

Solar Cells Reporting Summary

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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
☐ No

The dimensions of the tested devices are 0.04 cm², 1.28 cm², 6.75 cm², and 16 cm²

Explain why this information is not reported/not relevant.

Method used to determine the device area

☒ Yes
☐ No

Provide a description of the method and state where this information can be found in the text.

Masks were used to determine the active device area

2. Current-voltage characterization

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

☐ Yes
☒ No

State where this information can be found in the text.

No hysteresis phenomenon was observed so only the forward direction plots are provided

Voltage scan conditions

☒ Yes
☐ No

Voltage scan conditions are mentioned in the Methods section

Explain why this information is not reported/not relevant.

Test environment

☒ Yes
☐ No

The J-V plots were measured in ambient air, at room temperature

Explain why this information is not reported/not relevant.

Protocol for preconditioning of the device before its characterization

☐ Yes
☒ No

Provide a description of the protocol.

No preconditioning protocol

Stability of the J-V characteristic

☒ Yes
☐ No

The photocurrent at maximum power point is provided in Figure S2D

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
☒ No

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

No hysteresis or unusual behavior was observed during testing

Related experimental data

☐ Yes
☒ No

Provide a description of the related experimental data.

No hysteresis or unusual behavior was observed during testing

4. Efficiency

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

☒ Yes
☐ No

EQE spectrum is provided in Figure 2C

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
☐ No

EQE spectrum with integrated photoresponse is provided in Figure S2C

Explain why this information is not reported/not relevant.

For tandem solar cells, the bias illumination and bias voltage used for each subcell	☐ Yes ☒ No	Provide a description of the measurement conditions. This study only includes single-junction OPVs
5. Calibration		
Light source and reference cell or sensor used for the characterization	☒ Yes ☐ No	See Methods section Explain why this information is not reported/not relevant.
Confirmation that the reference cell was calibrated and certified	☒ Yes ☐ No	See Methods section Explain why this information is not reported/not relevant.
Calculation of spectral mismatch between the reference cell and the devices under test	☐ Yes ☒ No	Provide a value of the spectral mismatch and/or a description of how it has been taken into account in the measurements. The spectral mismatch calculation was not conducted in our lab
6. Mask/aperture		
Size of the mask/aperture used during testing	☒ Yes ☐ No	Shadow masks with 0.04 cm² aperture were used during testing Explain why this information is not reported/not relevant.
Variation of the measured short-circuit current density with the mask/aperture area	☐ Yes ☒ No	Report the difference in the short-circuit current density values measured with the mask and aperture area. All tests were performed with the same mask size
7. Performance certification		
Identity of the independent certification laboratory that confirmed the photovoltaic performance	☐ Yes ☒ No	Identify the independent certification laboratory. We did not get a certification test
A copy of any certificate(s)	☐ Yes ☒ No	Certificate copies should be provided in the Supplementary information. Please state the supplementary item number. We did not get a certification test
8. Statistics		
Number of solar cells tested	☒ Yes ☐ No	Over 10 devices were tested Explain why this information is not reported/not relevant.
Statistical analysis of the device performance	☒ Yes ☐ No	See Table 1 Explain why this information is not reported/not relevant.
9. Long-term stability analysis		
Type of analysis, bias conditions and environmental conditions	☒ Yes ☐ No	Stability analysis under different environmental conditions is shown in Figure 2, S2, and S3 Explain why this information is not reported/not relevant.