



# Application of luminescent materials in solar cells

Luminescent solar concentrators (LSCs) represent a promising frontier in solar energy capture, leveraging innovative technologies to concentrate and reshape light for enhanced photovoltaic performance. In this study, we compared various LSC technologies, including solar windows, within simulated real-world conditions. Our ...

SnO<sub>2</sub> conforms to the O Sn O structure and is an n-type, wide bandgap (3.6 eV) semiconductor oxide [44], [45] interestingly, the simultaneous occurrence of transparency and conductivity of SnO<sub>2</sub> is a unique feature among the group-IV elements of the periodic table. The study of SnO<sub>2</sub> has been triggered by its impressive range of ...

The materials and methods developed to fabricate solar cells by using downconversion effect are analyzed in Section 3. In Section 4, present-day solar cells devices that use downconversion approaches are discussed. Finally, this work ends with a summary of the perspectives and challenges related to the use of different materials for ...

1 &#0183; [2, 3] In essence, an LSC consists of a luminescent material (the luminophore) embedded in a waveguide matrix that is optically coupled to a PV cell (Figure 1a). The ...

In recent years, luminescent materials, which are capable of converting a broad spectrum of light into photons of a particular wavelength, have been synthesized and used to ...

A fast, non-invasive method assesses luminescent coupling between subcells in monolithic perovskite/silicon tandem solar cells, showing over 85% of ...

Improvement in multi-crystalline silicon solar cell efficiency via addition of luminescent material to EVA encapsulation layer. E. Klampaftis, ... This approach offers the opportunity for prompt application at production scale, since it neither requires any modification to the module manufacturing process nor does it add to the cost of power ...

This process is mainly based on the relationship between temperature and luminous efficiency. Different ferroelectric oxide materials have different responses to temperature. So, it is very important to find suitable ferroelectric oxide materials for doping. Solar cells are different. Solar cells focus on the conversion efficiency of solar energy.

This review will survey recent progress in the development of spectral converters, with a particular emphasis on lanthanide-based upconversion, quantum-cutting and down-shifting materials, for PV applications, and present technical challenges that arise in developing cost-effective high-performance solar cells based on these ...



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The concept of luminescent concentrators (LCs) was initially proposed in the 1970s, aiming to develop a low-cost technology of photovoltaic (PV) solar cells and ...

State Key Laboratory of Luminescent Materials and Devices, and Guangdong Provincial Key Laboratory of Fiber Laser Materials and Applied Techniques, Guangzhou, 510641 P. R. China ... and finally concluding remarks and perspectives in advancing NIR-DC and applications in novel solar cells are given. ...

By leveraging accessible photoluminescent measurements, ML models estimate optical properties, streamlining the process of developing novel materials, ...

Safe and visually appealing experiments can help the general public, even from a young age, to better understand the fundamental role of chemistry and materials in the energy transition and our everyday lives. Luminescent solar concentrators (LSCs) are efficient devices for harvesting sunlight based on the fluorescent compounds" ...

The use of a DS layer to improve the performance of solar cells has been first explored by Hovel et al. [54] since then DS materials have been studied both theoretically [14] and experimentally [55] nventional materials considered for DS layers in solar cells are polymers such as polymethylmethacrylate (PMMA) doped with ...

The solar cell has a poor spectral response in the UV region, which affects its power conversion efficiency (PCE). The utilization of a luminescent downshifting (LDS) layer has been suggested to improve the spectral response of the photovoltaics in the short wavelength region through photoluminescence (PL) conversion and antireflection ...

The cost of a structure consisting of a luminescent solar concentrator, in combination with a solar cell, will be less than the cost of a pure solar cell of similar efficiency. This is due to the fact that in the first case, the area of the photovoltaic panel will be less. Used materials

For enhanced applications of solar cells, organic luminescence materials like long persistent luminescence (LPL) present one of the promising avenues ...

Inorganic crystalline silicon solar cells account for more than 90% of the market despite a recent surge in research efforts to develop new architectures and materials such as organics and perovskites. The reason why most commercial solar cells are using crystalline silicon as the absorber layer include long-term stability, the ...

Our results demonstrate that the application of down-shifting materials is a viable strategy to improve the efficiency of Silicon solar cells with mass-compatible techniques that could serve to ...



