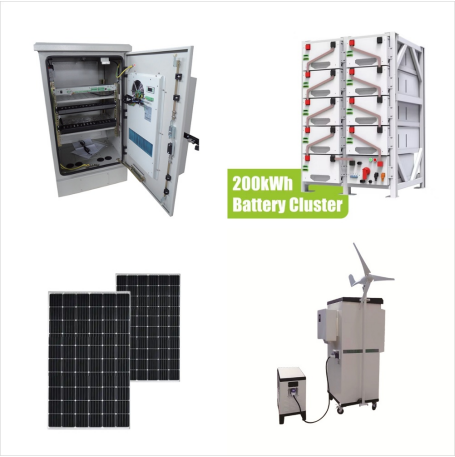
Which recombination mechanism is dominant in organic solar cells?

Bimolecular recombinationis often assumed to be the dominant recombination mechanism in organic solar cells. [50 - 52]This process occurs nonradiatively where a free electron and a free hole recombine with each other.

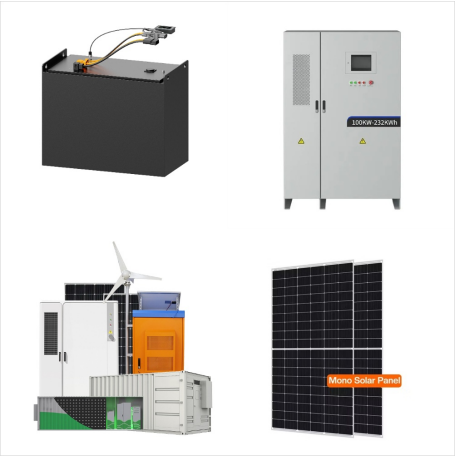
BIMOLECULAR RECOMBINATION IN ORGANIC PHOTOVOLTAICS



Insights into charge dynamics and recombination processes in ternary organic solar cells through photophysical characterization techniques. Author links open overlay panel Maria M?ndez 1, Jos? G. S?nchez 1, When the S value is close to 1, it suggests a ???

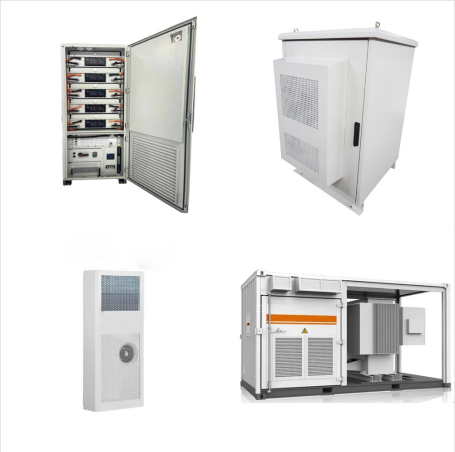


While bimolecular recombination in low-mobility semiconductors closely follows the Langevin mechanism 26, 27, being based on the diffusion of oppositely charged carriers toward each other in their mutual Coulomb field, the bimolecular recombination rate in efficient organic bulk-heterojunction solar cells can be orders of magnitude lower than



As shown in Fig. 1, nongeminate recombination includes the recombination of a free electron and a free hole known as bimolecular recombination (Fig. 1 b) and trap-assisted recombination Recombination in organic solar cells has been found to possess similar dependencies [189]. Thus it is clear that higher reaction orders at least in part

BIMOLECULAR RECOMBINATION IN ORGANIC PHOTOVOLTAICS



Reducing interface nonradiative recombination is important for realizing highly efficient perovskite solar cells. In this work, we develop a synergistic bimolecular interlayer (SBI) strategy via 4

