

Solar Cells Reporting Summary

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ü Experimental design

Please check: are the following details reported in the manuscript?

1. Dimensions

Area of the tested solar cells	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The device area was 0.25 cm ² (0.5cm x 0.5 cm) and the module area was 100 cm ² (10cm x 10 cm), as described in the Materials and Methods . <i>Explain why this information is not reported/not relevant.</i>
Method used to determine the device area	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Described in Methods and Materials (Photovoltaic performance measurements). A black metal mask with an area of 0.16 cm ² (0.4cm x 0.4 cm) and 53 cm ² are used to define the active area of small cell and module, respectively. <i>Explain why this information is not reported/not relevant.</i>

2. Current-voltage characterization

Current density-voltage (J-V) plots in both forward and backward direction	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The manuscript provides current density - voltage (JV) plots in both forward and backward direction (Fig. 2f, Fig. 5a,b, Fig. S21). Not applicable since the highlight of this work are new concept of perovskite inks formulation.
Voltage scan conditions <i>For instance: scan direction, speed, dwell times</i>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Voltage scan conditions are reported in the manuscript and described in the Methods and Materials (Photovoltaic performance measurements). <i>Explain why this information is not reported/not relevant.</i>
Test environment <i>For instance: characterization temperature, in air or in glove box</i>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The current-voltage characteristics are obtained under ambient temperature and air conditions, as reported in the manuscript. <i>Explain why this information is not reported/not relevant.</i>
Protocol for preconditioning of the device before its characterization	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Current-voltage characteristics were recorded in accordance with the procedure reported in the manuscript and in the Methods. No specific protocol for preconditioning was applied. No preconditioning is required before characterization.
Stability of the J-V characteristic <i>Verified with time evolution of the maximum power point or with the photocurrent at maximum power point; see ref. 7 for details.</i>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Maximum power point tracking was conducted, as reported in the manuscript (Fig. S21b). Not applicable since the highlight of this work are new concept of perovskite inks formulation.

3. Hysteresis or any other unusual behaviour

Description of the unusual behaviour observed during the characterization	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Very low hysteresis was observed upon altering the scan direction is reported in the manuscript (Fig. 2, 5). Not applicable since the highlight of this work are new concept of perovskite inks formulation.
Related experimental data	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The manuscript provides current density - voltage (JV) plots in both forward and backward direction (Fig. 2f, Fig. 5a,b, Fig. S21). Not applicable since the highlight of this work are new concept of perovskite inks formulation.

4. Efficiency

External quantum efficiency (EQE) or incident photons to current efficiency (IPCE)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	IPCE spectra were recorded, as reported in Fig. 2, Fig. S15, S17. <i>Explain why this information is not reported/not relevant.</i>
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A comparison between the integrated response under the standard reference spectrum and the response measure under the simulator	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>The integrated Jsc from IPCE spectra is consistent with the Jsc from JV measurements, as detailed in the manuscript (Fig. 2e, Fig. S15, S17).</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
For tandem solar cells, the bias illumination and bias voltage used for each subcell	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<p><i>State where this information can be found in the text.</i></p> <p>Not applicable as no tandem solar cells are reported in this work.</p>
5. Calibration		
Light source and reference cell or sensor used for the characterization	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>The light source was a 300-W Xenon lamp (Oriel) equipped with a SchottK113 Tempax sunlight filter (Prazisions Glas & OptikGmbH) to match the emission spectrum of the lamp to the AM1.5G standard. Before each measurement, the exact light intensity was determined using a calibrated Si reference diode equipped with an infrared cut-off filter (KG-3, Schott), as detailed in the Materials and Methods (Photovoltaic performance measurements).</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
Confirmation that the reference cell was calibrated and certified	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>The Si reference cell was calibrated and certified by Newport Corporation PV Lab, Bozeman, MT, USA, as detailed in the Methods.</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
Calculation of spectral mismatch between the reference cell and the devices under test	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>The spectral mismatch between our simulator and the AM 1.5 solar source was insignificant as the integrated current densities estimated from the IPCE spectra were in good agreement with the values obtained from the current density - voltage (J-V) curves as detailed in the manuscript. Spectra mismatch factor of 1 was used.</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
6. Mask/aperture		
Size of the mask/aperture used during testing	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>All measurements were conducted using a non-reflective metal mask with an aperture area of 0.16 cm² for small cells and 53 cm² for modules to cover part of the active area of the device and avoid stray light capturing by our device, as detailed in the Materials and Methods (Photovoltaic performance measurements).</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
Variation of the measured short-circuit current density with the mask/aperture area	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<p><i>State where this information can be found in the text.</i></p> <p>We haven't measured the cells with apertures of different sizes.</p>
7. Performance certification		
Identity of the independent certification laboratory that confirmed the photovoltaic performance	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<p><i>State where this information can be found in the text.</i></p> <p>No certification are conducted in this work since the no record efficiency is reported. And the highlight of this work are new concept of perovskite inks formulation.</p>
A copy of any certificate(s) <i>Provide in Supplementary Information</i>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<p><i>State where this information can be found in the text.</i></p> <p>Not applicable as we have not yet certified our devices by an independent accredited laboratory.</p>
8. Statistics		
Number of solar cells tested	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>At least 10 devices for each condition were tested, as reported (Table 1, Fig. S7, S16, S18, and S21).</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
Statistical analysis of the device performance	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>Histograms of efficiency for the devices are reported (Table 1, Fig. S7, S16, S18, and S21).</p> <p><i>Explain why this information is not reported/not relevant.</i></p>
9. Long-term stability analysis		
Type of analysis, bias conditions and environmental conditions <i>For instance: illumination type, temperature, atmosphere humidity, encapsulation method, preconditioning temperature</i>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<p>The long-term stability analysis is detailed in the manuscript with respect to the type of analysis, illumination, bias, and environmental conditions (involving temperature and atmosphere humidity), as well as the exclusion of encapsulation, which is detailed in the manuscript (Fig. S8 and S22)</p> <p><i>Explain why this information is not reported/not relevant.</i></p>

