Fraunhofer FEP

PRESS RELEASE

12 | 24

Innovative layer systems for sustainable photovoltaic solutions in the building sector

In the construction and building sector, sustainable solutions for reducing energy requirements and improving the carbon footprint are more in demand than ever. In view of rising energy prices and strict regulations for lower energy consumption in buildings, innovative technologies such as perovskite and organic solar cells offer great potential. However, the cost, durability and efficiency of these solar cells pose a major challenge. As part of the EU-funded PEARL and BOOSTER projects, the Fraunhofer FEP is developing new coating and process technologies that will significantly increase the durability and efficiency of solar cells and sustainably reduce costs and material requirements. At the BAU 2025 trade fair, Fraunhofer FEP will be presenting a number of pioneering technologies and demonstrating their potential applications in the construction and building sector from January 13 to 17, 2025 at the joint Fraunhofer booth in Hall C2, Booth 528.

The construction and building sector is facing major challenges: Climate change, rising energy prices and stricter regulations require sustainable solutions to reduce the energy requirements of buildings and improve the carbon footprint. Solar energy plays a key role in this, especially innovative technologies such as perovskite solar cells. These new types of cells offer great potential for building-integrated photovoltaics (BIPV), as they are flexible, easy and inexpensive to manufacture and have impressed with enormous advances in efficiency in recent years.

Further efforts are required in terms of durability and stability on the way from laboratory samples to modules ready for practical use. Flexible organic solar cells also offer great potential for building integration, but there is still further space for optimization in the manufacturing processes and with regard to increase their efficiency and service life.

The Fraunhofer Institute for Electron Beam and Plasma Technology FEP thus conducts research into new materials and coating technologies as part of the two EU-funded projects PEARL and BOOSTER in order to overcome these challenges and develop components for sustainable, long-lasting solar solutions for the construction and building sector.

Fraunhofer FEP is a leading international player in the development of innovative layer systems and coating processes on flexible materials. With its comprehensive expertise in

The projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101122283 and 952911

Funded by the European Union

Fraunhofer Institute for Electron Beam and Plasma Technology FEP
Winterbergstraße 28 | 01277 Dresden, Germany | www.fep.fraunhofer.de

Head of Communications: Annett Arnold, M.Sc. | Phone +49 351 2586-333 | annett.arnold@fep.fraunhofer.de

vacuum coating and plasma technology, the institute makes decisive contributions to the further development of technologies in sheet-to-sheet and roll-to-roll processes. These processes are used in a wide variety of industries. Especially for the construction and building sector, the scientists at Fraunhofer FEP develop customized coatings that meet the high requirements for durability, energy efficiency and sustainability.

PEARL - Flexible perovskite solar cells for sustainable energy

As part of the EU-funded PEARL project (grant agreement no. 101122283), the Fraunhofer FEP is developing next-generation flexible perovskite solar cells together with international partners under the coordination of VTT Technical Research Centre of Finland Ltd. Over the next few years, the researchers in Dresden want to develop a combined permeation barrier with a transparent electrode layer that will significantly improve both the durability and efficiency of the solar cells. This technology will enable production materials and steps to be reduced, making the manufacture of flexible solar cells more cost-efficient and sustainable.

Dr. Christian May explains the focus: "Permeation barrier layers and transparent electrode layers already exist. In the project, we now want to combine both products in order to save film material on the one hand and a process step on the other. This should have a long-term impact on the cost efficiency of manufacturing the products and thus make solar energy more affordable."

The challenge is to combine the properties of both components – barrier and electrode – in such a way that they do not impair each other. The application and structuring of the electrode must not influence the barrier effect, and conversely the function of the electrode must not be restricted. The know-how of the Fraunhofer FEP in the field of vacuum coating processes and the influences on barrier properties is of decisive importance here. Initial results have already been achieved on the coFlex in-line vacuum coating system for roll-to-roll coating.

"The PEARL project offers us the opportunity to significantly advance the development of perovskite solar cells. By combining barrier and electrode layers, we are creating the basis for a high-performance, stable and cost-efficient solar technology of the future," summarizes Dr. Christian May.

BOOSTER - Organic photovoltaics for the building sector

The EU-funded BOOSTER project (grant agreement no. 952911) focuses on the development of organic photovoltaic modules (OPV), which are particularly suitable for building applications such as building applied photovoltaics (BAPV).

OPV is a technology that addresses the problem of global energy production with an environmentally friendly approach. The production of OPV modules is characterized by

a low energy payback time and uses resources that are abundant, easily accessible and non-toxic. In addition, organic photovoltaic modules are lightweight and highly flexible, making them ideal for use on buildings, especially on curved surfaces and in vertical directions.

