

Shift current bulk photovoltaic effect

What is bulk photovoltaic effect?

The bulk photovoltaic effect (BPVE) refers to the generation of a steady photocurrent and above-bandgap photovoltage in a single-phase homogeneous material lacking inversion symmetry. The mechanism of BPVE is decidedly different from the typical p-n junction-based photovoltaic mechanism in heterogeneous materials.

Which DC-current response is dominant in the bulk photovoltaic effect (bpve)?

Rajender Prasad Tiwari, Balaji Birajdar, and Ram Krishna Ghosh *Shift current is the dominant dc-current response in the bulk photovoltaic effect (BPVE), which is the conversion of solar energy into electricity in the materials with broken inversion symmetry.

Does the bulk photovoltaic effect rely on p-n junctions?

This interface-free current generation mechanism, referred to as the bulk photovoltaic effect (BPVE), does not rely on p-n junctions. Here, we explore the shift current generation, a major mechanism responsible for the BPVE, in single-element two-dimensional (2D) ferroelectrics represented by phosphorene-like monolayers of As, Sb, and Bi.

Can shift currents improve photovoltaic efficiency?

Nature Communications 8, Article number: 14176 (2017) Cite this article While the basic principles of conventional solar cells are well understood, little attention has gone towards maximizing the efficiency of photovoltaic devices based on shift currents.

Does shift photovoltaic current coexist with ballistic currents?

No eLetters have been published for this article yet. Science The quantum phenomenon of shift photovoltaic current was predicted decades ago, but this effect was never observed directly because shift and ballistic currents coexist. The atomic-scale relaxation...

What is rectified bulk photovoltaic effect (bpve)?

Urmimala Dey 1, Jeroen van den Brink 2,3,4, and Rajyavardhan Ray 2,3,5,*The rectified bulk photovoltaic effect (BPVE) in noncentrosymmetric semiconductors, also called shift current, is considered promising for optoelectronic devices, terahertz emission, and possibly solar energy harvesting.

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 bulk photovoltaic effect (BPVE), sometimes also called the photogalvanic effect (PGE), refers to the electric current generation in a homogeneous material under light illumination, in contrast to the traditional photovoltaics where a heterojunction, such as a p-n junction, is needed to separate the photo-generated carriers (). 1-4 It has attracted increasing ...

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The bulk photovoltaic effect (BPVE) -- the generation of electric currents by light in noncentrosymmetric materials in the absence of electric fields and gradients -- was intensively investigated at the end of the last century. The outcomes, including all main aspects of this phenomenon, were summarized in reviews and books. A new upsurge of interest in the BPVE ...

We investigate the shift current bulk photovoltaic response of materials close to a band inversion topological phase transition. We find that the bulk photocurrent reverses direction across the band inversion transition, and that its magnitude is enhanced in the vicinity of the phase transition. These results are demonstrated with first principles density functional theory ...

The bulk photovoltaic effect (BPVE) refers to the generation of a steady photocurrent and above-bandgap photovoltage in a ... is a nonlinear optical effect. We note that the shift current also

To further understand the microscopic origin of the SPE, we studied the dependence of the bulk photovoltaic effect in the WSe₂/BP interface (device 2; ... N. Ogawa, T. Kurumaji, Y. Tokura, M. Kawasaki, Shift current photovoltaic effect in a ferroelectric charge-transfer complex. Nat. Commun. 8, 281 (2017). Crossref. PubMed. Google Scholar. 22.

Shift current is the dominant dc-current response in the bulk photovoltaic effect (BPVE), which is the conversion of solar energy into electricity in the materials with broken inversion symmetry. While the guiding principle of BPVE is a lack of inversion symmetry in a material which also results in ferroelectricity, it is

The bulk photovoltaic effect (BPVE) is a strong contender for next-generation photovoltaic applications Spanier et al. (). The BPVE stems from the static second-order optical response of a crystal with broken inversion symmetry and consists of the shift current, injection current, optical rectification Sipe and Shkrebtii (), ballistic current Sturman and recombination current ...

We calculate the bulk photovoltaic response of the ferroelectrics BaTiO_3 and PbTiO_3 from first principles by applying the "shift current" theory to the electronic structure from density functional theory. The first principles results for BaTiO_3 reproduce experimental photocurrent direction and magnitude as ...