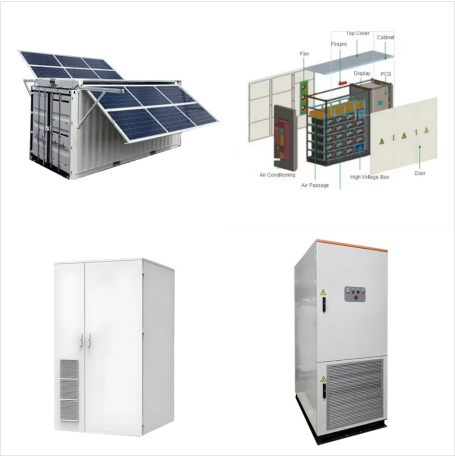
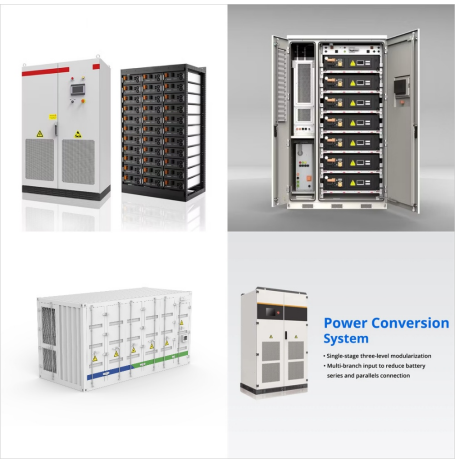
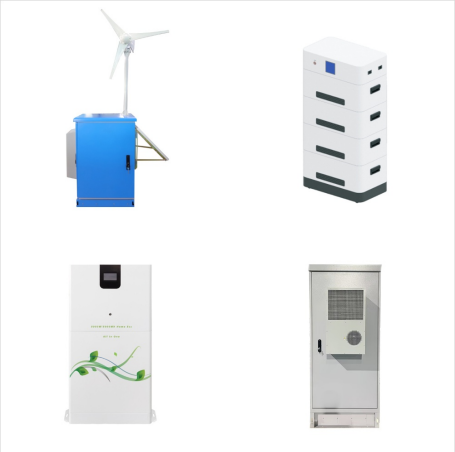


Illustration of the relevant energy levels and transitions for charge generation and recombination in organic bulk-heterojunction solar cells. The nongeminate recombination of electrons and holes from the charge separated (CS) state to ???



The light intensity dependence of J SC follows the relationship J SC ??? P ??, in which ?? < 1 indicates some extent of bimolecular recombination and ?? = 1 means no bimolecular recombination. 45 Slight decreases in ?? values are observed when applying Ag mirror to the STOPVs (Figure 3 C), suggesting that more bimolecular recombination is

BIMOLECULAR RECOMBINATION IN ORGANIC PHOTOVOLTAICS



Organic solar cells (OSC) benefit from their light weight, flexibility, potentially low cost and weak environmental impact. The nearly linear intensity dependencies of the current densities indicate that bimolecular recombination is relatively weak at the short circuit and at the maximum power point [23, 24].

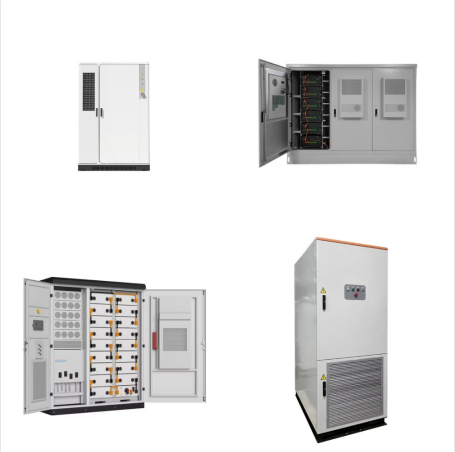
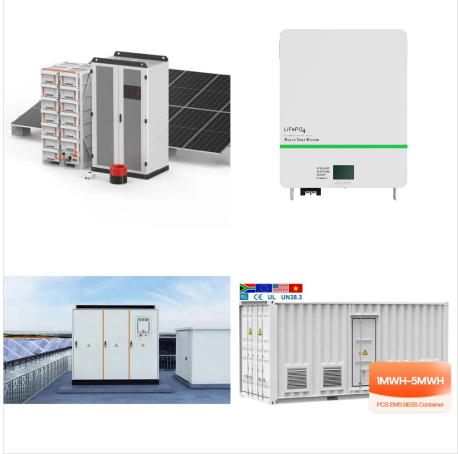


Figure 1. (Left) Schematic of bimolecular recombination processes of free charge carriers (FC) in OPV (not to energy scale). Encounters of spin-uncorrelated charges at D???A interface form charge-transfer states with both singlet (1CT) and triplet (3CT) spin characteristics. These CT states could either reionize into FC or recombine terminally across the interface. ???



