# Rare earth photovoltaic cells

For rare-earth-based up-conversion materials used in perovskite solar cells, the hosts of Ln 3+ ions, including single crystals of NaYF 4 and various core-shell structures, can be placed in various parts of the solar cell, including the electron/hole transporting layers, and the perovskite layer.

3.1 Inorganic Semiconductors, Thin Films. The commercially availabe first and second generation PV cells using semiconductor materials are mostly based on silicon (monocrystalline, polycrystalline, amorphous, thin films) modules as well as cadmium telluride (CdTe), copper indium gallium selenide (CIGS) and gallium arsenide (GaAs) cells whereas GaAs has ...

3.1 FTIR studies. To investigate the chemical interaction of rare earth doped ZnO, FTIR analysis of undoped and rare earth doped samples was done in the range of 400 to 4000 cm -1 (Fig. 1).The FTIR sample of undoped ZnO shows two absorption bands around 450 cm -1 and 560 cm -1 corresponds to the stretching vibrations of Zn-O. When monoethanol ...

The declining of photovoltaic performance BTOSc-7 devices is presumably due to the more defects and the poor ETL/perovskite interfacial contact caused by excessive rare earth doping as aforementioned (Fig. 2i and 2 l). Compared to the planar SNO devices, BTO cell shows a 5.05% enhancement in PCE (20.81% vs. 19.81%).

This work focuses on using rare-earth (RE) elements to titanium dioxide (TiO2) to fabricate effective photoanodes for dye-sensitized solar cells (DSSC) designed for indoor applications. Using a straightforward solid-state hand-grinding technique, different RE elements, including Nd+3, Sm+4, Er+3, and Yb+3 were used as dopants in TiO2. The impact of RE ...

Comprehensive Summary. Rare earth (RE) ions, with abundant 4f energy level and unique electronic arrangement, are considered as substitutes for Pb 2+ in perovskite nanocrystals (PNCs), allowing for partial or complete replacement of lead and minimizing environmental impact. This review provides a comprehensive overview of the characteristics of ...

Rare earth nanomaterials, which feature long-lived intermediate energy levels and intraconfigurational 4f-4f transitions, are promising supporters for photon upconversion. Owing to their unique optical properties, rare earth upconversion nanomaterials have found applications in bioimaging, theranostics, photovoltaic devices, and photochemical reactions. Here, we review ...

Another effective strategy to improve the device performance is rare-earth doping, which can expand the spectral response range by down or up conversion [17], [18], [19] to convert ultraviolet (UV) or infrared light into visible light, which can be absorbed by Ru-based dyes in DSSCs (e.g., N719, N749, and N3) [19], [20], [21], [22].The down-conversion (DC) ...

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Although the efficiency of Dye-sensitized and Perovskite solar cell is still below the performance level of market dominance silicon solar cells, in last few years they have grabbed significant attention because of their ...

A new report by the French Environment and Energy Management Agency (Ademe) shows that rare earth minerals are not widely used in solar energy and battery storage technologies. And despite...

Rare earth ions doped NiO x hole transport layer for ... The improved photovoltaic properties of the device can be attributed to the more efficient charge extraction and ... NiO x layer, A is the active area of testing cell (0.1 cm 2) and R is the resistance obtained from the J-V curves. As compared in Table S1, it is obvious ...

Enhanced photovoltaic performances of the dye-sensitized solar cell by utilizing rare-earth modified tin oxide compact layer. Organic Electronics, Volume 43, 2017, pp. 121-129.

Therefore, the successful incorporation of rare earth elements (REEs) into host materials in controlled concentrations offers competitive advantages to fabricate portable energy devices, radiation sensors, and radiation shielding glasses, as well as to improve the performance of existing photovoltaic cells, which is of great interest to both ...

The major losses in solar cell devices are related to the thermalization and transparency losses due to photon mismatches [1]. Rare earth (RE)-ion-doped nanocrystals exhibit emission in the wide range from near-infrared (NIR) to ultraviolet (UV). This feature has increased the focus of RE doped nanocrystal in solar cell research in recent years ...

Controlling the formation of harmful defects plays an important role in obtaining high efficiency Cu 2 ZnSn(S,Se) 4 (CZTSSe) solar cells. Here, the extra tiny Ce 3+ is used to reduce the cation disordering of absorber, improving the performance of devices. Based on the ionic liquid-based solution approach, we prepared the different Ce-doped CZTSSe devices and ...

In order to enhance the efficiency of photovoltaic solar cells and overcome their limitations, a matching between solar spectrum and semiconductor band gap is needed using luminescent materials. The following work present in this paper is mainly based on the adjustment of the solar spectrum to the cell bandgap by developing downconverting materials. Down conversion ...

At present, SCs account for only 0.04% of the total energy production [5], [6].The module cost of a PV device is US$0.5 per watt today [7].The relatively high cost per kilowatt-hour of PV cells is the main factor for the low contribution of PV energy [8].There are two strategies to reduce the cost, one of which is to lower the product cost, and the other is to increase the ...