Shift current and ballistic current have been proposed to explain the bulk photovoltaic effect (BPVE), and there have been experiments designed to separate the two mechanisms. These experiments are based on the assumption that under magnetic field, ballistic current can have a Hall effect while the shift current cannot, which is from some energy-scale ...

The anomalous photovoltaic effect (APE) is a type of a photovoltaic effect which occurs in certain semiconductors and insulators. The "anomalous" refers to those cases where the photovoltage (i.e., the open-circuit voltage caused by the light) is larger than the band gap of the corresponding semiconductor

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some cases, the voltage may reach thousands of volts.

Shift photovoltaic current, which contributes to the bulk photovoltaic effect (BPE) (2-4), has recently generated substantial interest in solid state science, physical chemistry, optoelectronics, and engineering, in part because this remarkable phenomenon involving inversion symmetry breaking has been proposed as a mechanism for ...

The bulk photovoltaic effect (BPVE) is a second-order optical process in noncentrosymmetric materials that converts the light into DC currents. BPVE is classified into shift current and injection current according to the generation mechanisms and their dependence on the polarization of light is sensitive to the spatial and time-reversal symmetry of materials. In ...

The study of bulk photovoltaic effect (BPVE) has a long history 1,2,3, and recently it has attracted great renewed interest because it potentially allows the energy conversion efficiency to ...

Here, we report a facile, direct-current, steady-state method for unambiguous determination of shift by means of the simultaneous measurements of linear and circular bulk photovoltaic currents under magnetic field, in a sillenite ...

Shift current bulk photovoltaic effect induced by quasiparticle and exciton Ruixiang Fei,¹ Liang Z. Tan,² and Andrew M. Rappe¹, ¹Department of Chemistry, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6323, USA ²Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, California 94720, United States We compute the shift ...

First principles calculation of the shift current photovoltaic effect in ferroelectrics. Phys. Rev. Lett. 109, 116601 ... Shift current bulk photovoltaic effect in polar materials--hybrid and ...

Introduction to the Shift Current Photovoltaic Effect Sean Raglow The bulk photovoltaic effect (BPVE) is a nonlinear optical effect that generates photocurrents in ... One alternative source for photo-current is the bulk photovoltaic effect (BPVE), which has been shown capable of producing an above band-gap photovoltage, may allow the Shockley ...

between the shift current and the shift vector [20], a gauge-invariant quantity related to the Berry connection, without some special requirements like the momentum independence of the dipole matrix elements [21]. The bulk photovoltaic effect in magnetic topological semimetals is more poorly understood, although a recent

The bulk photovoltaic effect is inherently associated to the room-temperature polar ordering in two-dimensional CuInP₂S₆. ... M. et al. Shift current photovoltaic effect in a ferroelectric charge ...

The nonlinear shift current (associated with the bulk photovoltaic effect) in centrosymmetric crystals, known to be absent in crystals with inversion symmetry, could still be activated by a photon-drag effect.

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Using strain-gradient engineering, the flexo-photovoltaic effect, that is, the strain-gradient-induced bulk photovoltaic effect, can be activated in centrosymmetric semiconductors, considerably ...

The shift current is one such mechanism of the bulk photovoltaic effect (BPVE) that is related to the quantum geometric phase of electrons in solids (8-17) and can be the promising principle for the solar cell and photodetector (18, 19). Specifically, the shift current originates from the shift of an electron wave packet in the real space ...

Shift current is the dominant dc-current response in the bulk photovoltaic effect (BPVE), which is the conversion of solar energy into electricity in the materials with broken ...

The shift current (SHC) has been accepted as the primary mechanism of the bulk photovoltaic effect (BPVE) in ferroelectrics, which is much different from the typical p - n junction-based photovoltaic mechanism in heterogeneous materials. In the present work, we use first-principles calculations to investigate the SHC response in the ferroelectric semiconductor ...

uniform optical field in the ultraclean limit. In addition to shift and injection current, we find that polarized light incident on a metallic system generates an intrinsic contribution to the bulk photovoltaic effect deriving from photoinduced electronic transitions on the Fermi surface. In velocity gauge, this contribution originates

The bulk photovoltaic effect (BPVE) -- the generation of electric currents by light in noncentrosymmetric materials in the absence of electric fields and gradients -- was intensively investigated at the end of the last century. ... resulting in a flood of misleading theoretical and experimental publications centered around the so-called shift ...

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