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PRESS RELEASE

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Milestone in Flexible Perovskite Solar Cells: EU-funded PEARL Consortium Demonstrates Roll-to-Roll Production

Oulu, Finland – At month 18 of its three-year Horizon Europe project, the PEARL consortium has made decisive progress toward its target of 25% efficient, low-cost flexible perovskite solar cells with carbon electrodes. By combining cutting-edge materials research, pilot-scale roll-to-roll (R2R) manufacturing and comprehensive sustainability measures, partners across Europe have delivered a series of significant achievements.

PEARL
Flexible Perovskite Solar Cells with Carbon Electrodes

The researchers have developed solar cells with an efficiency of over 21% on flexible PET substrates. The most important achievements of the project partners include:

- Power conversion efficiency of 21.6% through special surface treatments (molecular surface passivation with fullerene and silane self-assembled materials) was achieved by the Spanish research institute ICIQ.
- University of Rome Tor Vergata achieved 17.03% using greener perovskite solvents and optimized blade-coating protocols.
- Finnish research organization VTT demonstrated a lab-scale champion cell power conversion efficiency of 14.8% with a new printing process (gravure printed perovskite with DMSO-based ink).
- 9.1% power conversion efficiency with a fully roll-to-roll slot-die coated perovskite stack was achieved by the Dutch research institute TNO.

In parallel, VTT and TNO have scaled up R2R coating and patterning to larger formats and developed flexible minimodules with an area of 36 cm² and a power conversion efficiency of 4.5%.

The consortium has also developed protective encapsulation that keeps the solar cells stable for over 2,000 hours under damp-heat conditions (85°C temperature and 85% humidity) – proving their durability for real-world applications.

"Our flexible perovskite cells have already surpassed 21% efficiency on bendable substrates, and we've demonstrated scalable roll-to-roll processes," said Dr. Riikka Suhonen, PEARL Project Coordinator at VTT. "These achievements bring us firmly within reach of our 25 % target – paving the way to low-cost, high-performance solar modules for applications from building-integrated photovoltaics to the Internet of Things."

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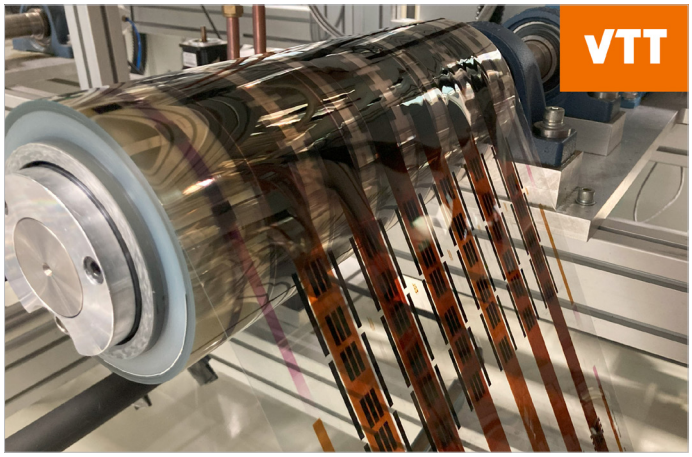
Focus on sustainability

The consortium attaches great importance to sustainability. Initial life cycle assessments show that the use of carbon electrodes, recycled PET, and green energy can reduce the carbon footprint by more than 50%. In addition, processes have been developed to recover valuable materials such as lead and cesium from production waste – an important step toward a circular economy.

Outlook

In the second phase of the project, PEARL will further optimize its roll-to-roll pilot manufacturing processes, test larger modules for outdoor use, and publish the results of the life cycle assessments. The goal is to bring flexible solar cells to market for applications such as building-integrated photovoltaics and the Internet of Things. Deliverables will include an optimized module design report, R2R encapsulation processes, and pilot-scale production protocols that collectively establish Europe's leadership in flexible perovskite PV manufacturing.

Together with its partners from the Network of EU-funded Perovskite projects, PEARL will be exhibiting at the joint stand F6 at EU PVSEC in Bilbao, September 22 to 24, 2025. PEARL is also represented at this conference as a panelist in the "Perovskite Innovation Roundtable: Driving EU Leadership in Perovskite Innovation" (Monday, September 25 at 17:00).



Flexible perovskite solar cell roll-to-roll processing at VTTs pilot line

Picture in printable resolution: www.fep.fraunhofer.de/press

About PEARL – Flexible Perovskite Solar Cells with Carbon Electrodes

The project PEARL started on 1st October 2023 and will run 36 months. The project receives funding from the European Union's Horizon Europe research and innovation programme under grant agreement no. 101122283.

This work was funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding Guarantee (grant number 10097706) and has received funding from the Swiss State Secretariat for Education, Research and Innovation (SERI).

For more information, please visit the project's website: www.pearl-project.eu

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