

Calculation of Germanium usage in solar cells

Why is germanium used in solar cells?

As one of the critical raw materials the use of it (mainly driven by solar cells) is a major contributor to mineral resource depletion. Today, Germanium is used as a growth template for certain solar cells. While the thickness of the Germanium on a solar cell level is extremely thin, around 140 μm, actually only 10-20 μm are actively being used.

What are the electrical properties of germanium-based solar cells?

The devices obtained in this study have good electrical properties. The VOC of the germanium-based solar cells under the single-junction CC nanostructure absorber structure array is 0.31 V, and the JSC reaches 45.5 mA/cm². The FF value of the device can be calculated as 72.7% by Equation (4).

How do germanium-based solar cells improve absorption efficiency?

In this paper, germanium-based solar cells were designed based on germanium (Ge) materials, and the cross-cone (CC) nanostructures were used as the absorber layer of the solar cells. The optical path inside the absorber layer was increased by microstructure reflection, thereby increasing the absorption efficiency of the germanium-based solar cell.

What is the VOC of germanium-based solar cells?

The VOC of the germanium-based solar cells under the single-junction CC nanostructure absorber structure array is 0.31 V, and the JSC reaches 45.5 mA/cm². The FF value of the device can be calculated as 72.7% by Equation (4). The η of the device of 10.3% can be reached by Equation (5).

What are the research findings on multijunction germanium based solar cells?

In 2016, Masuda [12] reported on the growth of multijunction germanium-based solar cells based on molecular beam epitaxy technology, and the open-circuit voltage of ~0.175 V was obtained. In 2020, Baran [13] studied the effect of temperature and light intensity on the conversion efficiency of Ge-based solar cells.

What is the recycling process for germanium?

The rest is structural. An activity with TDE and Umicore, Belgium, has developed and implemented a recycling process for Germanium with specific steps for areas where recycling is not currently done, such as the thinning process of the germanium wafers used for the cells.

Devices achieve a single junction efficiency above 23% and open-circuit voltage of 1.01 V, demonstrating that spalled germanium does not need to be returned to a pristine, polished ...

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The potential of a thinned Ge subcell inside a standard GaInP/Ga (In)As/Ge triple-junction solar cell is assessed by simulations, pointing to an optimum thickness around 5-10 μm . This would reduce the weight by more than 90%, whereas the available current for the Ge subcell would decrease only by 5%.

This paper describes a new approach for improving the performance of the Germanium bottom subcell by the application of a proper rear surface passivation combined with a low substrate doping level in the range of $p=10^{16} \text{ cm}^{-3}$. The new passivation layer sequence consists of amorphous $\text{Si}_x\text{C}_{1-x}$ layers, followed by SiO_2 and Al. The ...

In this software, silicon germanium solar cell analysis can be performed easily. Cell structure dimension is used with predefined parameters and electrical properties to solve the complex equation internally to provide best and instant result. Properties of silicon and germanium are prestored in GUI. 3. Graphical User Interface Working. Figure 2 shows the main window of ...

In this study, we focus on optimizing the structure of perovskite solar cells (PSCs) comprising a single absorption layer of FTO/n-CsGeI₃/MAGeI₃/p-CsGeI₃/Pt. Subsequently, a novel double absorption layer structure based on FTO/n-CsGeI₃/MAGeI₃/CsGeI₃/p-CsGeI₃/Pt PSCs is proposed. We have designed high-performance devices by selectively integrating CsGeI₃ ...

Implementing solar photovoltaics (PV) is one of the low-carbon technology options that, when combined to reduce CO₂ emissions, has the potential to result in significant emission reductions of 4.9 gigatonnes of carbon dioxide in 2050, or 21% of the total emission mitigation potential in the energy sector [2]. Solar PV will supply 25% of the world's electricity ...

In recent years, non-toxic germanium-based perovskite solar cells have attracted wide attention, but the efficiency is not high. We designed a new type of germanium-based perovskite structure to improve the efficiency (FTO/Cd_{0.5}Zn_{0.5}S/IDL1/CH₃NH₃GeI₃/IDL2/MASnBr₃/Au). We chose Cd_{0.5}Zn_{0.5}S and MASnBr₃ as electron transport material ...

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Devices achieve a single junction efficiency above 23% and open-circuit voltage of 1.01 V, demonstrating that spalled germanium does not need to be returned to a pristine, polished state to achieve high-quality device performance.

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The effect of temperature on the performance parameters [short-circuit current density (JSC), open-circuit voltage (VOC), fill factor (FF), and conversion efficiency (?)] of ...

We implemented a new pas-sivated Ge backside technology to enhance the current generation in the Ge junction, and we propose realistic steps to realize solar cells with 45% efficiency using this cell architecture. cells on GaAs and an engineered InP-on-GaAs substrate were bonded together to form a monolithic two-terminal cell.

In this paper, qualitative investigation of the numerical model of silicon germanium heterojunction solar cell is performed using MATLAB graphical user interface. The heterostructure is designed as $\text{Si}_{1-x}\text{Ge}_x$ for speculative determination of appropriate germanium mole fraction to get the maximized thin-film solar cell efficiency ...

This paper describes a new approach for improving the performance of the Germanium bottom subcell by the application of a proper rear surface passivation combined with a low substrate ...

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