

UNIQUE

Carbon Based Perovskite Solar Cells with UNI-Directional Electron Bulk Transport: in the QUest of a Short Time to Market

Project duration: from 09.2019 to 08.2022

Report submitted: 03.2021

Publishable Summary

VISION

Photovoltaic research and commercial products that focus on **sustainability** and foster the future of **local PV** production in Europe is currently an imperative commitment.

A profound, true and fruitful collaboration among the main European centres developing carbon-based perovskite solar cells is paramount for the achievement of such a vision. UNIQUE embraces this commitment with the industrial partners (SOLARONIX and DYENAMO) paving the way to the wider industrial scenery.

AMBITION

Unique European know-how and industrial involvement is combined here to realize high-efficient large area perovskite devices with long lifetimes for a truly commercially viable perovskite PV technology. Sustainable, industrial-relevant processes and low-cost materials are implemented to aim at a competitive new-generation of PV. Short energy- and CO₂-payback times and a low CO₂ emission are key factors accounted for in this project.

EXCELLENCE

Printable solution-processed inorganic porous metal oxides with carbon counterelectrode, functionalized interfacial passivating layers and high quality perovskite crystals will compose the enhanced cell architecture to achieve a uni-directional charge transport. The outcome of this approach is the manufacture of **stable C-PSCs with 23% steady-state certified power conversion efficiency (PCE) on < 1 cm²**.

The success of the project is monitored through the following targets:

- **Demonstration of PCE > 17% on 30x30 cm²** through industrially established processes
- **Extrapolated operational lifetime of 20 years**
- **Calculated carbon footprint < 5 g CO₂-eq/kWh_{el}** (1/10 of that of Si-PV)
- **Reduction of material cost** down to the cost of the substrate resulting in estimated levelized cost of electricity **LCoE < 0.03 €/kWh**

Finally, the market exploitability will be showed by the fabrication of an up to **10 m² working and outdoor installed C-PSC demonstrator**. In the direction of the full environmental sustainability, the C-PSC structure will be used as a platform to easily examine Pb-less and Pb-free perovskites with the aim to achieve 10% PCE.

IMPACT

UNIQUE offers the chance to develop a European, efficient and sustainable PV technology which can be produced locally. UNIQUE aims to bring back the EU strategic PV manufacturing know-how

and value chain to Europe. To promote EU interaction and to raise the awareness for the potential of this technology, a public focused symposium is planned by the end of the project with research institutes, stakeholders and EU companies at the location where the demo has been installed.

UNIQUE CONSORTIUM

UNIQUE combines the effort of partners from TRL 3 - EPFL (deposition of highest efficient perovskites) and UAM (functionalization of carbon electrodes), to TRL 4 - CEA (development of novel gas barriers), LEPMI (lifetime extrapolations) and ISE (development of standardized uni-directional devices) and to TRL 5 - UNITOV (high precision laser patterned interconnected cells), SWANSEA (outdoor testing and adjustment to industrial processing), DYENAMO (batch synthesis of materials) and SOLARONIX (prototyping of C-PSC modules and printable uni-directional materials).

Project consortium

Coordinator and all contact details:

Full name of organisation	Fraunhofer Institute for Solar Energy Systems ISE
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Participating countries and financing:

Country	Number of organisations involved	Project costs in EUR	Public funding in EUR
Germany	1	484 183	483 667
France	2	593 874	311 287
Switzerland	2	854 328	0
Italy	1	169 583	84 792
United Kingdom	1	72 805	0
Spain	1	228 000	148 000
Sweden	1	251 674	175 562
<i>Total</i>	9	2 654 447	1 203 308

Funding agencies involved and contracts

Funding Agency	Contract N° and Title
PTJ	03EE1034, Verbundvorhaben: Unique - Kohlenstoffbasierte Perowskit-Solarzellen mit UNI-direktionalem Elektronentransport: mit dem Ziel einer schnellen Markteinführung; Teilvorhaben: Zellentwicklung und Koordination
ANR	PROJET N° ANR-19-SOL2-0004-03 & -04 Convention Attributive D'aide Valant Conditions Particulieres
MIUR	contract assignment ongoing
MINECO-AEI	PCI2019-111889-2 Celulas Solares De Perovskita Con Electrodo De Carbono Y Un Transporte Unidireccional De Las Cargas: En La Busqueda De Una Comercializacion Rapida
SWEA	Project number 48383-1 Carbon Based Perovskite Solar Cells with Uni-Directional Electron Bulk Transport: in the Quest of a Short Time to Market (Kolbaserade perovskitsolceller för lokal europeisk produktion)