

Press Release

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World Record Solar Cell with 44.7% Efficiency

The Fraunhofer Institute for Solar Energy Systems ISE, Soitec, CEA-Leti and the Helmholtz Center Berlin jointly announced today having achieved a new world record for the conversion of sunlight into electricity using a new solar cell structure with four solar subcells. Surpassing competition after only over three years of research, and entering the roadmap at world class level, a new record efficiency of 44.7% was measured at a concentration of 297 suns. This indicates that 44.7% of the solar spectrum's energy, from ultraviolet through to the infrared, is converted into electrical energy. This is a major step towards reducing further the costs of solar electricity and continues to pave the way to the 50% efficiency roadmap.

Back in May 2013, the German-French team of Fraunhofer ISE, Soitec, CEA-Leti and the Helmholtz Center Berlin had already announced a solar cell with 43.6% efficiency. Building on this result, further intensive research work and optimization steps led to the present efficiency of 44.7%.

These solar cells are used in concentrator photovoltaics (CPV), a technology which achieves more than twice the efficiency of conventional PV power plants in sun-rich locations. The terrestrial use of so-called III-V multi-junction solar cells, which originally came from space technology, has prevailed to realize highest efficiencies for the conversion of sunlight to electricity. In this multi-junction solar cell, several cells made out of different III-V semiconductor materials are stacked on top of each

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other. The single subcells absorb different wavelength ranges of the solar spectrum.

“We are incredibly proud of our team which has been working now for three years on this four-junction solar cell,” says Frank Dimroth, Department Head and Project Leader in charge of this development work at Fraunhofer ISE. “This four-junction solar cell contains our collected expertise in this area over many years. Besides improved materials and optimization of the structure, a new procedure called wafer bonding plays a central role. With this technology, we are able to connect two semiconductor crystals, which otherwise cannot be grown on top of each other with high crystal quality. In this way we can produce the optimal semiconductor combination to create the highest efficiency solar cells.”

“This world record increasing our efficiency level by more than 1 point in less than 4 months demonstrates the extreme potential of our four-junction solar cell design which relies on Soitec bonding techniques and expertise,” says André-Jacques Auberton-Hervé, Soitec’s Chairman and CEO. “It confirms the acceleration of the roadmap towards higher efficiencies which represents a key contributor to competitiveness of our own CPV systems. We are very proud of this achievement, a demonstration of a very successful collaboration.”

“This new record value reinforces the credibility of the direct semiconductor bonding approaches that is developed in the frame of our collaboration with Soitec and Fraunhofer ISE. We are very proud of this new result, confirming the broad path that exists in solar technologies for advanced III-V semiconductor processing,” said Leti CEO Laurent Malier.

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Concentrator modules are produced by Soitec (started in 2005 under the name Concentrix Solar, a spin-off of Fraunhofer ISE). This particularly efficient technology is employed in solar power plants located in sun-rich regions with a high percentage of direct radiation. Presently Soitec has CPV installations in 18 different countries including Italy, France, South Africa and California.

Text of the PR and photos can be downloaded from our web page: www.ise.fraunhofer.de

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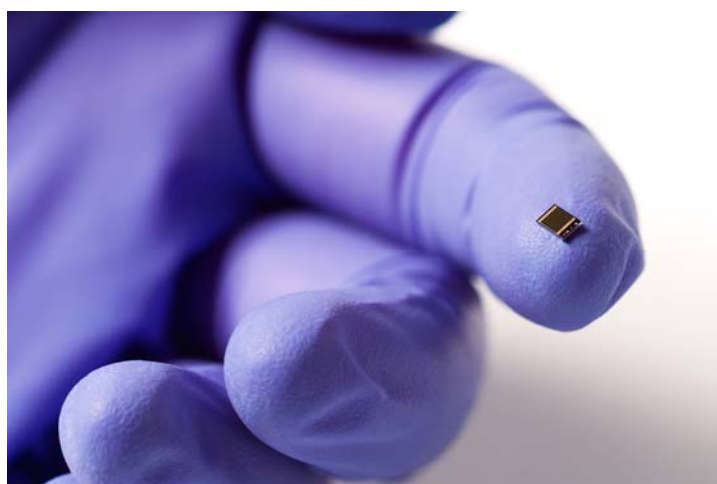
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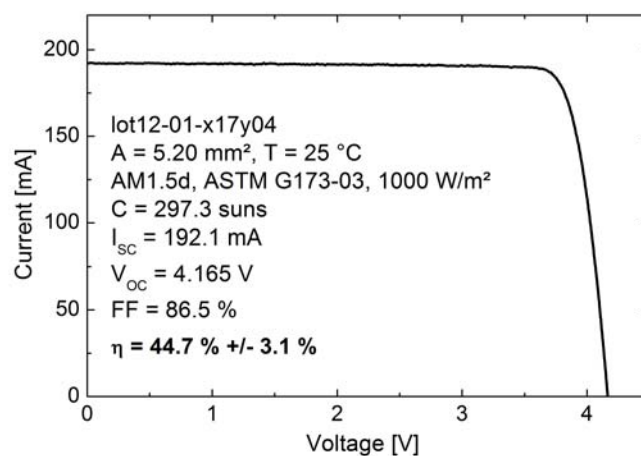
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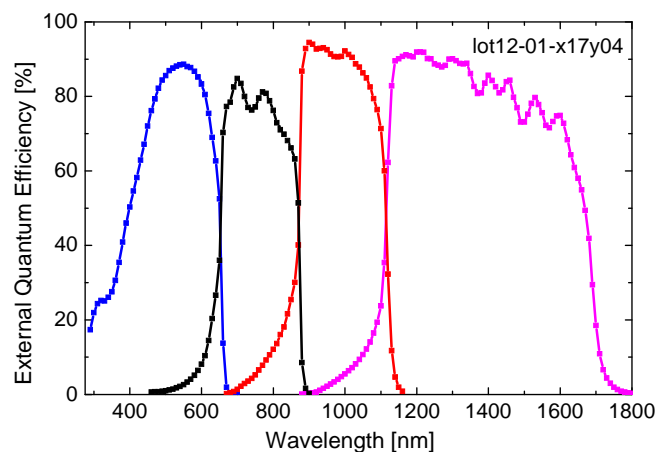
World record solar cell with 44.7% efficiency, made up of four solar subcells based on III-V compound semiconductors for use in concentrator photovoltaics.
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IV-characteristic for the current best four-junction solar cell under AM1.5d ASTM G173-03 spectrum at a concentration of 297 suns. The measurements were carried out at the Fraunhofer ISE Callab. ©Fraunhofer ISE



