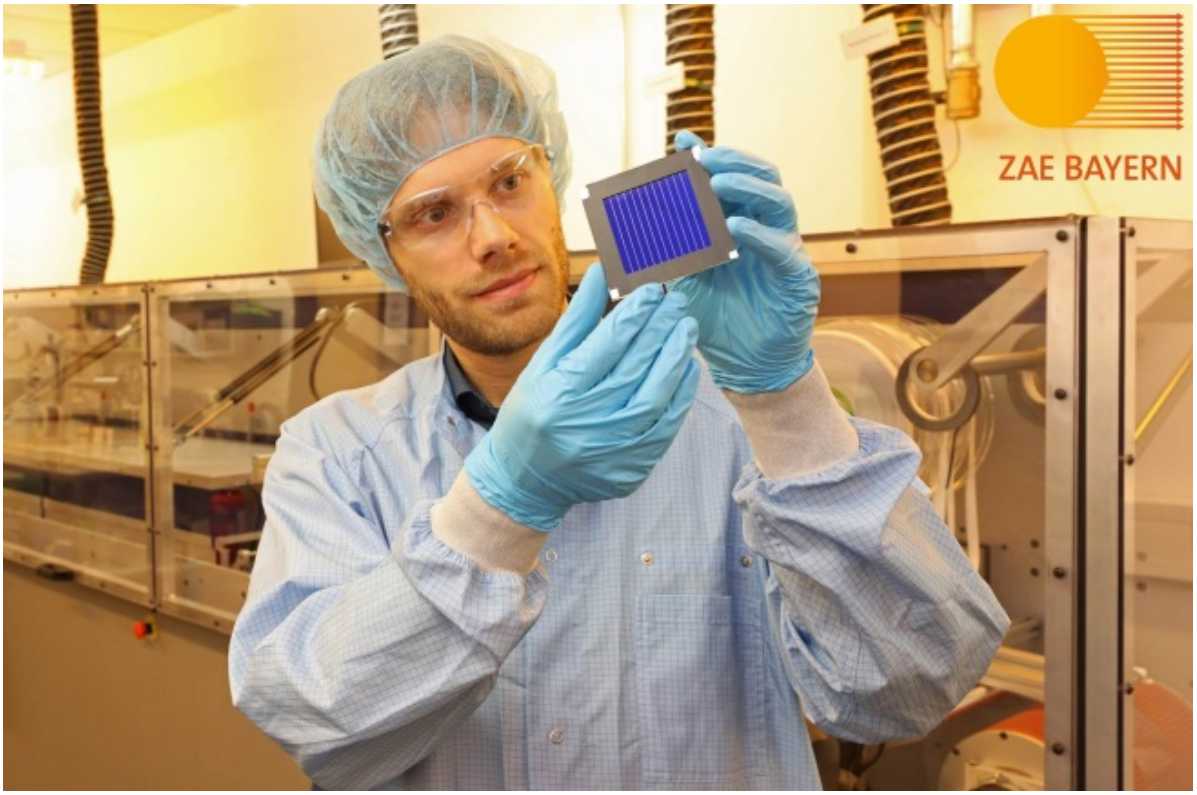
Press Release

New World Record Efficiency for Organic Solar Modules

Nuremberg, 11 November 2019 - A research team from Nuremberg and Erlangen has set a new record for the power conversion efficiency of organic photovoltaic modules (OPV). The scientists from Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), the Bavarian Center for Applied Energy Research (ZAE), and the Helmholtz Institute Erlangen-Nürnberg for Renewable Energy (HI ERN), a branch of Forschungszentrum Jülich, in cooperation with South China University of Technology (SCUT), designed an OPV module with an efficiency of 12.6 percent on an area of 26 square centimeters. The new world record exceeds the previous record of 9.7 percent by 30 percent.



Dr. Andreas Distler (ZAE Bayern) with the organic record solar module at the "Solar Factory of the Future". In the background, the pilot line for printed thin-film photovoltaics. (© ZAE/Kurt Fuchs)

This efficiency of 12.6 percent is the highest value ever reported for an organic photovoltaic module. It was confirmed by a certified calibrated measurement under standard test conditions by the independent certification laboratory of Fraunhofer ISE (Freiburg) in September 2019. The multi-cell module was developed at the "Solar Factory of the Future" at Energie Campus Nürnberg (EnCN) in a coating laboratory with a unique megawatt pilot line for thin-film photovoltaics, which was designed and implemented with the financial support of the Bavarian Ministry of Economic Affairs.

"This breakthrough shows that Bavaria is not only a leader in the expansion of photovoltaic installations, but also occupies a leading position in the development of future technologies," emphasizes Hubert Aiwanger, Bavarian State Minister of Economic Affairs, Regional Development and Energy.

Organic solar cells usually consist of two different organic components possessing the necessary semiconductor properties. In contrast to conventionally used silicon, which is manufactured by energy-intensive melting processes, organic materials can be applied from solutions directly onto a carrier film or glass carrier.

On the one hand, this reduces manufacturing costs and, on the other hand, the use of flexible, lightweight materials enables new applications, for example in mobile devices or clothing, even if the efficiency is not yet comparable to that of traditional silicon solar cells.

