SOLAR PRO.

Crystalline silicon solar cell concept

Why is crystalline silicon used in solar cells?

Because of its earth-abundant element, a suitable band gap of 1.12 eV, high purity, high minority carrier lifetime, very low grain boundary defects, and easy control of resistivity, crystalline silicon (c-Si) is widely used for solar cells and accounts for more than 90% of the current photovoltaic market [1, 4].

What is the efficiency of crystalline silicon solar cells?

Commercially,the efficiency for mono-crystalline silicon solar cells is in the range of 16-18%(Outlook,2018). Together with multi-crystalline cells,crystalline silicon-based cells are used in the largest quantity for standard module production,representing about 90% of the world's total PV cell production in 2008 (Outlook,2018).

What is a crystalline solar cell?

The first generation of the solar cells,also called the crystalline silicon generation,reported by the International Renewable Energy Agency or IRENA has reached market maturity years ago . It consists of single-crystalline,also called mono,as well as multicrystalline,also called poly,silicon solar cells.

What is the device structure of a silicon solar cell?

The device structure of a silicon solar cell is based on the concept of a p-n junction,for which dopant atoms such as phosphorus and boron are introduced into intrinsic silicon for preparing n- or p-type silicon,respectively. A simplified schematic cross-section of a commercial mono-crystalline silicon solar cell is shown in Fig. 2.

Which crystalline silicon solar cell has the highest conversion efficiency?

With this design Kaneka Corporationhas surpassed the world record by 0.7 % to a new world record of world's highest conversion efficiency of 26.33% in a practical size (180 cm2) crystalline silicon solar cell.The theoretical efficiency limit of this type of cell as calculated is 29%.The difference of 2.7 % is attributed to a number of losses.

What is crystalline silicon?

In solar cell fabrication,crystalline silicon is either referred to as the multicrystalline silicon(multi-Si) or monocrystalline silicon (mono-Si) [70-72]. The multi-Si is further categorized as the polycrystalline silicon (poly-Si) or the semi-crystalline silicon,consisting of small and multiple crystallites.

Crystalline silicon solar cells make use of mono- and multicrystalline silicon wafers wire-cut from ingots and cast silicon blocks. An alternative to standard silicon wafer technology is constituted by amorphous or nanocrystalline silicon thin films, which will be described in the next subsection.

Silicon-based solar cells occupy an absolutely dominant position in the solar cell market, accounting for more than 90% of the market share. With the advantages of abundant raw materials, mature production technology, long service life, and high efficiency, crystalline silicon solar cells are the most promising solar cells in the short term [169] .

High carrier recombination loss at the metal and silicon contact regions is one of the dominant factors constraining the power conversion efficiency (PCE) of crystalline silicon (c-Si) solar cells. Metal compound-based carrier-selective contacts are being intensively developed to address this issue. In this work, we present a high-performance electron-selective ...

This paper describes a silicon solar cell based in part upon Violet Cell technology, but additionally employing a new surface structure to reduce reflection losses markedly. The surface...

Photovoltaic (PV) installations have experienced significant growth in the past 20 years. During this period, the solar industry has witnessed technological advances, cost reductions, and increased awareness of ...

This type of solar cell includes: (1) free-standing silicon "membrane" cells made from thinning a silicon wafer, (2) silicon solar cells formed by transfer of a silicon layer or solar cell structure from a seeding silicon substrate to a surrogate nonsilicon substrate, and (3) solar cells made in silicon films deposited on a supporting ...

At present, the global photovoltaic (PV) market is dominated by crystalline ...

To further increase the conversion efficiency of crystalline silicon (c-Si) solar cells, it is vital to reduce the recombination losses associated with the contacts. Therefore, a contact structure that simultaneously passivates the c-Si surface while selectively extracting only one type of charge carrier (i.e., either electrons or holes) is desired. Realizing such passivating contacts in c-Si ...

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