

Supporting Information to

First-day degradation and night-time recovery mechanisms of lead-tin perovskite solar cells

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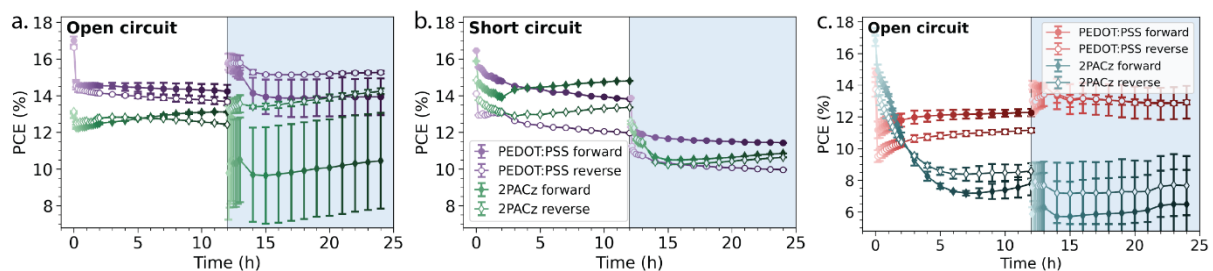


Fig. S1: The power conversion efficiencies of the PEDOT:PSS and 2PACz devices during light soaking at (a) open circuit and (b) short circuit, and subsequent recovery. (c) The power conversion efficiencies of PEDOT:PSS and 2PACz devices passivated using EACI as an additive during light soaking at open circuit and subsequent recovery.

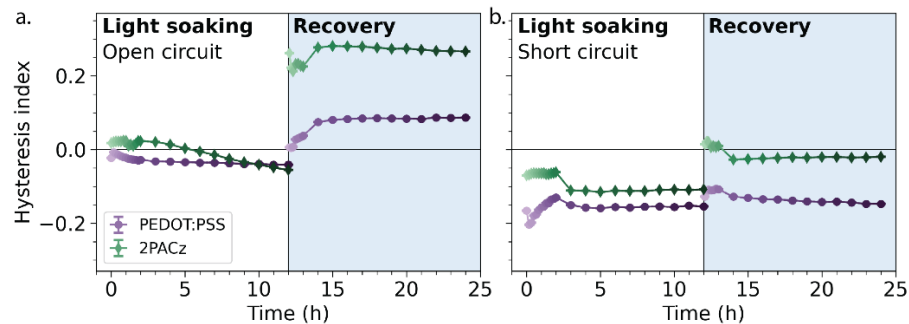


Fig. S2: The hysteresis index of the PEDOT:PSS and 2PACz devices during light soaking at (a) open circuit and (b) short circuit, and subsequent recovery. The hysteresis index was defined as the difference between the forward and reverse PCE, divided by the reverse PCE.¹

