Ferroelectric photovoltaic solar cells

What is a ferroelectric photovoltaic?
Ferroelectric photovoltaics have attracted attention for their unusual photovoltaic effect and controllability. The photogenerated voltage that is independent of bandgap along the polarization direction can be generated in ferroelectric materials,undoubtedly making up for the lack of solar cells.

What makes ferroelectric photovoltaics different from p-n based solar cells?
Another unique feature of ferroelectric photovoltaics is that,unlike p-n based solar cells,the photovoltage of FePvs is not limited by the material's bandgap(E g); open circuit voltages (VOC) as large as 1600 V have been measured in LiNbO 3.

When was photovoltaic effect discovered in ferroelectric materials?
The discovery of photovoltaic effect in ferroelectric materials can be traced back to more than 50 years ago(1 - 3). In contrast to classical semiconductor solar cells,photoexcited carriers in ferroelectric materials are spontaneously separated due to the inversion symmetry breaking.

Can ferroelectric materials be integrated with photovoltaic devices?
The integration of ferroelectric materials with photovoltaic devices,where the ferroelectric materials are used as a component in the active layer or as an interfacial layer in conjunction with the perovskite layer,has also been exploredto generate a stable and controllable polarized electric field for charge separation and charge collection.

Can ferroelectric energy conversion improve the performance of perovskite solar cells?
As a result,the integration of the ferroelectric process with the photon-to-electron energy conversion process becomes feasibleto generate interesting photo-physical properties and further boost the device performance of perovskite solar cells (PSCs),which have started to attract more and more attention in recent years.

Can ferroelectric semiconductors be used in ultrathin-film solar cells?
Our study also demonstrates the great potentialof ferroelectrics for use in ultrathin-film PV devices,which may benefit the development of high-efficiency,low-cost,and low-weight solar cells. Lopez-Varo,P. et al. Physical aspects of ferroelectric semiconductors for photovoltaic solar energy conversion.

Recent developments in photovoltaic materials have led to continual improvements in their efficiency. We review the electrical characteristics of 16 widely studied geometries of photovoltaic materials with efficiencies of 10 to 29%.

The power conversion efficiency (PCE) of ferroelectric photovoltaics (FePvs) was originally not expected to surpass 0.01%, ... absorption and charge separation occur within a single layer of a ferroelectric material as opposed to p-n junction solar cells. Additionally, FePvs can work without rectification or charge selective

contacts, making ...

One of the key loss mechanisms in the operation of organic solar cells is the separation and extraction of the generated charge carriers from the active region. The use of a ferroelectric layer is ...

Most known ferroelectric photovoltaic materials have very wide electronic bandgaps (that is, they absorb only high-energy photons) but here a family of perovskite oxides is described that have ...

The bulk photovoltaic effect (BPVE) 1,2,3,4,5 in ferroelectric materials has been intensively investigated because of properties such as above bandgap photovoltage generation or the possibility of ...

The ferroelectric-photovoltaic devices have a great potential in future application as solar cells [5, 25, 26], optically triggered memories [17, 27, 28], and optical transistors . Fig. 5.1 A diagram presenting a photocurrent generation a and energy band diagram b of a poled Pt/SbSI/Pt ferroelectric-photovoltaic device.

Since the discovery of the ferroelectric photovoltaic (FEPV) effect 1,2, ferroelectric (FE) materials have been intensely investigated for photovoltaic (PV) applications 3,4,5,6,7.Under ...

Thus, solar cells and photodetectors could be fabricated using this class of materials owing to their unique coupling of optical properties with intrinsic polarization . ... comparing the ferroelectric photovoltaic properties, LN-ZnSnS 3 would be highly effective to overcome the major limitations of the conventional ferroelectric PV devices.

Traditional positive-negative (PN) junction based solar cells have many limitations. Herein, we introduce ferroelectric-semiconductor solar cells that use the bound surface charges of the ferroelectric for achieving charge separation in the semiconductor. The feasibility of the new concept cells was verified both experimentally and theoretically in detail. The new cells are ...

Steps in the electrostatic potential at domain walls in a ferroelectric material give rise to a new kind of photovoltaic effect that produces voltages significantly higher than the bandgap of the ...

To advance the understanding of the ferroelectric photovoltaic mechanism, the effects of a family of PVDF-based grafted ferroelectric polymers, ... Solar cell fabrication: PTB7-Th:PC 71 BM (1:1.5 ratio) and based devices were fabricated in the conventional device structure of glass/ITO/PEDOT:PSS/active layer/Al. On the pre-cleaned ITO substrate ...

1. Introduction. Photovoltaic (PV) materials and devices, generally known as solar cells, convert sunlight into electrical energy. Clean and reliable electricity generation is one of the major benefits of PV technology when it comes to avoid serious environmental and energy issues [1], [2].The PV technologies can be classified according to the materials.

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Ferroelectric materials exhibiting anomalous photovoltaic properties are one of the foci of photovoltaic research. We review the foundations and recent progress in ferroelectric materials for photovoltaic applications, including the physics of ferroelectricity, nature of ferroelectric thin films, characteristics and underlying mechanism of the ferroelectric ...

"The new ferroelectric material - which is grown in the lab from cesium germanium tribromide (CsGeBr 3 or CGB) - opens the door to an easier approach to making solar cell devices," they ...

However, the light-to-electricity conversion efficiency (power conversion efficiency) of the bulk PV effect in ferroelectric thin film-based solar cells is reported to be significantly lower (< 10 -4) than that of silicon-based solar cells available in the market.2,10 Moreover, the large energy band gap of ferroelectric materials allows ...

Conventional solar cells have been devised based on the photovoltaic effect of semiconductor p-n junctions, with their photogenerated voltage being influenced by the bandgap of the semiconductors, limiting their further development. Ferroelectric photovoltaics have attracted attention for their unusual photovoltaic effect and controllability.

In this review, we refer to the solar cells based on both ferroelectric and photovoltaic effects of photoferroelectric perovskites as the photoferroelectric perovskite solar cells ...

INTRODUCTION. Ferroelectrics with effective out-of-plane charge separation have attracted renewed attention [].Over the past decade, ferroelectric photovoltaic devices have facilitated great progress in the areas of anomalous photovoltaic effects [], interface engineering [8, 9] and single and multilayer solar cells [].As a cutting-edge topic related to ferroelectrics, a ...

Combining ultra-thin layers of different materials can raise the photovoltaic effect of solar cells by a factor of 1,000, according to researchers at Martin Luther University Halle-Wittenberg (MLU) in Germany. Their findings, published in the journal "Science Advances," described a lattice arrangement of three different layers of ferroelectric crystals (in this case, of ...

US scientists have discovered a lead-free perovskite material with ferroelectric properties that can be used in solar cells. The perovskite compound was grown from cesium germanium tribromide and...

Herein, we firstly present the (K,Bi)(Nb,Yb)O 3 inorganic ferroelectric photovoltaic (FPV) film, in which a nearly ideal bandgap of ~1.45 eV in the center of the solar spectrum and the co-existence of oxygen vacancies as well as ferroelectric polarization were confirmed. Furthermore, a novel cell structure is successfully fabricated by combining charge-transporting ...

To study the ferroelectric photovoltaic effect based on polycrystalline films, preparation of high-quality polycrystalline films with low leakage and high remnant polarization is essential. Polycrystalline BiFeO3

(BFO) thin films with extremely large remnant polarization (2P r = 180 C/cm2) were successfully deposited on glass substrates coated with indium tin oxide ...

Multiferroic films are increasingly being studied for applications in solar energy conversion because of their efficient ferroelec. polarization-driven carrier sepn. and above-bandgap ...