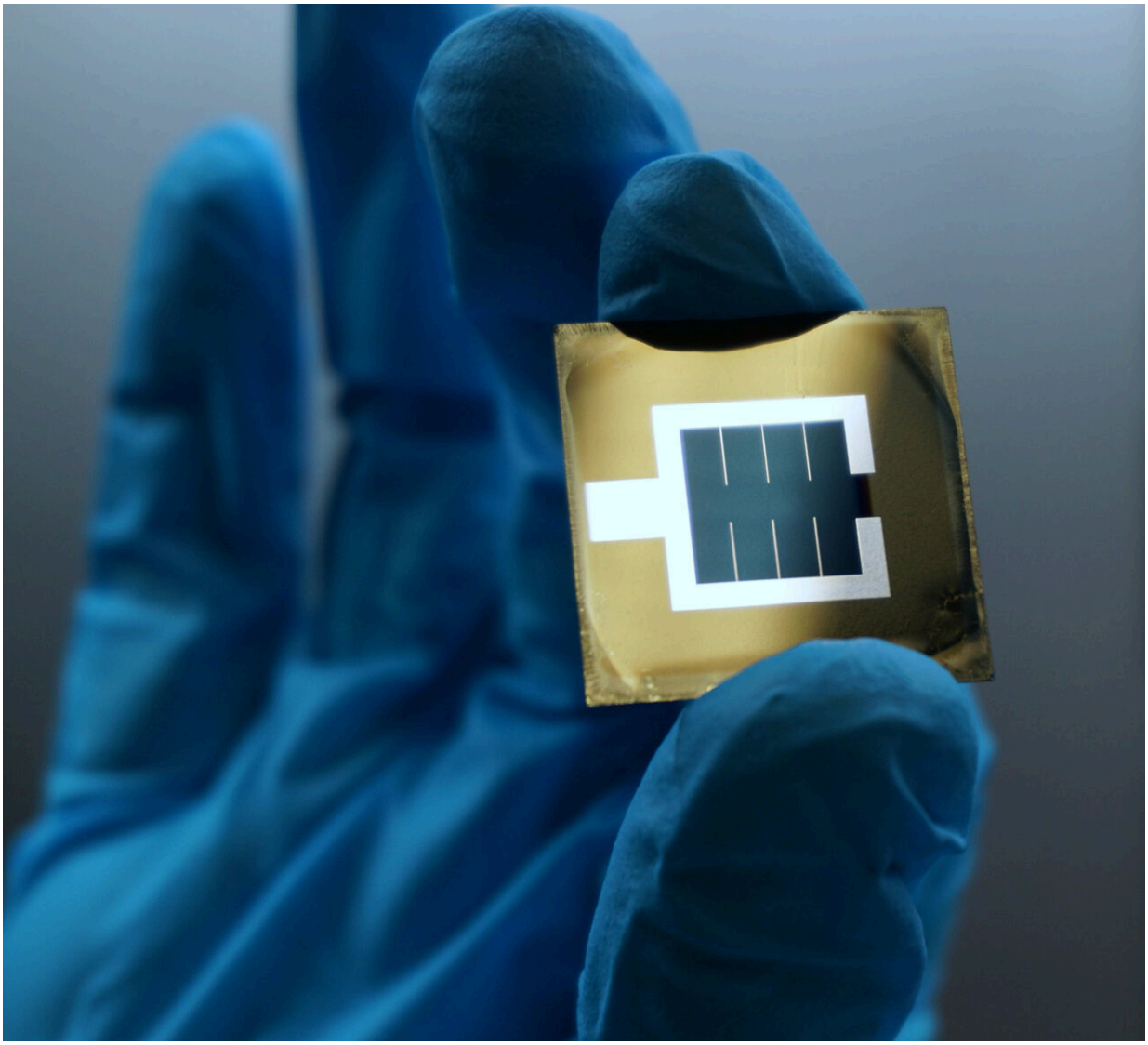
Tandem solar cell achieves 32.5% efficiency

December 19 2022



Perovskite/silicon tandem solar cell. You can see the active bluish area in the middle of the wafer, which is enclosed by the metallic, silvery electrode. Credit: Johannes Beckedahl/Lea Zimmerman/HZB

The current world record of tandem solar cells consisting of a silicon bottom cell and a perovskite top cell has once again been broken at HZB. The new tandem solar cell converts 32.5% of the incident solar radiation into electrical energy. The certifying institute European Solar Test Installation (ESTI) in Italy measured the tandem cell and officially confirmed this value which is also included in the NREL chart of solar cell technologies, maintained by the National Renewable Energy Lab, U.S..

Scientists from HZB could significantly improve on the efficiency of perovskite/silicon tandem solar cells. "This is a really big leap forward that we didn't foresee a few months ago. All the teams involved at HZB, especially the PV Competence Center (PVComB) and the HySPRINT Innovation lab teams have worked together successfully and with passion," says Prof. Steve Albrecht.

