Electronic Supplementary Information

Solvent-extraction Crystal Growth for Highly Efficient Carbon-based Mesoscopic Perovskite Solar Cells free of Hole Conductors

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Table S1. Photovoltaic parameters of carbon-based perovskite solar cells with the perovskite layer synthesized using solvent-extraction for crystal growth (SECG) with varied substrate temperatures under simulated AM-1.5G illumination (power density 100 mW cm^{-2}) with active area 0.4 cm^2 covered with a metal mask 0.09 cm^2.

Substrate Temperature /°C	J_{SC} /mA cm^{-2}	V_{OC} /mV	*FF*	η /%
25	0.23	483	0.488	0.1
50	8.39	779	0.570	3.7
60	10.99	770	0.635	5.4
70	13.42	799	0.722	7.7
80	8.20	787	0.727	4.7

Table S2. Photovoltaic parameters of carbon-based perovskite solar cells with the perovskite layer synthesized using solvent extraction for crystal growth (SECG) with varied volume of perovskite precursor under simulated AM-1.5G illumination (power density 100 mW cm^{-2}) with active area 0.4 cm^2 covered with a metal mask 0.09 cm^2.

Drop Volume /μL	J_{SC} /mA cm^{-2}	V_{OC} /mV	*FF*	η /%
1.5	2.44	641	0.666	1.0
3	14.66	855	0.734	9.2
4	20.04	846	0.723	12.3
5	14.37	841	0.618	7.5
6	0.13	522	0.666	0.0

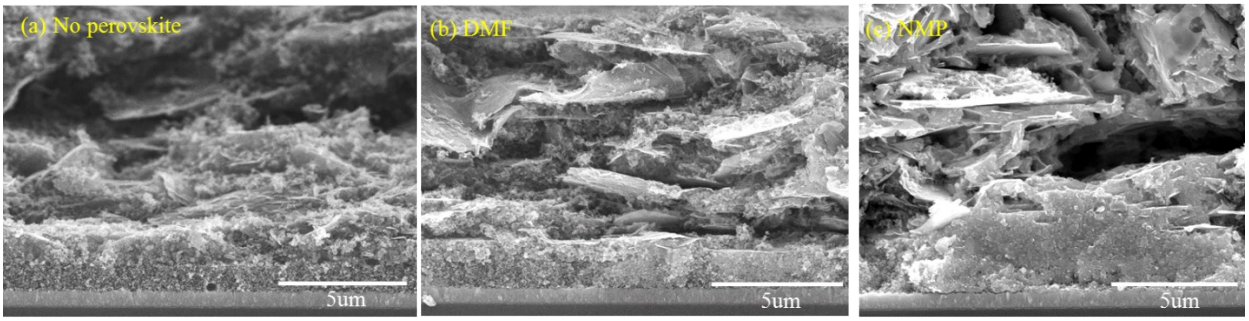

Figure S1. Side-view SEM images of mesoporous films (a) without added perovskite, (b) with perovskite using one-step annealing (solvent DMF) and (c) with perovskite using one-step annealing (solvent NMP).

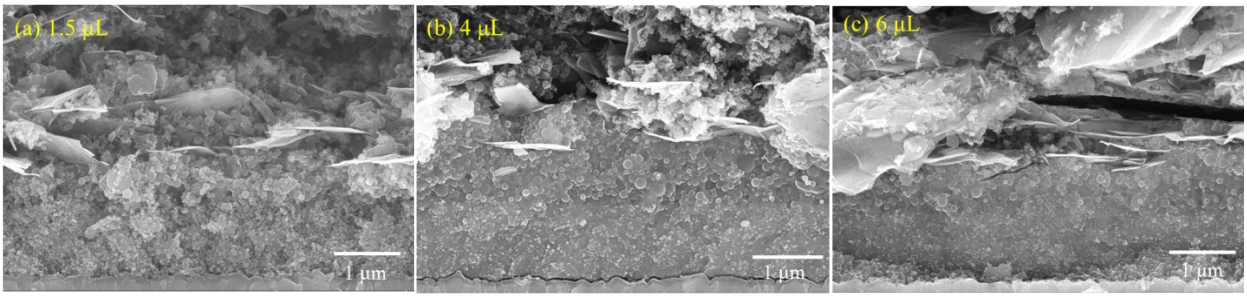

Figure S2. Side-view SEM images of SECG devices fabricated with varied volume of perovskite precursor solution: (a) 1.5 µL, (b) 4 µL and (c) 6 µL.