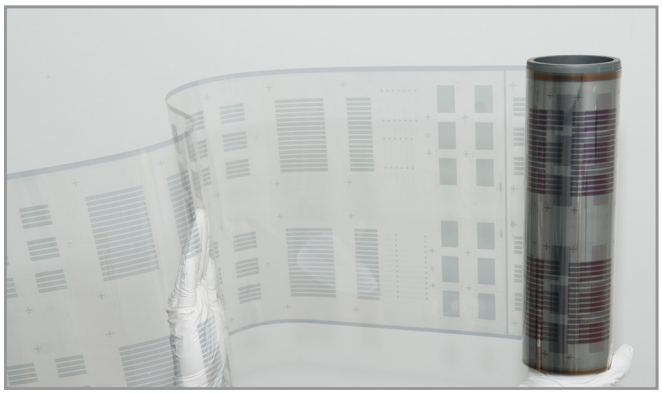
Recently, great progress has also been made in their performance by developing new materials that are used in printing processes. The BOOSTER project aims to further develop OPV technology so that the first demonstrators can be realized and used and tested under real conditions. Efficiency and lifetime are to be increased, and costs reduced at the same time. Specifically, at the end of the project, three different demonstrators are to be integrated at locations in Germany and Italy in order to investigate their efficiency under real conditions in the final year of the project.
As part of the project, Fraunhofer FEP is developing a highly transparent and durable frontsheet that protects the OPV modules from UV radiation and moisture. This protective layer is crucial for the service life of the modules, as the efficiency of the solar cells depends largely on the transparency of the frontsheet.

Patrick Schlenz, project manager of the BOOSTER project at Fraunhofer FEP, explains: "With BOOSTER, we are working on improving the service life and efficiency of OPV modules under real outdoor conditions. With our expertise in the development of special coating systems, e.g. as a permeation barrier or to achieve special optical properties, and in process development for the coating of flexible films, we are addressing various issues in the project. We are specifically implementing a solution that meets the requirements for the barrier layers for OPV and at the same time offers advantages in terms of optical properties compared to the state-of-the-art material."

As a result, the researchers at Fraunhofer FEP want to develop a film substrate that not only offers better protection against environmental pollution from the barrier layer, but also increases transparency. This in turn increases the efficiency of the modules. Initial results have already been achieved on processed OPV modules in the project: Lifetimes of over 4000 hours under accelerated ageing conditions, i. e. at an elevated temperature of 85°C and increased humidity of 85% r.h., have been demonstrated by the researchers. In addition, an increase in the transparency properties of the films from 85 to 90% was achieved.

In addition, the project partners in BOOSTER are focusing on developing a production concept for the OPV modules that offers efficient coating at low cost. To this end, a roll-to-roll production line is being optimized and work is being carried out on scaling up all materials and processes for such production. At the end of the project, an OPV module including the process technologies should be available that can be used and transferred by future manufacturers of flexible solar cells or other opto-electronic components.

The presented technologies and results as well as possible applications of thin-film technologies in the construction and building sector will be presented at the Fraunhofer joint booth (Hall C2, Booth 528) at the BAU 2025 trade fair from January 13 to 17, 2025. There, interested visitors can learn more about the innovative technologies of solar cell development and find out about the possible applications of perovskite and OPV technologies in the construction and building sector.



Flexible Perovskite solar cell test structures
© VTT Technical Research Centre of Finland Ltd
Picture in printable resolution: www.fep.fraunhofer.de/press

Futuristic building with perovskite solar cells on roof and integrated organic photovoltaic on curved facades
© Picture generated by AI
Picture in printable resolution: www.fep.fraunhofer.de/press

About the projects PEARL and BOOSTER

PEARL – Flexible perovskite solar cells with carbon electrodes

Project duration: October 1, 2023 – September 30, 2026

Funding authority:
European Union research and innovation program "Horizon Europe" under the funding code 101122283

Further information: www.pearl-project.eu

BOOSTER – Boost of organic solar technologies for European radiance

Project duration: September 1, 2020 – February 28, 2027

Funding authority:
Research and innovation program "Horizon Europe 2020" of the European Union under the funding code 952911

Further information: www.booster-opv.eu

Fraunhofer FEP at BAU 2025

January 13 – 17, 2025, Munich Trade Fair Center, Germany
Fraunhofer joint booth: hall C2, booth no. 528

The following topics will be presented at the Fraunhofer FEP during the trade fair:

- A model of a building with the institute's coating technologies for the construction and building sector, including:
  - Low-e coatings
  - Thermochromic coatings
  - Antibacterial coatings and surfaces
  - Anti-reflective coatings for glass applications
  - Coatings for ultra-thin, flexible glass
  - Barrier coatings for solar applications
  - 3D coatings for tube collectors and zeolite heat accumulators
  - Structuring processes for design PV applications
- Production of sustainable building materials through biogenic lime synthesis
- Glass modules with anti-reflective coating
- Reconstruction of historical mirrors using mercury-free thin films

Further information: https://s.fhg.de/CSDt