Can photogenerated hot carriers be harnessed in spatially confined photovoltaic materials?

Key points Photogenerated hot carriers can be harnessed in spatially confined photovoltaic materials(2D van der Waals heterostructures),owing to slow hot carrier cooling and restricted loss channels,resulting in power conversion efficiency beyond the Shockley-Queisser limit.

Why is interfacial carrier generation important in Van der Waals heterostructures?

Efficient interfacial carrier generation in van der Waals heterostructures is critical for their electronic and optoelectronic applications. We demonstrate broadband photocarrier generation in WS2-...

Is direct interlayer hot carrier transfer efficient in Van der Waals heterostructures?

Unlike conventional bulk heterostructures,direct interlayer hot carrier transfer on the ultrafast timescale can be efficientin van der Waals heterostructures without phonon emission due to momentum conservation at the K-point.

Are VDW heterostructures a promising material for efficient HC photovoltaics?

The vdW heterostructures,a promising class of materials for efficient HC photovoltaics,is a recent discovery. Thus,studies reported so far mostly use the ultrafast transient spectroscopic techniques.

Can a van der Waals heterostructure provide new hot-carrier-based device concepts?

The energy transfer mechanism revealed here might enable new hot-carrier-based device conceptswith van der Waals heterostructures. Here,the authors investigate the interfacial charge/energy transfer dynamics in a WSe2/graphene heterostructure.

Are 2D van der Waals layered materials and perovskite nanostructures efficient?

Both 2D van der Waals layered materials and perovskite nanostructures demonstrate high carrier multiplication conversion efficiency. Moreover,2D van der Waals heterostructures also demonstrate highly efficient interlayer carrier multiplication near room temperature.

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

The recent discovery of 2D van der Waals (vdW) magnets provides a new platform for spin photovoltaic effects based on atomically thin materials with intrinsic magnetic order (18???21).Among these magnets, chromium triiodide (CrI_3) is particularly interesting because of its layered antiferromagnetism (AFM), where the ferromagnetic monolayers with out-of-plane ???

Figure 1. Achieving high EQE in van der Waals heterostructures: (a) A schematic of the van der Waals device stack where nanophotonic light trapping combined with e???cient exciton dissociation and carrier collection yields EQEs >50%. (b) A schematic of comparing near-unity

2D materials exhibit a diverse array of optical and electronic properties, ranging from insulating hexagonal boron nitride and semiconducting transition metal dichalcogenides to semimetallic graphene. 1-5 Stacked 2D materials, or van der Waals (vdW) heterostructures, 6-8 have generated considerable recent interest as designer plasmonic, photonic, and ???

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

Unveiling the Hot Carrier Distribution in Vertical Graphene/h-BN/Au van der Waals Heterostructures for High-Performance Photodetector. Photocurrent Direction Control and Increased Photovoltaic Effects in All-2D Ultrathin Vertical Heterostructures Using Asymmetric h-BN Tunneling Barriers.

Van der Waals (vdW) stacking of two-dimensional (2D) materials to create artificial structures has enabled remarkable discoveries and novel properties in fundamental physics. Y. H. Lee, Hot carrier photovoltaics in van der Waals heterostructures. Nat. Rev. Phys. 3, 178???192 X. Luo, G. Li, Y. Chen, C. Zhang, J. He, Tunable ultrafast

The controlled isolation and assembly of single- and few-layer sheets of two-dimensional (2D) materials into van der Waals (vdW) heterostructures has thrown open the doors for the design and

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

Recently van der Waals heterostructures (HS), obtained by stacking graphene sheets with other 2D crystals (e.g. boron nitride, transition metal dichalcogenides or graphene itself), have received

Photonic and electronic design of 2D semiconductor photovoltaics represents a new direction for realizing ultrathin, efficient solar cells with applications ranging from conventional power ???

Emerging van der Waals (vdW) heterostructures provide the ideal platform for BPVE due to interfacial interactions naturally breaking the crystal symmetries of the individual co nstituents and

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

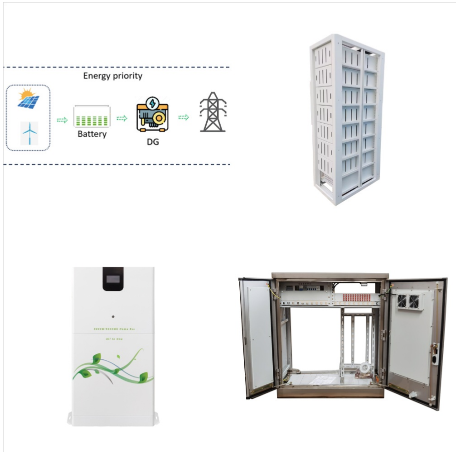
Particularly, van der Waals heterostructures devices with ultrathin and ultralight features are much suitable for the application where the weight and dimension consideration are essential in the

Exploiting Janus monolayers in constructing two-dimensional van der Waals (vdW) heterostructures has emerged as an effective strategy for designing highly efficient optoelectronic devices this paper, using first-principles calculations, we explore the stability, structural, and electronic properties of Janus XMoSiP 2 /BAs (X = S, Se) heterostructures in twelve possible ???