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To overcome the mismatch between the incident solar spectrum and the absorption of incident photons, it is required to modify the spectrum. This can be done using a layer of luminescent material that will convert high energy photons into two or more low energy photons (Downconversion) or low energy photons into high energy photons ...

The application of concentrating luminescent down-shifting structures onto CdS/CdTe solar cells in order to combine the benefits of light concentration and wavelength shifting properties of luminescent plates is proposed. ... meaning that glass-glass-encapsulation is a good option with toxic solar cell materials from fire safety point of ...

The broad range of applications of metal-ion-doped luminescent materials, ... In section 6, the application of silicate materials to solar cells" conversion efficiency is analyzed via phosphor size, coverage, emission wavelength, arrangement, and so on. Finally, this work ends with a summary and prospects of the review article. ...

The perovskite materials and their application in solar cells using different device structures and interlayers modification have been well reviewed. [81-87] In this review, the main focus is given on the overview of DC materials mechanism, their implementation methods in PSCs, PCE improvement, and the impact of DC materials on device stability ...

10 &#0183; Abstract. Luminescent coupling is a characteristic of multi-junction solar cells which has often been neglected in models of their performance. The effect ...

Safe and visually appealing experiments can help the general public, even from a young age, to better understand the fundamental role of chemistry and materials in the energy transition and ...

As large-area photon harvesting devices, luminescent solar concentrators (LSCs) are an important supplement to the existing photovoltaic systems, and the cost of LSCs is much lower than that of monocrystalline silicon solar cells of the same size. 6 Such low-priced sunlight collection devices are usually composed of a transparent ...

Luminescent materials, including organic/inorganic phosphors, nanocrystals, semiconductors, glass, and ceramics, have been widely investigated due to their special physicochemical properties and their potential applications in light-emitting diode (LED), laser (LD), catalysis, solar cells, photoelectric detector, bio-medicine, etc.

Porphyrin-based donor materials have been shown to contribute to many record-high device efficiencies in small molecule, tandem, ternary, flexible, and OSC/perovskite hybrid solar cells. ...

As a result, the maximum theoretical conversion efficiency for a single-junction c-Si solar cell with energy



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gap of 1.1 eV is limited to 30%. 4, 5 Reducing these losses in c-Si solar cells may be achievable through spectrum modification by employing down-converting phosphors. 6-9 In a down-conversion (DC) process, a high-energy ...

The DC materials were initially applied in luminescent devices such as a fluorescent tube or plasma discharge panels, and so forth., and later were also explored for solar cell application to absorb ...

Numerous investigations have been done in pursuing phosphors with quantum yield (QY) greater than unity in terms of downconversion (DC) strategies, as well as applications in display, ...

Photon management, through wavelength shifting or light concentration, can be achieved using luminescent plates (LP). These devices have the potential to improve the short wavelength conversion efficiency of photovoltaic systems and reduce costs by concentrating light onto smaller solar cells [6].LPs consist of molecules that absorb ...

Graphene and graphene oxide: Application in luminescence and solar cell. Amol Nande, ... S.J. Dhoble, in Functional Materials from Carbon, Inorganic, and Organic Sources, 2023 4.4 Fundamental information about luminescence and solar cell materials 4.4.1 Luminescent materials. Luminescence--"Luminescenz"--was first reported by German physicist ...

1 Introduction. While single junction solar cells are approaching their theoretical efficiency limit, [1-3] monolithic tandem solar cells are emerging as promising candidates for the next generation of commercial mainstream solar technology. [4-6] One inherent phenomenon of tandem cells is LC, which occurs naturally within the monolithic ...

Ferroelectric oxides possess abundant fascinating physical functionalities, such as electro-optic, acousto-optic, and nonlinear optical characteristics, etc. However, most pristine ferroelectric oxides exhibit no ...

Semantic Scholar extracted view of &quot;Application of concentrating luminescent down-shifting structures to CdS/CdTe solar cells with poor short wavelength response&quot; by T. Parel et al. ... {Thomas S. Parel and Lefteris Danos and Tom Markvart}, journal={Solar Energy Materials and Solar Cells}, year={2015}, volume={140}, ...

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