Bimolecular charge recombination is one of the most important loss processes in organic solar cells. However, the bimolecular recombination rate in solar cells based on novel non-fullerene

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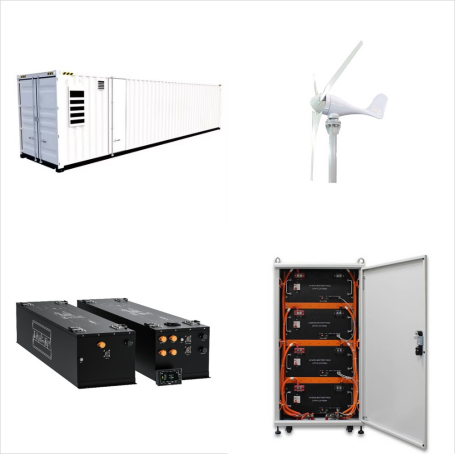
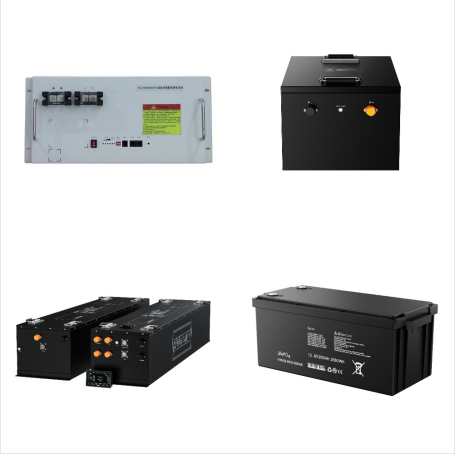
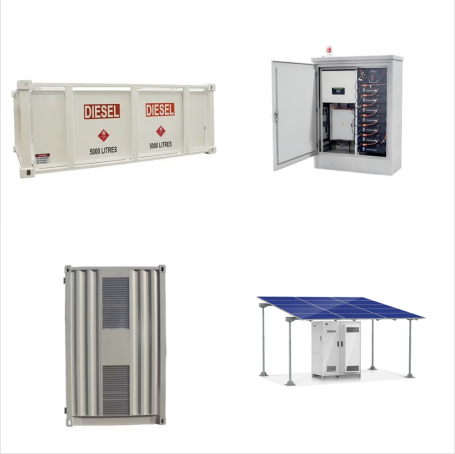


The subtle link between photogenerated charge generation yield (CGY) and bimolecular recombination in organic semiconductor-based photovoltaics is relatively well established as a concept but has proven extremely challenging to demonstrate and probe especially under operational conditions. Received wisdom al Recent Open Access Articles



The high non-radiative energy loss is a bottleneck issue that impedes the improvement of organic solar cells. The formation of triplet exciton is thought to be the main source of the large non



We review scientific literature on bimolecular recombination (BR) in bulk heterojunction organic photovoltaic devices to bring forward existing ideas on the origin and nature of BR and highlight both experimental and theoretical work done to quantify its extent.

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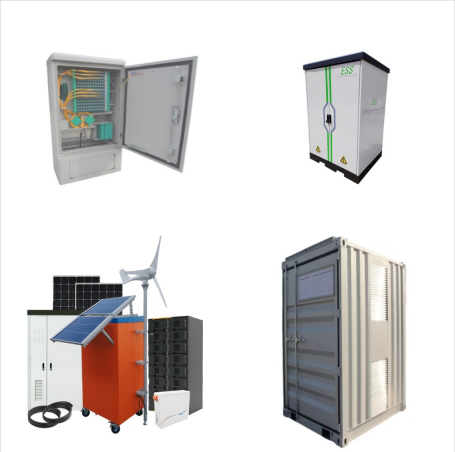
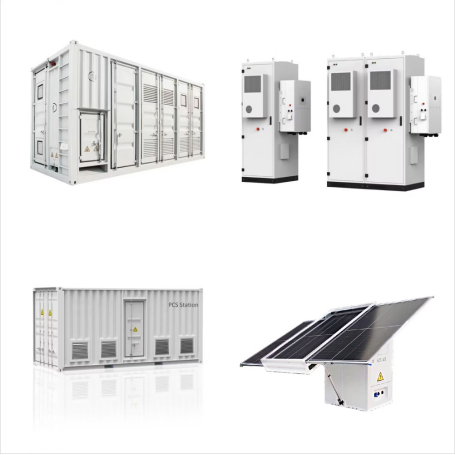
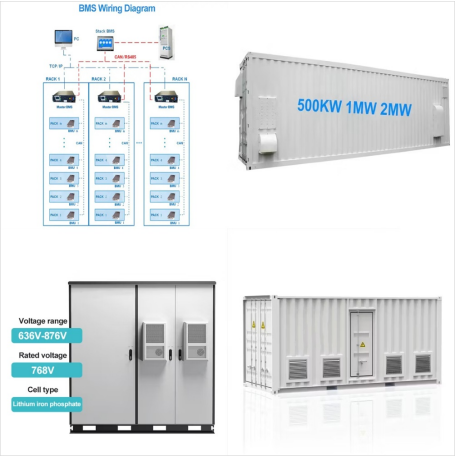