The need for low-carbon solar electricity production has become increasingly urgent for energy security and climate change mitigation. However, the bandgap and carrier separation critical requirements of high-efficiency solar cells are difficult to satisfy simultaneously in a single material. In this work, several van der Waals ZnIn2X4 (X = S, Se, and Te) ???

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

The peculiar nature of light-matter interaction in atomically thin transition metal dichalcogenides is recently under examination for application in novel optoelectronic devices. Here, we show that heterostructures composed of two or more such layers can be used for solar energy harvesting. The strong absorption in these atomically thin layers makes it possible to ???



Van der Waals semiconductor heterostructures could be a platform to harness hot photoexcited carriers in the next generation of optoelectronic and photovoltaic devices. The internal quantum ef???ciency of hot-carrier devices is determined by the relation between photocarrier extraction and thermalization rates. Using ab initio

Two-dimensional van der Waals heterostructures exhibit distinctive electronic and optoelectronic properties, making them promising structures for constructing advanced multifunctional devices. However, devices based on conventional charge-carrier transport mechanisms often perform only a single function, which limits its integration and

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

These structures are called van der Waals heterostructures (vdWHs). Engineering graphene and TMDs based van der Waals heterostructures for photovoltaic and photoelectrochemical solar energy conversion. Chem. Soc. Rev., 47 (13) effects on hot-carriers. Nano Lett. (2019) Google Scholar [81]

@article{Kim2020UnveilingTH, title={Unveiling the Hot Carrier Distribution In Vertical Graphene/h-BN/Au Van der Waals Heterostructures for High Performance Photodetector.}, author={Young Rae Kim and Thanh Luan Phan and Yong Seon Shin and Won Tae Kang and Ui Yeon Won and Ilmin Lee and Ji Eun Kim and Kunnyun Kim and Young Hee ???

A van der Waals (vdW) heterostructure is formed by combining multiple materials through vdW bonds. Additionally, the application of 2D/3D heterostructures demonstrates significant potential for photovoltaic (PV) applications. Chen ???

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

Correction for "Broadband ultrafast photovoltaic detectors based on large-scale topological insulator Sb 2 Te 3 /STO heterostructures" by Honghui Sun, et al., Nanoscale, 2017, 9, 9325

quantitative characterization of few-atomic-layer thickness optoelectronic devices in van der Waals heterostructures. In this paper, we demonstrate external quantum efficiencies > 50% (Figure 1(a)), indicating that van der Waals heterostructures have considerable potential for efficient photovoltaics.

Successfully designing an ideal solar cell requires an understanding of the fundamental physics of photoexcited hot carriers (HCs) and the underlying mechanism of unique photovoltaic performance. Harnessing photoexcited HCs offers the potential to exceed the thermodynamic limit of power conversion efficiency, although major loss channels employing ultrafast ???

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

By suppressing the loss of excessive energy to defects, the alkali cations also reduce the threshold carrier density for achieving picosecond carrier cooling via hot phonon effect by an order of magnitude. These results underscore the opportunities in designing optimal hybrid perovskite structures for hot carrier solar cells.

DOI: 10.1021/acs.nanolett.6b04449 Corpus ID: 206737413; Tuning Carrier Tunneling in van der Waals Heterostructures for Ultrahigh Detectivity. @article{Vu2017TuningCT, title={Tuning Carrier Tunneling in van der Waals Heterostructures for Ultrahigh Detectivity.}, author={Quoc An Vu and Jin Hee Lee and Van Luan Nguyen and Yong Seon Shin and Seong Chu Lim and Kiyoung ???

Hot carrier photovoltaics in van der Waals heterostructures Vertical van der Waals heterostructures 14 can be obtained by manual stacking 15,16 or growth 17,18,19 of different 2D materials in

HOT CARRIER PHOTOVOLTAICS IN VAN DER WAALS HETEROSTRUCTURES

Efficient interfacial carrier generation in van der Waals heterostructures is critical for their electronic and optoelectronic applications. We demonstrate broadband photocarrier generation in WS 2-graphene heterostructures by imaging interlayer coupling???dependent charge generation using ultrafast transient absorption microscopy terlayer charge-transfer (CT) transitions and ???