The efficient and cost-effective conversion of solar energy into electricity through PV cells remains a daunting task [11]. According to Schockley-Queisser"s model by using the principle of detailed balance between

incident and escaping photons and extracted electrons, the theoretical maximum efficiency of c-Si SCs with Eg of 1.1 eV is about ...

The quest for clean energy conversion has become one of the most important efforts for tackling the greenhouse effect for a sustainable environment. This involves energy-scavenging processes like photovoltaics and catalysis, which have been manifested using the solar spectrum. For high-efficiency and durable conversion processes, the search for the low ...

Rare earth complexes with high quantum efficiencies absorb light at shorter wavelengths and subsequently emit light at longer wavelengths. The high energy region of the solar light spectrum is shifted to longer wavelengths, hence the cell output power is expected to become higher because the emitted light can match with the higher sensitivity region in longer ...

The host type of rare-earth ions determines the role of rare-earth ions in perovskite photoelectric devices. With MYF4 (M = Li, Na, K, Ru. and Cs) as host, Ln 3+ ions ...

In photovoltaic solar cells, several energy losses are related to device electronic properties, including contact voltage loss, recombination loss, and junction loss [1, 2] sides, there are two more primary loss mechanisms linked to photon harvesting, that is, thermalization loss of above-bandgap photons and transmission loss of sub-bandgap photons ...

Yao N, Huang J, Fu K, et al. Rare earth ion doped phosphors for dye-sensitized solar cells applications. RSC Adv, 2016, 17546-17559. Article CAS Google Scholar Strümpel C, McCann M, Beaucarne G, et al. Modifying the solar spectrum to enhance silicon solar cell efficiency--An overview of available materials. Sol Energ Mater Sol Cells, 2007 ...

Therefore, UC and DC effects offer the potential of broadening the spectral absorption range and the possibility of overcoming the Shockley-Queisser limit for the single-junction solar cell. In this review, the spectral-converting mechanism underling the rare-earth-based UC/DC processes is first discussed.

The emitted photons are captured by the dye and concentrated into the edges where the solar cell is located by total attenuated total reflection (Papakonstantinou et al., 2021). ... The emergence of LSCs based on rare-earth elements in the agricultural sector has not been fully developed and investigated; therefore, innovative luminescent ...

Basic spectroscopic studies of Yb and Er-doped M2O2S (M= Gd, La,Y) phosphor was reported with particular attention to its upconversion properties under 1550 nm excitation. Since the absorption spectra of Co2+overlaps with Er3+(4 I13/2->4I15/2) at near infrared (NIR) region, we are proposing the concept of an efficiency enhancement of infrared upconverting ...

Cerium rare-earth ions reinforced built-in electric field to enable efficient carrier extraction for highly efficient

and stable perovskite solar cells. ... Poor interface contact between the active layer and other solar cell modules is a common source of leakage current. Thus, ...

These materials would also be lightweight, cheap to produce, and as efficient as today"s leading photovoltaic materials, which are mainly silicon. They"re the subject of increasing research and investment, but companies looking to harness their potential do have to address some remaining hurdles before perovskite-based solar cells can be ...

In order to enhance the photovoltaic performance of dye-sensitized solar cell (DSSC), a novel design is demonstrated by introducing rare-earth compound europium ion doped yttrium fluoride (YF3:Eu3 ...

Although the efficiency of Dye-sensitized and Perovskite solar cell is still below the performance level of market dominance silicon solar cells, in last few years they have grabbed significant attention because of their fabrication ease using low-cost materials, and henceforth these cells are considered as a promising alternative to commercial photovoltaic ...

Therefore, UC and DC effects offer the potential of broadening the spectral absorption range and the possibility of overcoming the Shockley-Queisser limit for the single-junction solar cell. In this review, the ...

Abstract. Basic spectroscopic studies of Yb and Er-doped M 2 O 2 S (M= Gd, La,Y) phosphor was reported with particular attention to its upconversion properties under 1550 ...

This article present an reports on optical and band gap study of rare earth doped (RE = Tb3+, Pr3+, Ce3+, Dy3+ and Ce3+/Pr3+ ions) KSr(PO4) nanoparticles. ... These kind of rare earth doped inorganic phosphor acts as an active layer for Si-solar cell due to their potential in improving the spectral response of Si solar cells and enhancing the ...

Herein the first preparation of 980-nm laser-driven photovoltaic cells (980LD-PVCs) by introducing of a film of rare-earth up-converting nanophosphors in conventional dye-sensitized solar cells is reported. ... Under the irradiation of a 980-nm laser with a power of 1 W, the visible up-converting luminescence of rare-earth nanophosphors can be ...

Rare earth bisphthalocyanine complexes, p-type organic compounds, have been used in Schottky and pn photovoltaic cells. Depending on the lanthanide rare earth of Pc 2 Ln complex, the absorption band characteristics of Pc and Pc 2 Ln generates intense, weak or no photocurrent. This observation can be directly related to the size of the Ln or to the ...

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