External quantum efficiency of the four-junction solar cell. The measurements were carried out at the Fraunhofer ISE Callab.

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About Fraunhofer ISE

With a staff of 1300, the Fraunhofer Institute for Solar Energy Systems ISE, based in Freiburg, is the largest solar energy research institute in Europe. Fraunhofer ISE is committed to promoting energy supply systems which are sustainable, economic, safe and socially just. It creates the technological foundations for supplying energy efficiently and on an environmentally sound basis in

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industrialized, threshold and developing countries. To this end, the institute develops materials, components, systems and processes for a total of eight different business areas: Energy-Efficient Buildings, Applied Optics and Functional Surfaces, Solar Thermal Technology, Silicon Photovoltaics, Photovoltaic Modules and Systems, Alternative Photovoltaic Technology, Renewable Power Supply and Hydrogen Technology. Fraunhofer ISE also has numerous accredited test facilities. For more information, visit www.ise.fraunhofer.de

About Soitec

Soitec is an international manufacturing company, a world leader in generating and manufacturing revolutionary semiconductor materials at the frontier of the most exciting energy and electronic challenges. Soitec's products include substrates for microelectronics (most notably SOI: Silicon-on-Insulator) and concentrator photovoltaic systems (CPV). The company's core technologies are Smart Cut™, Smart Stacking™ and Concentrix™, as well as expertise in epitaxy. Applications include consumer and mobile electronics, microelectronics-driven IT, telecommunications, automotive electronics, lighting products and large-scale solar power plants. Soitec has manufacturing plants and R&D centers in France, Singapore, Germany and the United States. For more information, visit: www.soitec.com.

About CEA-Leti

Leti is an institute of CEA, a French research-and-technology organization with activities in energy, IT, healthcare, defence and security. Leti is focused on creating value and innovation through technology transfer to its industrial partners. It specializes in nanotechnologies and their applications, from wireless devices and systems, to biology, healthcare and photonics. NEMS and MEMS are at the core of its activities. An anchor of the MINATEC campus, CEA-Leti operates 8,000-m² of state-of-the-art clean room space on 200mm and 300mm wafer platforms. It employs 1,700 scientists and engineers including 320 Ph.D. students and 200 assignees from partner companies. CEA-Leti owns more than 2,200 patent families. For more information, visit www.leti.fr

About Helmholtz Zentrum Berlin

Part of the cell technology was developed at the Helmholtz Zentrum Berlin in the research group of Prof. Thomas Hannappel, (now with Technical University Ilmenau). Energy research at HZB focuses on

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renewable energies, namely thin-film-photovoltaics and solar fuels, as well as fundamental research on electrochemical energy storage and energy efficiency. Worldwide, HZB is the only center which offers a neutron source (BER II) and a soft X-ray synchrotron radiation source (BESSY II) for energy research. Both sources serve more than 3,000 external international users per year. The dedicated user service for energy research at BESSY II and a very strong position in particular for photovoltaics and solar fuels materials research will be further strengthened by establishing the "Energy Materials In-Situ Laboratory" (EMIL) starting operation in 2015. Technology transfer is ensured by PVcomB. For more information, visit: <http://www.helmholtz-berlin.de>

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