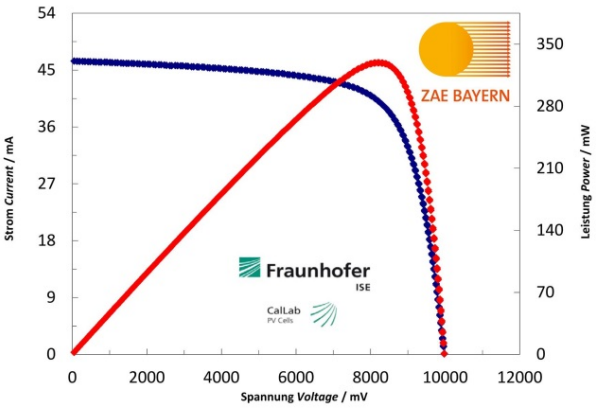
“This milestone in research on organic semiconductors shows that the latest performance developments with certified cell efficiencies of over 16 percent are not limited to the laboratory scale, but can already be scaled up to the level of prototype modules,” explains Prof. Christoph Brabec from FAU, Director at HI ERN, and Scientific Director of the “Solar Factory of the Future”, a research group of ZAE Bayern.

Due to their design, the efficiency of complete photovoltaic modules is always somewhat lower than that of individual cells. Part of the module area, for example, is always inactive, since this area is used to interconnect the individual cells. With increased module area, the losses caused by the electrical resistance of the electrodes also increase.

The record module consists of twelve cells connected in series and has a geometric fill factor (GFF) of over 95 percent. This part of the module area actively contributes to the power generation. With respect to its active area, the module even achieves 13.2 percent efficiency. The minimization of inactive areas was achieved by means of high-resolution laser structuring, as developed and optimized in recent years at the “Solar Factory of the Future”.

Technical data:

Module area: 26.129 cm² (± 0.026 cm²)
Power conversion efficiency (PCE): 12.60 % (± 0.19 %)
Open-circuit voltage (Voc): 9.978 V (± 0.04 V)
Short-circuit current (Isc): 46.43 mA (± 0.65 mA)
Fill factor (FF): 71.06 % (± 0.38 %)
Interconnection: 12 cells in series
Geometric fill factor (GFF): 95.5 %
PCE with respect to the active area of the module: 13.2 %



Measurement of the organic record solar module performed by the independent certification laboratory of Fraunhofer ISE (Freiburg).

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About ZAE

ZAE Bayern is a non-university institute for applied energy research with about 180 employees, institutionally funded by the Bavarian Ministry of Economic Affairs, Regional Development and Energy. In its central fields of expertise, renewable energies, energy storage, and energy efficiency, ZAE Bayern combines materials research, development of components, and system optimisation in an interdisciplinary approach. ZAE's researchers work, among other things, on thermal and electrochemical energy storages, energy efficiency in processes, energetically optimised buildings, photovoltaics, nanomaterials, smart grids, and cross-sector energy systems (electricity and heat/cold). With its two main locations in Würzburg and Garching near Munich and, as well as its branches in Nuremberg and Hof, ZAE Bayern is present statewide and offers complete innovation packages to its customers when it comes to efficient and sustainable energy systems. For further information visit www.zae-bayern.de.

About Friedrich-Alexander-Universität Erlangen-Nürnberg

Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), established in 1743, is one of the largest universities in Germany, with approximately 38,000 students, 580 professors and more than 14,000 members of staff. In addition to the Cluster of Excellence 'Engineering of Advanced Materials' (EAM) and the Graduate School of Advanced Optical Technologies (SAOT), which was founded as part of the Excellence Initiative, FAU currently has more than 40 coordinated programmes funded by the German Research Foundation (DFG).

FAU offers around 260 degree programmes, including eight Bavarian Elite Master's degree programmes and around 50 programmes with a distinct international focus. No other German university offers such a broad and interdisciplinary range of subjects on all qualification levels. FAU students enjoy global mobility thanks to partnerships with higher education institutions throughout the world.

About Forschungszentrum Jülich

Forschungszentrum Jülich makes a vital contribution to solving major challenges facing society in the fields of information, energy, and bioeconomy. It focuses on the future of information technologies and information processing, complex processes in the human brain, the transformation of the energy system, and a sustainable bioeconomy. Forschungszentrum Jülich develops simulation and data sciences as a key research method and makes use of large, often unique, scientific infrastructures. Its work spans a range of topics and disciplines and it exploits synergies between the research areas.With some 6,000 employees, Jülich–a member of the Helmholtz Association–is one of Europe's large research centres.

About Energie Campus Nürnberg

The Energie Campus Nürnberg is a research center developing new technologies for the entire energy system. As an independent research network it collaborates with the Friedrich-Alexander-University Erlangen Nürnberg, the University of Applied Sciences Nuremberg Georg Simon Ohm, the Bavarian Center for Applied Energy Research, the Fraunhofer Institutes for Integrated Circuits, for Integrated Systems and Device Technology and or Building Physics and with the Ansbach University of Applied Sciences as an interdisciplinary think tank. Together with industry, Energie Campus works in projects to develop solutions for the energy needs of tomorrow.