

442 HIPER High-Efficiency Si Perovskite Tandem Solar Cells

Project duration: from 01.2017 – 07.2019

Report submitted: 09.2019

Publishable Summary

The overall project objective of the SOLAR-ERA.NET project HIPER is to reach efficiencies which cannot be obtained by single junction cSi technology: 28% cell efficiency. Furthermore, the project aims to develop scalable process methods to fabricate 6x6 inch² modules, and to include such modules in 25% hybrid tandem modules.

Main objectives

The HIPER project ran for 30 months, with the following main objectives:

- Realize a 28% perovskite/cSi hybrid tandem solar cell.
- Realize a 25% perovskite/cSi hybrid tandem solar module on 6 x 6 inch².
- Bring the technology readiness level (TRL) to 5 at end of project for the employed processing technologies.

Main Results

1. A record four terminal tandem device was realized by combining a 22.7% c-Si solar cell with a 18.0% semi-transparent perovskite solar cell. **The combination yields a hybrid tandem solar cell with 28.0%.**
2. The 18.0% is measured on an aperture of 2 x 2 mm. The value corresponds to the current world record for perovskite/cSi hybrid tandems. The cell was measured with a AAA class solar simulator under 1 sun AM1.5 conditions (1000 W/m²).
The 25% hybrid tandem was not obtained. The consortium reached 90% of the target with a 22.4% 6 inch hybrid tandem module consisting of a 22.5% cSi cell with a 13.5% semi-transparent perovskite module processed on 6 inch substrate.
3. As industrially scalable processes were deployed to manufacture both the semi-transparent perovskite mini-modules and the c-Si cell, we evaluate that with **the 22.4% 6 inch hybrid tandem module, a TRL of 5 has been reached.**

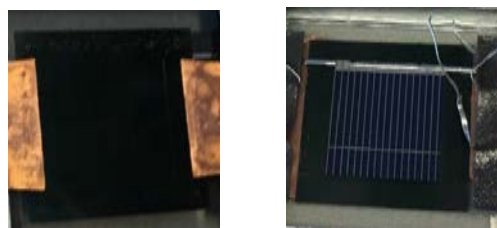


Figure 1.1 Front (perovskite) and backside (c-Si) of a (bifacial) hybrid tandem mini-module (~3x3 cm²)

Project consortium

Coordinator and all contact details:

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Participating countries and financing:

Country	Number of organisations involved	Project costs in EUR	Public funding in EUR
Spain	1	261'032	229'709
Turkey	1	254'150	183'863
The Netherlands	4	1'264'327	999'999
<i>Total</i>	<i>6</i>	<i>1'779'509</i>	<i>1'413'517</i>

Funding agencies involved and contracts

Funding Agency	Contract N° and Title
Ministerio de Economía y competitividad	PCIN-2017-014 Células solares tándem de Si Perovskita de alta eficiencia
The Scientific and technological research council of Turkey (TÜBİTAK)	Projet no: 9160050 Yüksek Verimli Çok Eklemlı Perovskit/Silisyum Fotovoltaik Modüllerin Geliştirilmesi
Rijksdienst voor Ondernemend Nederland	Project nr./ ref. nr. TEUE116193 Besluit tot verlening subsidie