Wetzelaer et al. presented an elegant steady-state method to probe bimolecular recombination in organic solar cells at high forward bias. By comparing current densities in a blend in hole-only, electron-only, and double-carrier diodes, charge recombination can be calculated for every voltage and temperature.

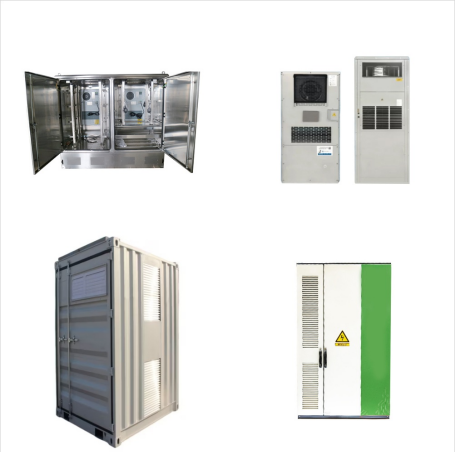


Single-component organic solar cells based on double cable polymers have achieved remarkable performance, with DCPY2 reaching a high efficiency of over 13%. In this study, DCPY2 is further optimized with an efficiency of 13.85%, maintaining a high fill factor (FF) without compromising the short circuit current. Bimolecular recombination

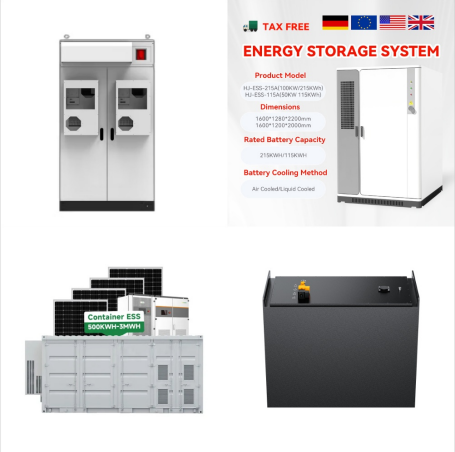


We investigated the variation of current density???voltage (J???V) characteristics of an organic solar cell (OSC) in the dark and at 9 different light intensities ranging from 0.01 to 1 sun of the

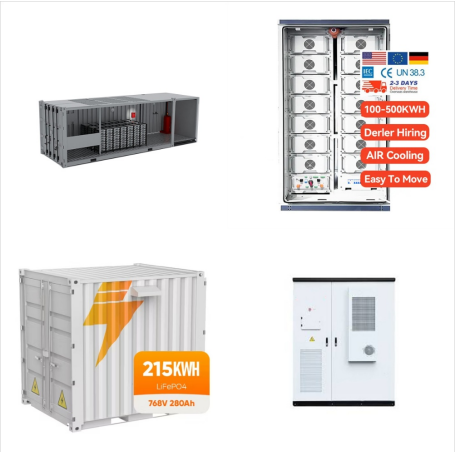
BIMOLECULAR RECOMBINATION IN ORGANIC PHOTOVOLTAICS



Organic solar cells are a rapidly expanding subfield of photovoltaics. The publication presents simulation results for organic cells with a focus on optimizing cells and maximizing performance using OghmaNano software. The efficiencies obtained from the simulation of the ternary solar devices were received. The efficiency achieved from simulations ???



