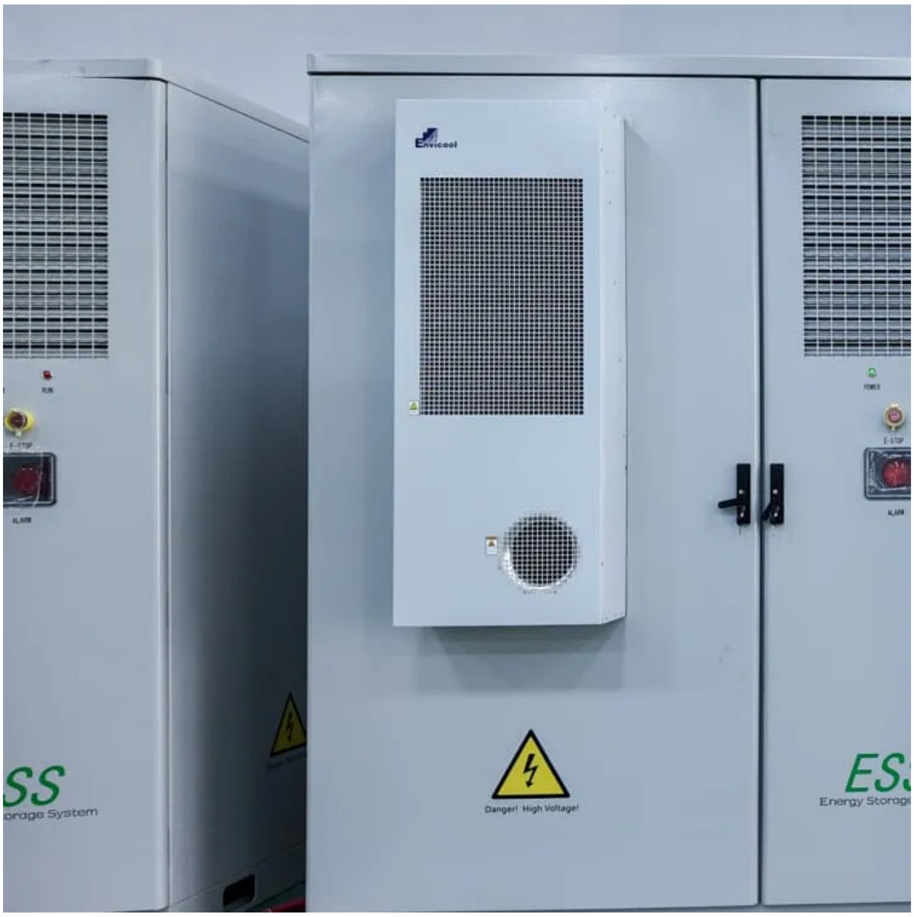
Silicon cells and solar modules



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Overview

Silicon solar cells are a mainstay of commercialized photovoltaics, and further improving the power conversion efficiency of large-area and flexible cells remains an important research objective1,2. Here we report a combined approach to i. Silicon solar cells are a mainstay of commercialized photovoltaics, and further improving the power conversion efficiency of large-area and flexible cells remains an important research objective1,2. Here we report a combined approach to improving the power conversion efficiency of silicon heterojunction solar cells, while at the same time rendering them flexible. We use low-damage continuous-plasma chemical vapour deposition to prevent epitaxy, self-restoring nanocrystalline sowing and vertical growth to develop doped contacts, and contact-free laser transfer printing to deposit low-shading grid lines. High-performance cells of various thicknesses (55–130 µm) are fabricated, with certified efficiencies of 26.06% (57 µm), 26.19% (74 µm), 26.50% (84 µm), 26.56% (106 µm) and 26.81% (125 µm). The wafer thinnin.

Crystalline silicon (c-Si) solar cells have been the mainstay of green and renewable energy3, accounting for 3.6% of global electricity generation and becoming the most cost-effective option for new electricity generation in most of the world4. Although c-Si solar cells now account for more than 95% of the market for solar cells, which usually have a wafer thickness of 150–180 µm, their use is unfeasible in some extreme application scenarios, such as satellites, spacecraft and unmanned aerial vehicles, and there is a need for further weight reduction and flexibility of solar cells5. Thus, reducing the thickness of the c-Si wafer to much thinner than that in typical c-Si solar cells, and thereby incorporating the advantages of ‘thin-film solar cells’ into c-Si solar cells, is the focus of much research1,6,7. However, the power conv.