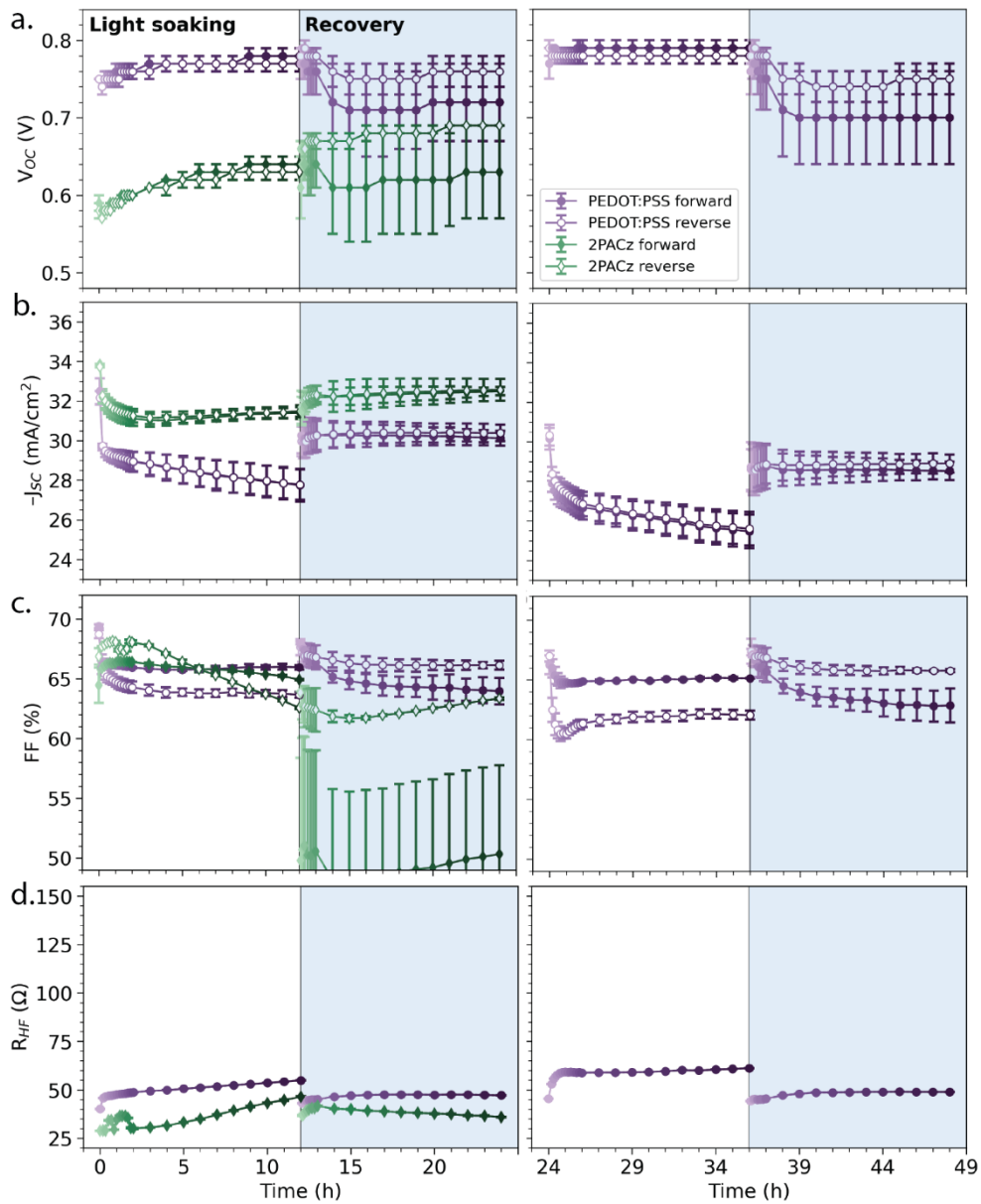


Figure S3: (a) V_{oc} , (b) J_{sc} , (c) FF, and (d) R_{HF} as extracted from JV and impedance curves measured during the (left) first and (right) subsequent second light soaking – recovery cycle at open circuit. The second cycle was only performed on the PEDOT:PSS device.

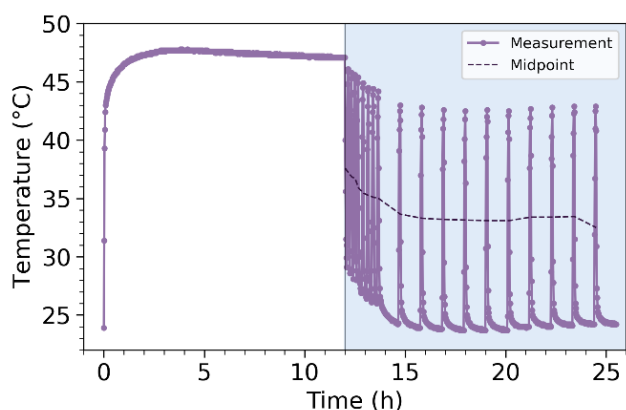


Figure S4: Progression of the temperature as measured on the bottom of the device during the light soaking and recovery period. The dashed line approximates the temperature at the midpoint of the JV and impedance measurement period.

