

Supporting Information

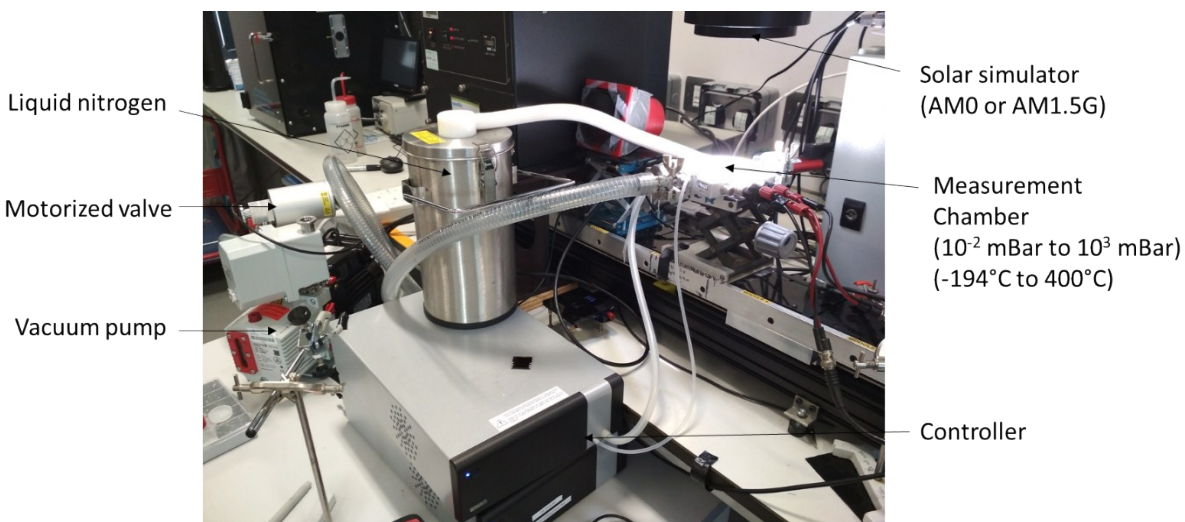


Figure S1. Set-up used for current-voltage measurements of perovskite solar cells under mimic HAPS environment.

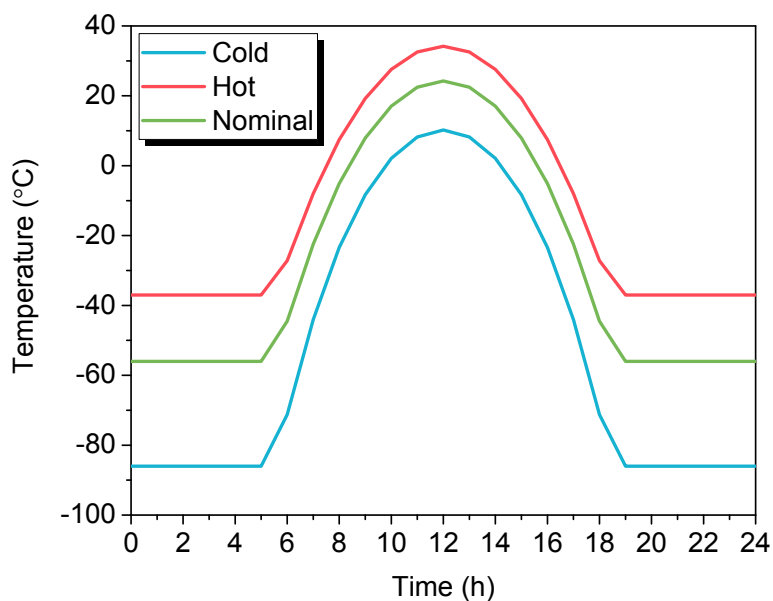


Figure S2. Solar cells temperature throughout the day in stratosphere calculated at summer solstice, -15° latitude in southern hemisphere. Values of -86°C (cold), -56°C (nominal) and -37°C (hot) were taken as assumptions for the outside air temperature at night. The cold and hot temperatures represent the extreme cases found in stratosphere.