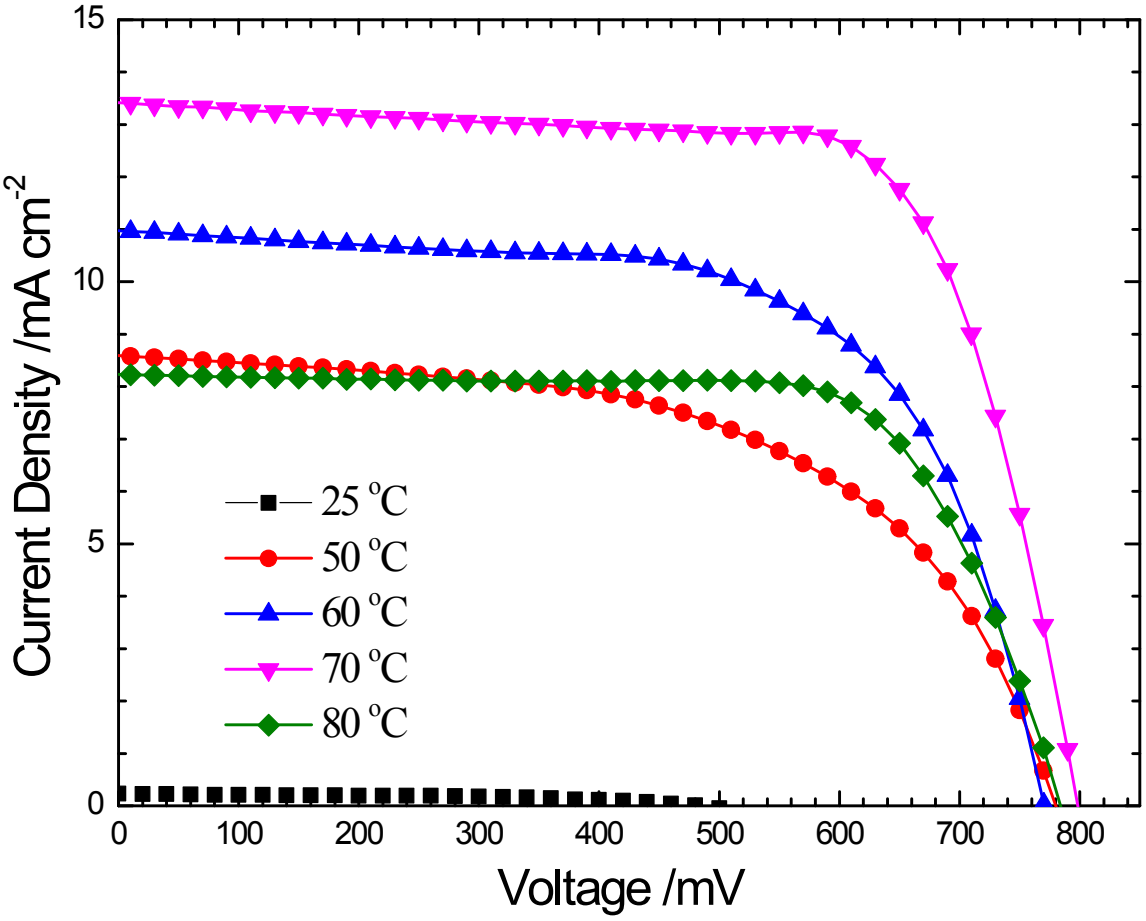

Figure S3. Current-voltage characteristic plots for SECG devices fabricated at varied temperature for pre-heating and infiltration as indicated.

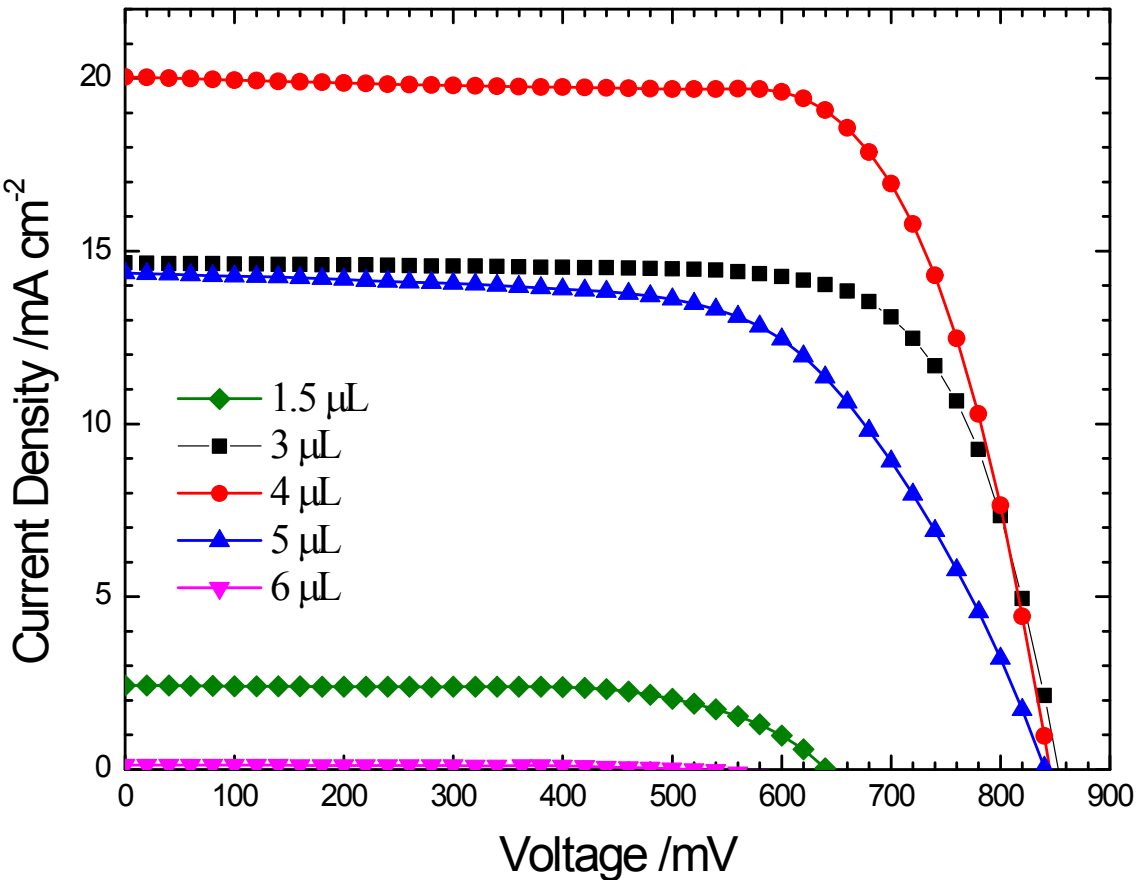

Figure S4. Current-voltage characteristic plots for SECG devices fabricated with varied volumes of perovskite precursor solution as indicated. The devices featured with an active area 0.4 cm^2.