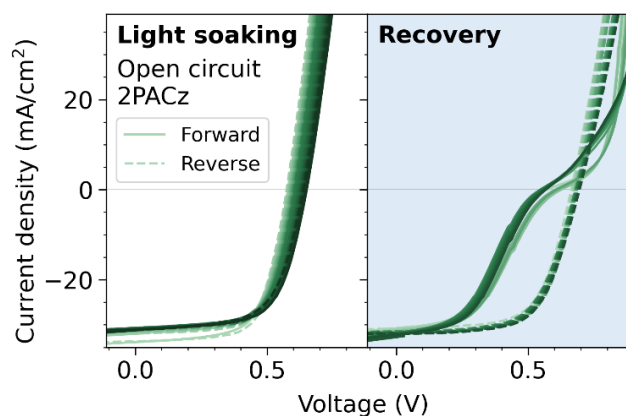


Figure S5: JV curves measured during ageing at open circuit and recovery of a different pixel of the 2PACz devices shown in Fig. 2 of the main text.

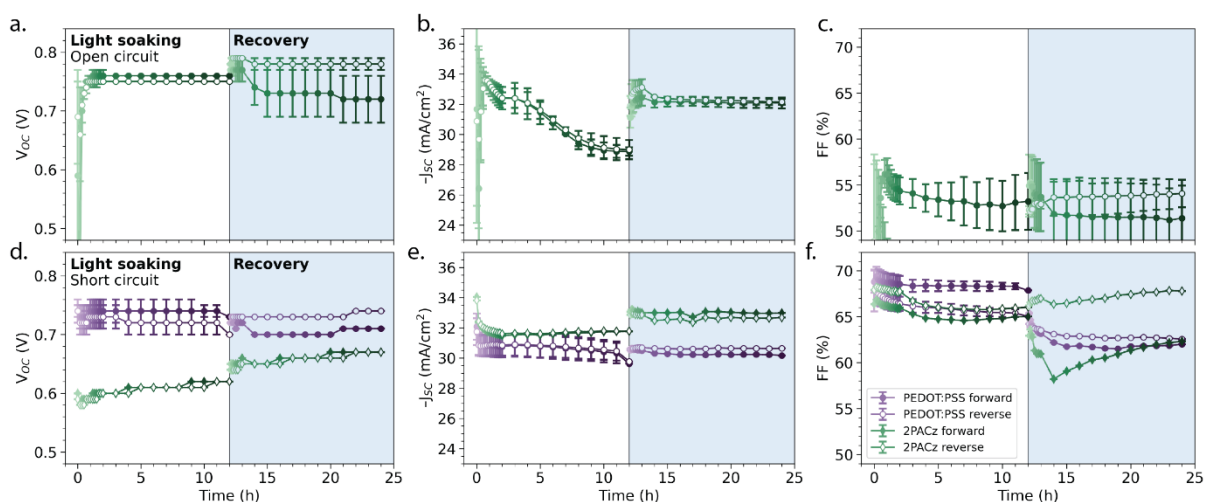


Figure S6: The values of the (a,d) V_{OC} , (b,e) J_{SC} , and (c,f) FF as extracted from the JV curves as measured during ageing at (a,b,c) open and (d,e,f) short circuit and the subsequent recovery period. The devices shown here belong to different batches than the devices shown in the main text but were prepared in the same way.

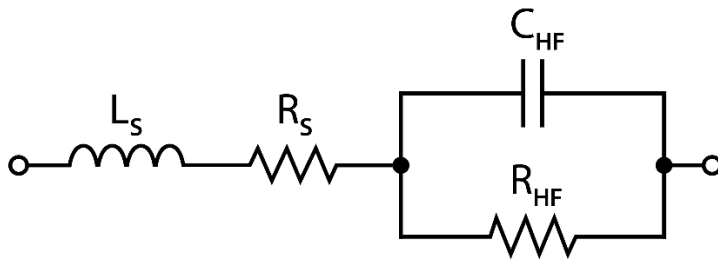


Figure S7: Equivalent circuit model used to fit the high frequency arc of the impedance spectra to extract the high frequency resistance. C_{HF} and R_{HF} model the high frequency arc, R_S corresponds to the series resistance of the device, and L_S was included to account for inductive effects in the cables used for the measurements.