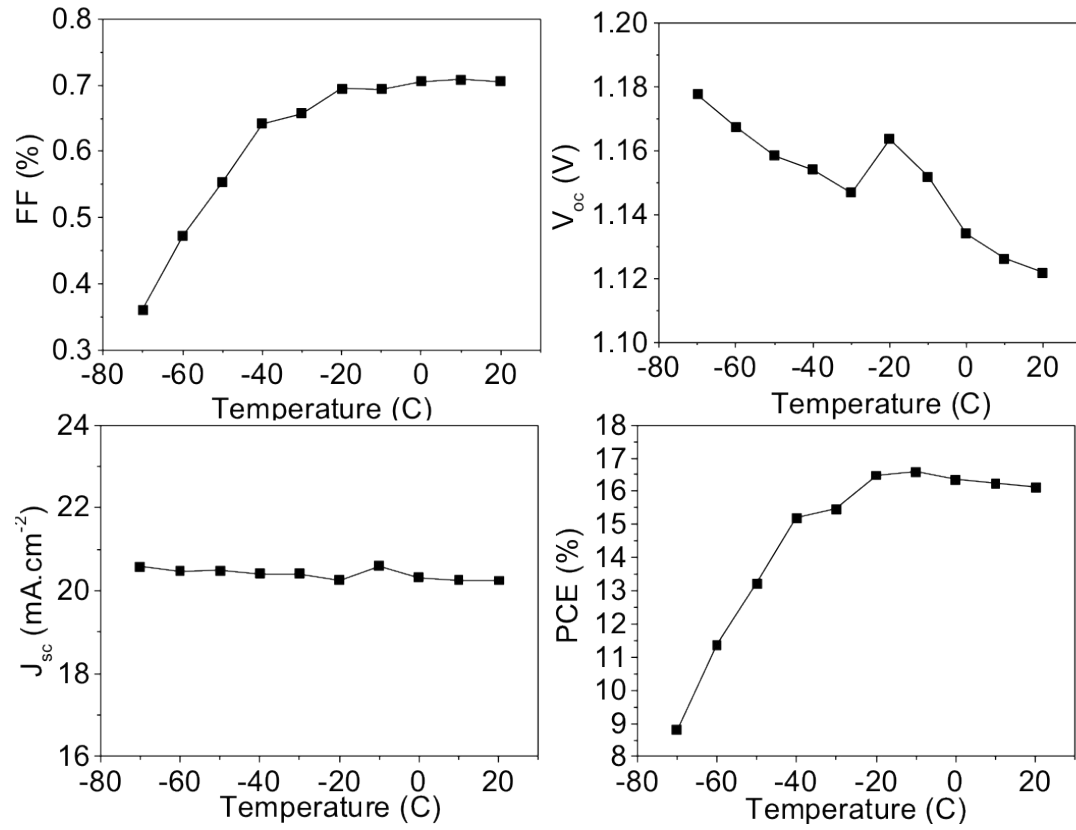


Figure S3. PV parameters (fill factor, V_{oc} , J_{sc} and PCE) of perovskite solar cells measured between -70°C and +20°C under constant AM1.5G illumination and vacuum (10 mbar).

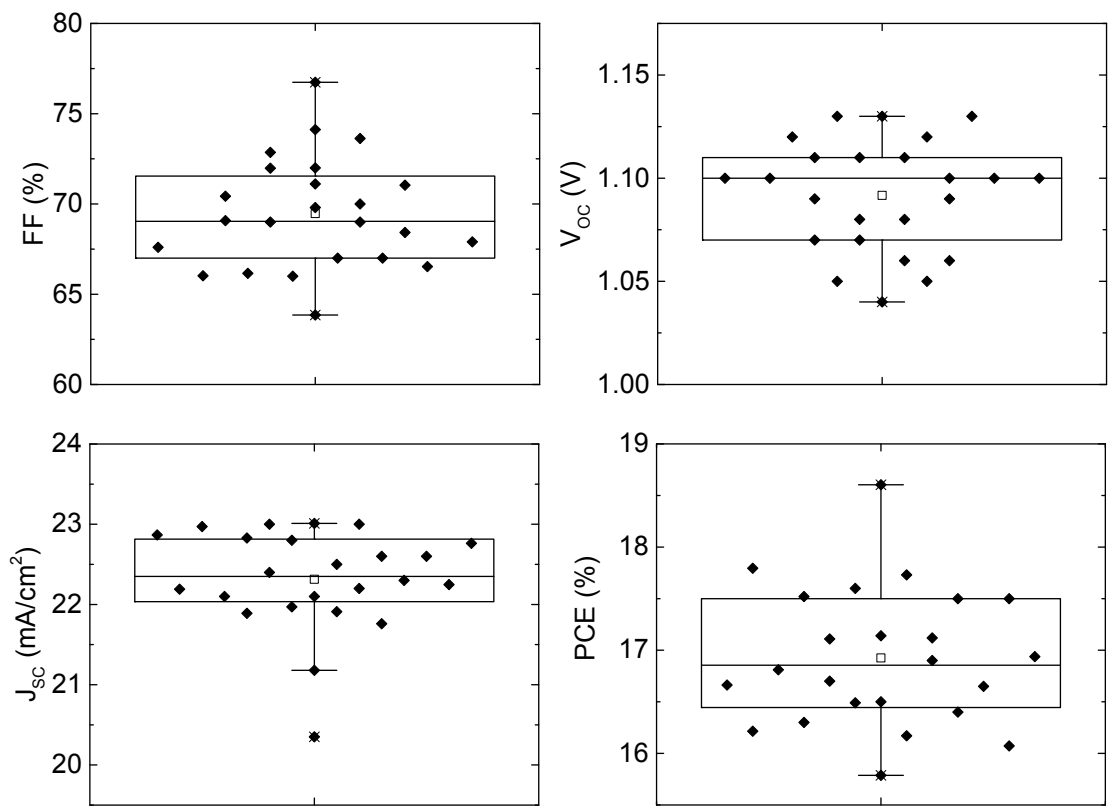


Figure S4. Statistical result of the device parameters under AM1.5G.

