

Solar Cells Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form is intended for publication with all accepted papers reporting the characterization of photovoltaic devices and provides structure for consistency and transparency in reporting. Some list items might not apply to an individual manuscript, but all fields must be completed for clarity.

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► Experimental design

Please check the following details are reported in the manuscript, and provide a brief description or explanation where applicable.

1. Dimensions

Area of the tested solar cells

Yes 0.25 cm² and 1.00 cm²

No Explain why this information is not reported/not relevant.

Method used to determine the device area

Yes Shadow mask area, measured by visible light microscopy

No Explain why this information is not reported/not relevant.

2. Current-voltage characterization

Current density-voltage (J-V) plots in both forward and backward direction

Yes Fig. 4; SI Fig. 14, SI Fig. 27

No

Voltage scan conditions

Yes Methods

No Explain why this information is not reported/not relevant.

Test environment

Yes Methods

No Explain why this information is not reported/not relevant.

Protocol for preconditioning of the device before its characterization

Yes Methods

No Explain why this information is not reported/not relevant.

Stability of the J-V characteristic

Yes Fig. 4; SI Fig. 14, SI Fig. 27

No Explain why this information is not reported/not relevant.

3. Hysteresis or any other unusual behaviour

Description of the unusual behaviour observed during the characterization

Yes Provide a description of hysteresis or any other unusual behaviour observed during the characterization.

No N/A

Related experimental data

Yes Provide a description of the related experimental data.

No N/A

4. Efficiency

External quantum efficiency (EQE) or incident photons to current efficiency (IPCE)

Yes Methods; SI Fig. 9

No Explain why this information is not reported/not relevant.

A comparison between the integrated response under the standard reference spectrum and the response measure under the simulator

Yes SI Fig. 9

No Explain why this information is not reported/not relevant.

For tandem solar cells, the bias illumination and bias voltage used for each subcell	<input type="checkbox"/> Yes	Provide a description of the measurement conditions.
	<input checked="" type="checkbox"/> No	N/A
5. Calibration		
Light source and reference cell or sensor used for the characterization	<input checked="" type="checkbox"/> Yes	Methods
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
Confirmation that the reference cell was calibrated and certified	<input checked="" type="checkbox"/> Yes	Methods
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
Calculation of spectral mismatch between the reference cell and the devices under test	<input checked="" type="checkbox"/> Yes	Methods
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
6. Mask/aperture		
Size of the mask/aperture used during testing	<input checked="" type="checkbox"/> Yes	0.25 cm ² and 1.00 cm ²
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
Variation of the measured short-circuit current density with the mask/aperture area	<input checked="" type="checkbox"/> Yes	Fig. 4 and Methods
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
7. Performance certification		
Identity of the independent certification laboratory that confirmed the photovoltaic performance	<input type="checkbox"/> Yes	Identify the independent certification laboratory.
	<input checked="" type="checkbox"/> No	Not certified
A copy of any certificate(s)	<input type="checkbox"/> Yes	Certificate copies should be provided in the Supplementary information. Please state the supplementary item number.
	<input checked="" type="checkbox"/> No	Not certified
8. Statistics		
Number of solar cells tested	<input checked="" type="checkbox"/> Yes	Main text and figure captions
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
Statistical analysis of the device performance	<input checked="" type="checkbox"/> Yes	Main text and figure captions
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.
9. Long-term stability analysis		
Type of analysis, bias conditions and environmental conditions	<input checked="" type="checkbox"/> Yes	Described in full in the main text and SI.
	<input type="checkbox"/> No	Explain why this information is not reported/not relevant.