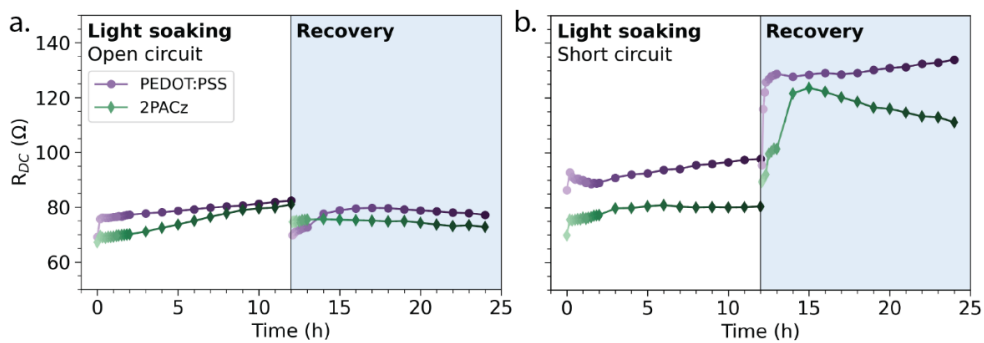


Figure S8: The evolution of the R_{DC} during the light soaking – recovery cycles at (a) open and (b) short circuit. The R_{DC} was approximated to be the real part of the impedance at the lowest frequency that was measured, i.e. 1 Hz.