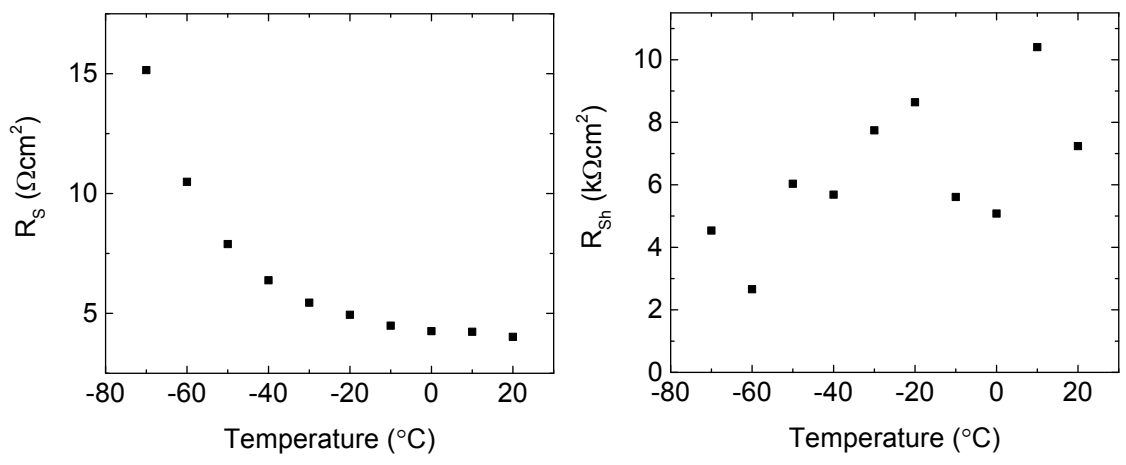


Figure S5. Series resistance (R_s) and shunt resistance (R_{sh}) at different temperatures extracted from the inverses of the slopes at V_{oc} and J_{sc} , respectively.

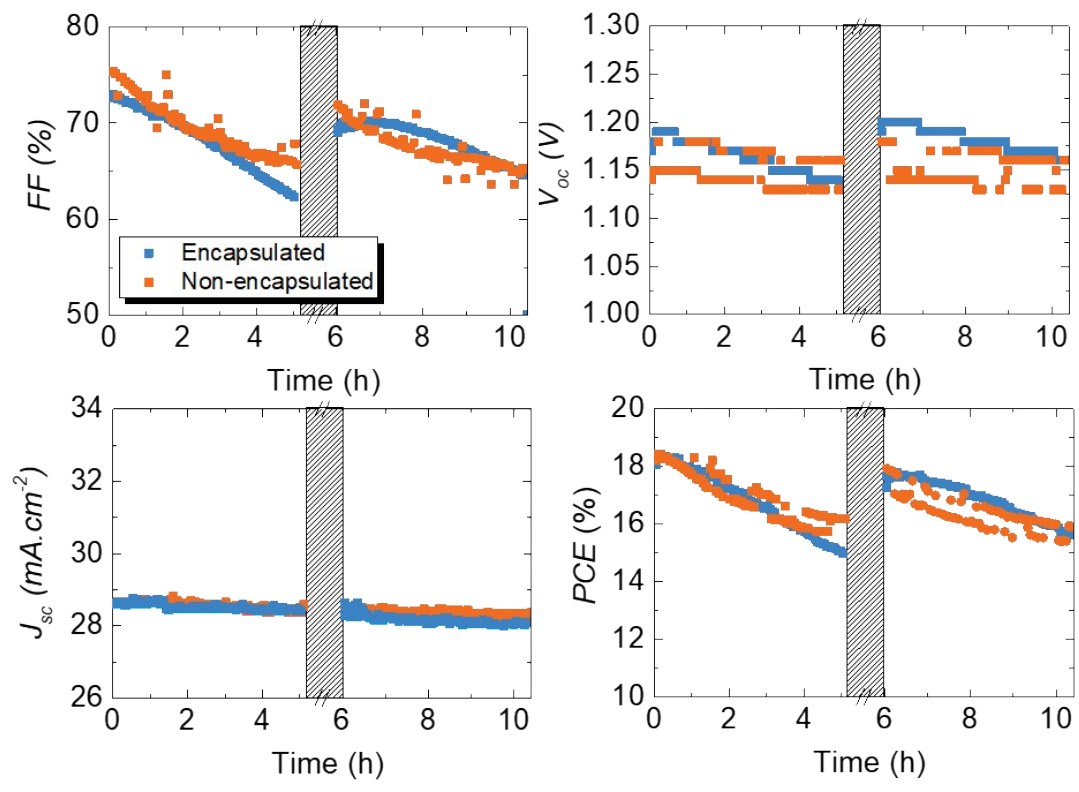


Figure S6. Variations in PV parameters of encapsulated and non-encapsulated devices measured at 10 mbar and 25°C under AM1.5G illumination.