While solution-processed bulk-heterojunction organic solar cells (OSCs) continue to attract attention as their efficiencies approach 20%, the physical origin of K by incorporating experimentally measured temperature-dependent mobilities into the drift-diffusion model, assuming bimolecular recombination as the primary recombination mechanism.



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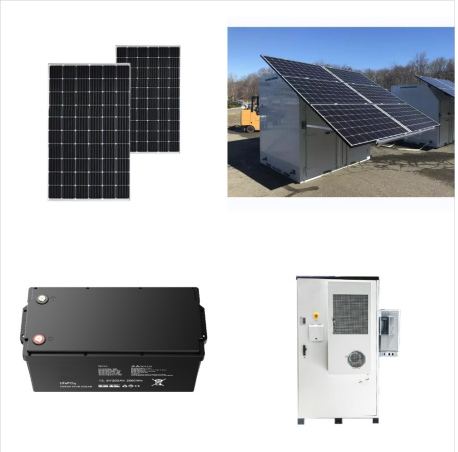

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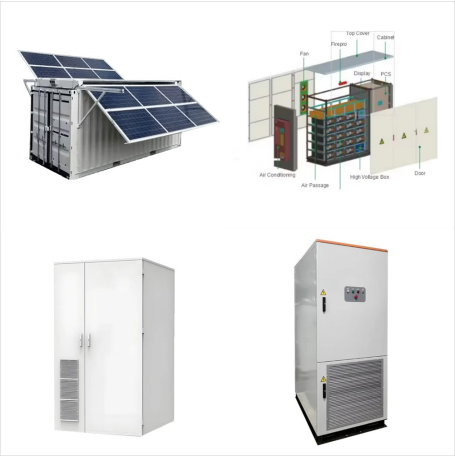

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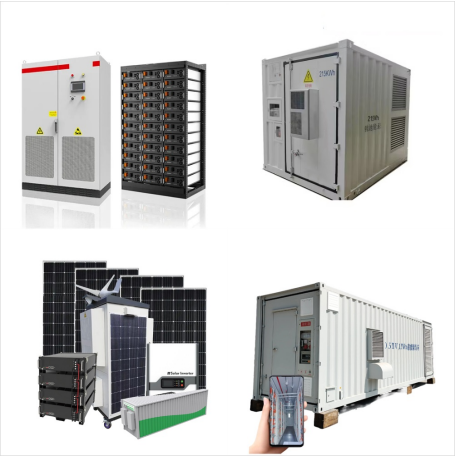

For organic solar cells (OSCs), bridging the gap with Shockley???Queisser limit necessitates simultaneously reducing the energy loss for a high open-circuit voltage, improving light utilization

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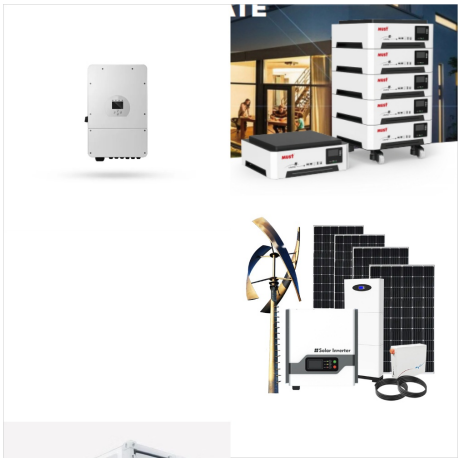
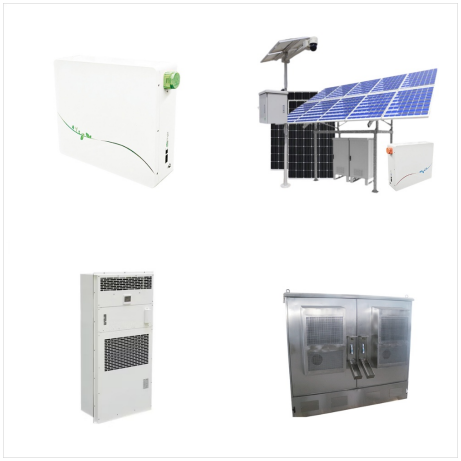


Diode Equation for Sandwich-Type Thin-Film Photovoltaic Devices Limited by Bimolecular Recombination Oskar J. Sandberg and Ardalan Armin PRX Energy 3, 023008 ??? Published 21 June 2024. (including organic solar cells) limited by bimolecular recombination has been lacking. Previous models neglect effects of injected charge carriers, which

Illustration of the relevant energy levels and transitions for charge generation and recombination in organic bulk-heterojunction solar cells. The nongeminate recombination of electrons and holes from the charge separated (CS) state to the electronic ground state involves the formation of a charge transfer (CT) pair as intermediate.