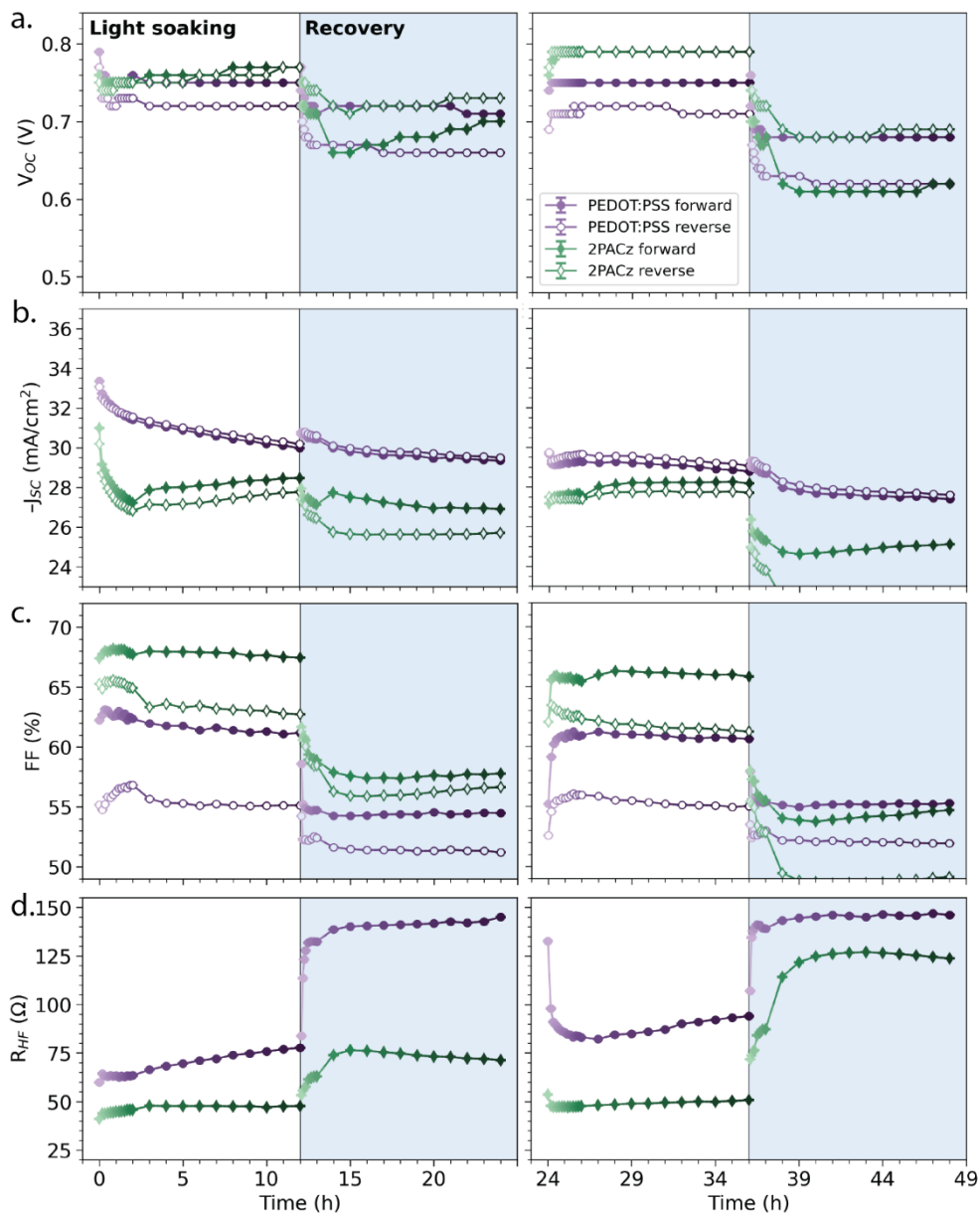


Figure S9: (a) V_{oc} , (b) J_{sc} , (c) FF, and (d) R_{HF} as extracted from JV and impedance curves measured during the (left) first and (right) subsequent second light soaking – recovery cycle at short circuit.

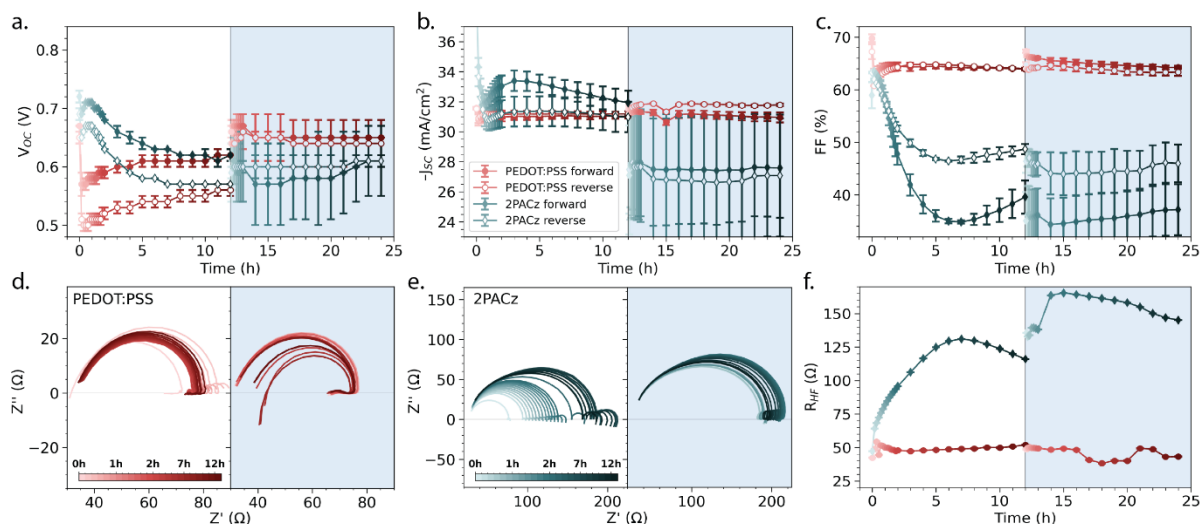


Figure S10: The values of the (a) V_{OC} , (b) J_{SC} , and (c) FF as extracted from the JV curves, along with the Nyquist plots of the (d) PEDOT:PSS devices and the (e) 2PACz devices, and (f) the extracted R_{HF} – as measured during ageing at open circuit and the subsequent recovery period. These devices had been passivated using EACL as an additive.

References

- (1) Habisreutinger, S. N.; Noel, N. K.; Snaith, H. J. Hysteresis Index: A Figure without Merit for Quantifying Hysteresis in Perovskite Solar Cells. *ACS Energy Lett.* **2018**, 3 (10), 2472–2476. <https://doi.org/10.1021/acsenergylett.8b01627>.