On the basis of our research, c-Si solar cells of >26% PCE with thicknesses in the range of 55–130 µm, possessing features of both high PCE and flexibility, can be produced. Therefore, flexibility must be taken into consideration as an important factor. We divided the c-Si solar cells into categories according to the minimum bending radius of curvature (rb): nonflexible cells (rb > 63 mm) with thicknesses of >150 µm; semiflexible (SF) cells (38 mm < rb < 63 mm) with thicknesses of between 100 and 150 µm; and flexible and thin (FT) cells (rb < 38 mm) with thicknesses of <100 µm (thinner than a piece of A4 paper). Thus, we demonstrate the potential of c-Si solar cells to become a category of thin-film solar cells with remarkable flexibility and plasticity (Fig. 1a), the cells can undergo various deformations, such as bending a.

The first step in resolving the efficiency bottleneck of FT and SF cells is to achieve good passivating contacts. For SHJ solar cells, passivation is typically implemented using intrinsic hydrogenated amorphous silicon (i:a-Si:H) or hydrogen-rich i:a-Si:H passivation layers in conventional techniques15,16,17,18, but epitaxial dendrite growth from the c-Si surface is inevitable (Extended Data Fig. 1a,b). Although oxygen doping is considered to be beneficial in suppressing epitaxial growth, it is associated with a decrease in the electrical properties of the passivating contacts19. In this work, a two-stage composite gradient passivation process was adopted to resolve this contradiction (Fig. 1b). In the first stage, 2–3 atomic layers of an oxygen-containing amorphous silicon subnanolayer (<0.5 nm; i:a-SiOx:.

We realized that the conventional discontinuous-plasma CVD process is not ideal, as the subnanolayer is vulnerable and highly sensitive to the plasma fluctuation and reignition (transient high-voltage surges). After being subjected to the stepwise PECVD procedure, i:a-SiOx:H (1) was found to have perforating defects distributed on its surface, and .

What is silicon solar cells & modules?

In the topic "Silicon Solar Cells and Modules", we support silicon photovoltaics along the entire value chain with the aim of bringing sustainable, efficient and cost-effective solar cells and modules to industrial maturity. We develop new solar cell and module concepts for our customers, evaluate production technology and test new materials.

How are silicon solar cells formed?

Individual silicon solar cells are formed into modules by connecting them in series and parallel. These modules are subsequently encapsulated to protect them from natural elements before they are deployed. Thin film cells can be much larger than silicon cells, and one thin film cell may form a single module.

What is a solar module?

A solar module—what you have probably heard of as a solar panel—is made up of several small solar cells wired together inside a protective casing. This simplified diagram shows the type of silicon cell that is most commonly manufactured. In a silicon solar cell, a layer of silicon absorbs light, which excites charged particles called electrons.

Why are silicon-based solar cells important?

During this period, the solar industry has witnessed technological advances, cost reductions, and increased awareness of renewable energy’s benefits. As more than 90% of the commercial solar cells in the market are made from silicon, in this work we will focus on silicon-based solar cells.

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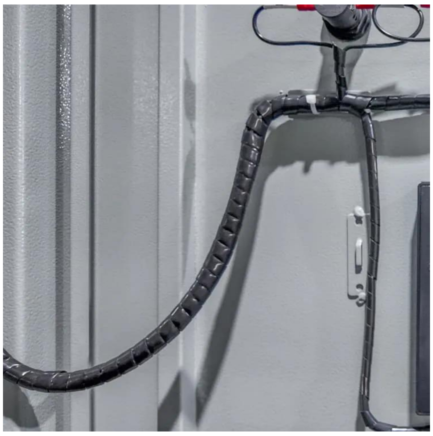

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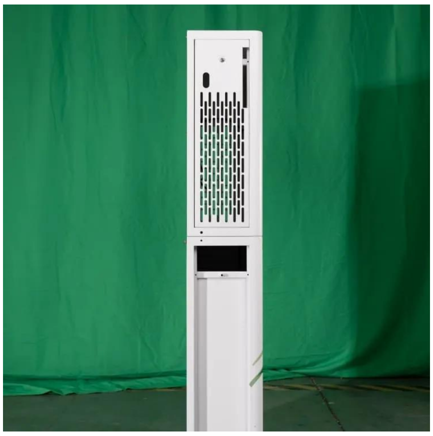

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