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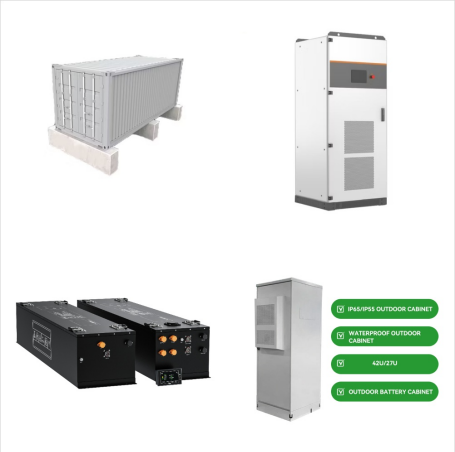
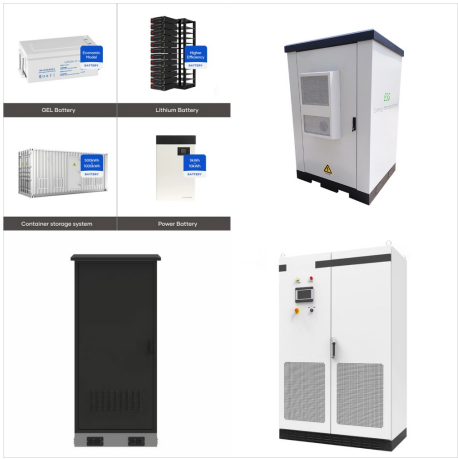
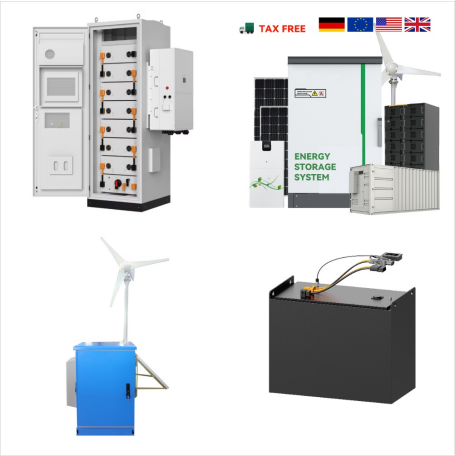


Time-resolved optical spectroscopy is used to characterize the effect of morphology through the use of solvent additives such as 1,8-octanedithiol (ODT) on triplet dynamics and charge recombination in blends of poly[2,6-(4,4-bis(2-ethylhexyl)-4H-cyclopenta]-dithiophene)] and [6,6]-phenyl-C71-butyric acid methyl ester. The nanoscale morphology and ???



Recombination at Open Circuit. Trap-Assisted Recombination at Open Circuit. Investigation of the Nature Recombination by Electroluminescence Measurements. Bimolecular Recombination Strength in Organic BHJ Solar Cells. Bimolecular Recombination Losses Under Short-Circuit Conditions. Effect of Bimolecular Recombination on Fill Factor and



A steady-state method to probe bimolecular recombination in organic solar cells is presented. The technique is applicable to thin-film solar cells at any temperature and does not require a separate measurement setup other than conventional solar-cell testing equipment.