Interface modifications

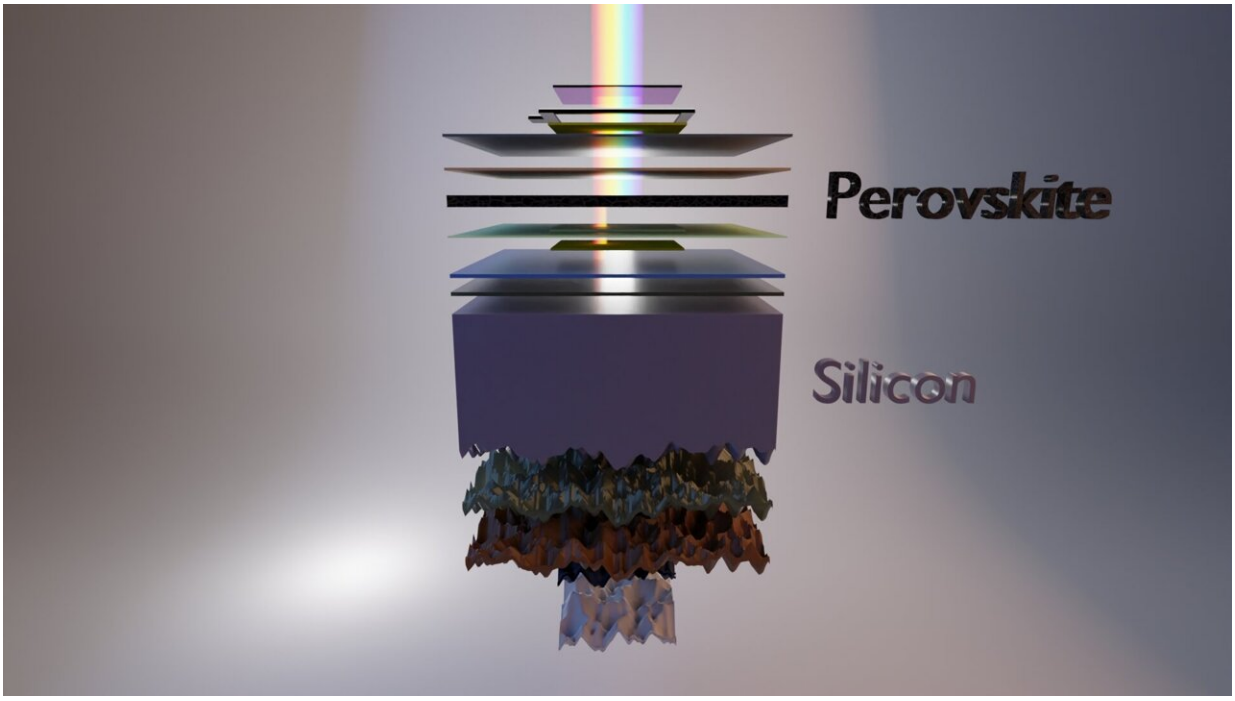
Albrecht's team used an advanced perovskite composition with a very smart interface modification. The lead authors, postdocs Dr. Silvia Mariotti, and Dr. Eike Köhnen in Albrecht's team, developed an interface modification to reduce charge carrier recombination losses and applied detailed analysis to understand the specific properties of the interface modification. These developments were then successfully implemented in tandem solar cells, and with help of Master's student Lea Zimmermann, combined with further optical improvements.

In addition, many more scientists and technicians helped to develop and fabricate the tandem cells to achieve this success. Altogether, the interface and optical modifications enabled highest photovoltages (open-circuit voltage) and resulted in the new record efficiency for this

fascinating tandem technology.

Fast progress

Ongoing efficiency development by various research institutes and companies over the last years and especially the last month have been quite exciting for the field: Various teams from HZB achieved a record value in late 2021 with an efficiency of 29.8% that was realized by periodic nanotextures. More recently, in summer 2022, the Ecole Polytechnique Fédérale de Lausanne, Switzerland, first reported a certified tandem cell above the 30% barrier at 31.3%, which is a remarkable efficiency jump over the 2021 value.



The illustration shows the schematic structure of the tandem solar cell with a bottom cell made of silicon and a top cell made of perovskite. While the top cell can utilize blue light components, the bottom cell converts the red and near-infrared components of the spectrum. Different thin layers help to optimally

utilize the light and minimize electrical losses. Credit: Eike Köhnen/HZB

With the new certified value of 32.5%, the record is again back at HZB. "We are very excited about the new value as it shows that the perovskite/silicon tandem technology is highly promising for contributing to a sustainable energy supply," says Albrecht.

HZB's scientific director, Prof. Bernd Rech, says, "At 32.5%, the solar cell efficiency of the HZB tandems is now in ranges previously only achieved by expensive III/V semiconductors. The NREL graph clearly shows how spectacular the last two increases from EPFL and HZB really are."

Provided by Helmholtz Association of German Research Centres

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