Van der waals materials for atomically-thin photovoltaics

Atomically thin 2D van der Waals (2D-vDW) materials have attracted significant attention for optoelectronic applications in photodetectors, photovoltaics, and quantum information science. Their atomically thin thickness, however, ...

In summary, we have proposed and demonstrated a van der Waals heterodiode with a unilateral depletion region and a narrow bandgap semiconductor carrier selective contact for high-performance photovoltaic detectors, which was successfully fabricated by assembling thick weak p-type MoS 2 and narrow bandgap AsP 2D layers.

Recent advances in techniques such as growth of wafer-scale 2D TMDs via CVD (31-33) and pickup and stacking of large-area van der Waals materials will enable the scaling of TMD solar cells from the micrometer to the ...

easier to integrate 2D semiconductor photovoltaics as the component sub-cells of a tandem photovoltaic structure integrated with or on conventional Si. 70-71, thin film CIGS, CdTe, or GaAs. 72. photovoltaics, or even organic semiconductors. 5, 73-74, where the 2D semiconductor forms a van der Waals vertically stacked device.

Carrier collection schemes for van der Waals materials and structures: (a) Schematic in-plane junction concepts for photovoltaic devices. Heterojunctions can be formed between two ...

Moreover, the absence of surface dangling bonds enables arbitrary van der Waals (vdWs) integration of 2D atomic crystal with other highly disparate materials [[6], [7], [8]]. Without the constraint on lattice matching and process compatibility, this approach provides intriguing possibilities to fabricate atomically clean and sharp ...

High-quality van der Waals (vdW) heterostructures are produced by stacking together different two-dimensional (2D) materials 1,2.The properties are highly customisable depending on the component ...

These atomically thin 2D materials have demonstrated strong light-matter interactions, tunable optical bandgap structures and unique structural and electrical properties, rendering possible the high conversion efficiency of solar energy with a minimal amount of active absorber material. ... Photovoltaics in Van der Waals Heterostructures. M ...

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the advent of atomically thin van der Waals materials and their heterostructures, it is now possible to realize a p-n junc- ... devices such as photodiodes, photovoltaic cells and light-emitting ...

Following the discovery of graphene, two-dimensional layered materials (2DLMs) have become a cornerstone of materials research. These materials, distinguished by weak van der Waals forces holding individual layers together, offer exceptional flexibility for constructing van der Waals heterostructures (vdWHs). By strategically stacking diverse materials such as ...

Title: Van der Waals Materials for Atomically-Thin Photovoltaics: Promise and Outlook. Authors: Deep Jariwala, Artur R. Davoyan, Joeson Wong, Harry A. Atwater. ... Photonic and electronic design of 2D semiconductor photovoltaics represents a new direction for realizing ultrathin, efficient solar cells with applications ranging from conventional ...

The exfoliation of two naturally occurring van der Waals minerals, graphite and molybdenite, arouse an unprecedented level of interest by the scientific community and shaped a whole new field of ...

A new generation of quantum material derived from intercalating zerovalent atoms such as Cu into the intrinsic van der Waals gap at the interface of atomically thin two-dimensional GeSe/SnS heterostructure is designed, and ...

Van der Waals contacts could have an even greater advantage for these vertical device geometries, where the ratio of contact area to device area is often higher than in lateral device geometries. Schottky-junction solar cells represent one specific device geometry where van der Waals metal contacts could enable high performance in vertical devices.

atomically thin photovoltaics is the photonic design of nanostructures that retain the electronic structure and photonic properties of monolayer 2D materials, while also exhibiting optical cross ...

the advent of atomically thin van der Waals materials and their heterostructures, it is now possible to realize a p-n junc-tion at the ultimate thickness limit3-10. Van der Waals junctions ... devices such as photodiodes, photovoltaic cells and light-emitting devices3,8,15-20. The availability of TMDCs with different bandgaps

The atomically scaled van der Waals p-n heterostructures presented here constitute the ultimate functional unit for nanoscale electronic and optoelectronic devices. Heterostructures based on atomically thin van der Waals materials are fundamentally different and more flexible than those made from conventional covalently bonded materials, in ...

With the advent of atomically thin van der Waals materials and their heterostructures, it is now possible to realize a p-n junction at the ultimate thickness limit3,4,5,6,7,8,9,10. Van der Waals junctions composed of p- and n-type semiconductors--each just one unit cell thick--are predicted to exhibit completely different charge transport ...

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A type-II van der Waals heterojunction made of molybdenum disulfide and tungsten diselenide monolayers and under appropriate gate bias an atomically thin diode is realized, ...

Further, this metal transfer process could enable van der Waals contacts to air- and moisture-sensitive nanomaterials, such as lead halide perovskites or black phosphorus, to be formed without removing the sample from an inert environment.

To date, a majority of the application-oriented research in this field has been focused on field-effect electronics as well as photodetectors and light emitting diodes. Here we present a perspective on the use of 2D semiconductors for photovoltaic applications.

Two-dimensional (2D) semiconductors provide a unique opportunity for optoelectronics due to their layered atomic structure, electronic and optical properties. To date, a majority of the application-oriented research in this field has been focused on field-effect electronics as well as photodetectors and light emitting diodes. Here we present a perspective ...

The intercalation of zerovalent elements into the van der Waals gaps of atomically thin layered materials at the nanoscale, leveraging advanced technologies, is a well-established and reliable technique.

Our work suggests an effective scheme to design high-performance photovoltaic devices assembled by 2D materials. Photovoltaic devices based on 2D materials still suffer from low quantum efficiencies due to interfacial charge recombination and inefficient contacts.

A new generation of quantum material derived from intercalating zerovalent atoms such as Cu into the intrinsic van der Waals gap at the interface of atomically thin two-dimensional GeSe/SnS heterostructure is designed, and their optoelectronic features are explored for next-generation photovoltaic applications.

Unlike traditional three-dimensional semiconductors, when van der Waals semiconductors are integrated to other materials, "lattice mismatch" in the vertical direction can be avoided because there is no dangling bond on their plane surfaces. Here, taking full advantage of the benefit of van der Waals heterostructure, we constructed the first vacuum-ultraviolet ...

Atomically thin 2D van Der Waals (2D-vDW) materials have attracted significant attention for optoelectronic applications in photodetectors, photovoltaics, quantum information science. Their atomically thin thickness, however, renders them poor absorbers.

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 ...

We investigate the ultra-thin photonic structures of WS2 as one of the candidates for enhancing the performance of quantum emitters in van der Waals materials. ... belonging to the class of van der Waals materials, are promising materials for optoelectronics and photonics. ... Van der Waals Materials for Atomically-Thin Photovoltaics: Promise ...