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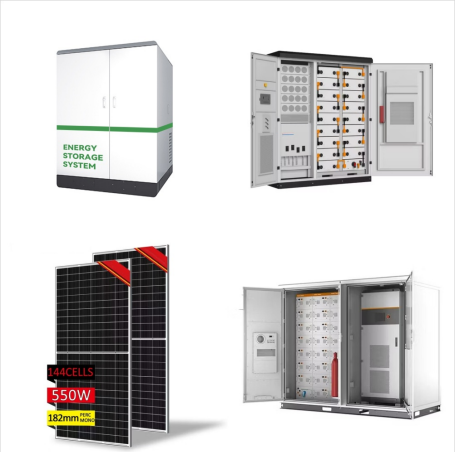
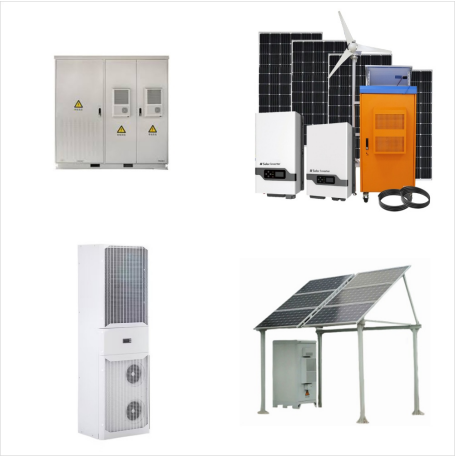
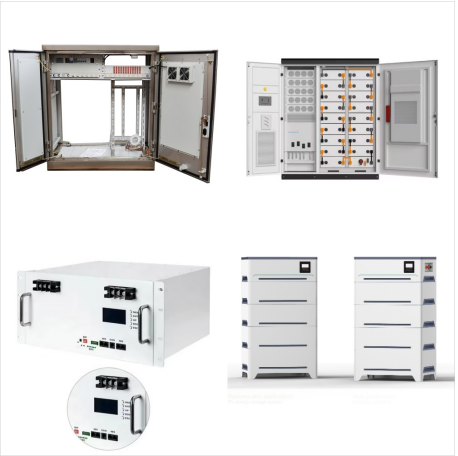


Bimolecular recombination in BHJs is commonly understood as a two-step process involving electron and hole encounter to form bound CT states and a subsequent decay of the bound states, which otherwise re-dissociate back to free charges. In recently reported NFA-based organic solar cells based on low-offset donor???acceptor systems,



Organic photovoltaic devices (OPVs) represent a highly attractive choice for harnessing solar energy in terms of low cost, easiness of production, flexibility and environmental sustainability.



However, it has been reported that the bimolecular recombination rates of efficient NFA organic solar cells are much less than the Langevin rate 41,42. In our transient absorption measurements, we

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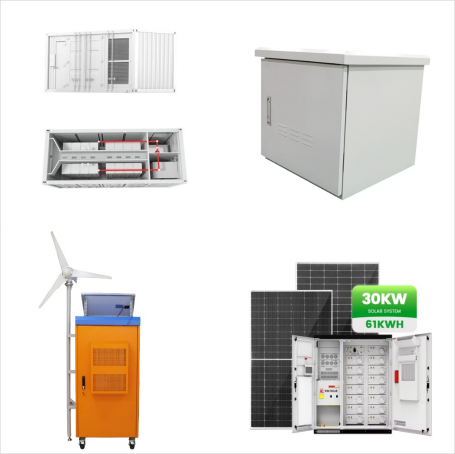
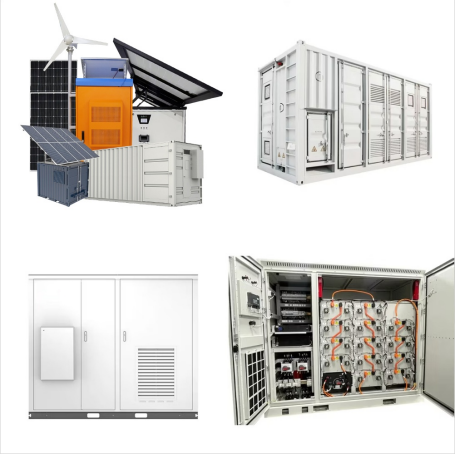


The interplay of spin, energetics and delocalization of the electronic excitations are shown to create a spin blockade of electron???hole recombination in organic photovoltaic cells, resulting in



and thus determine the bimolecular recombination ???ux. By comparison with the device short-circuit photocur-rent we conclude that the open-circuit voltage is primarily limited by bimolecular recombination. DOI: 10.1103/PhysRevB.78.113201 PACS number s : 73.50.Gr, 73.50.Pz, 73.61.Ph, 73.61.Wp Organic solar cells based on polymer:fullerene blend