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Supporting Information

Inorganic Stable Sn-based Perovskite Film with Regulated Nucleation for Solar Cell Application

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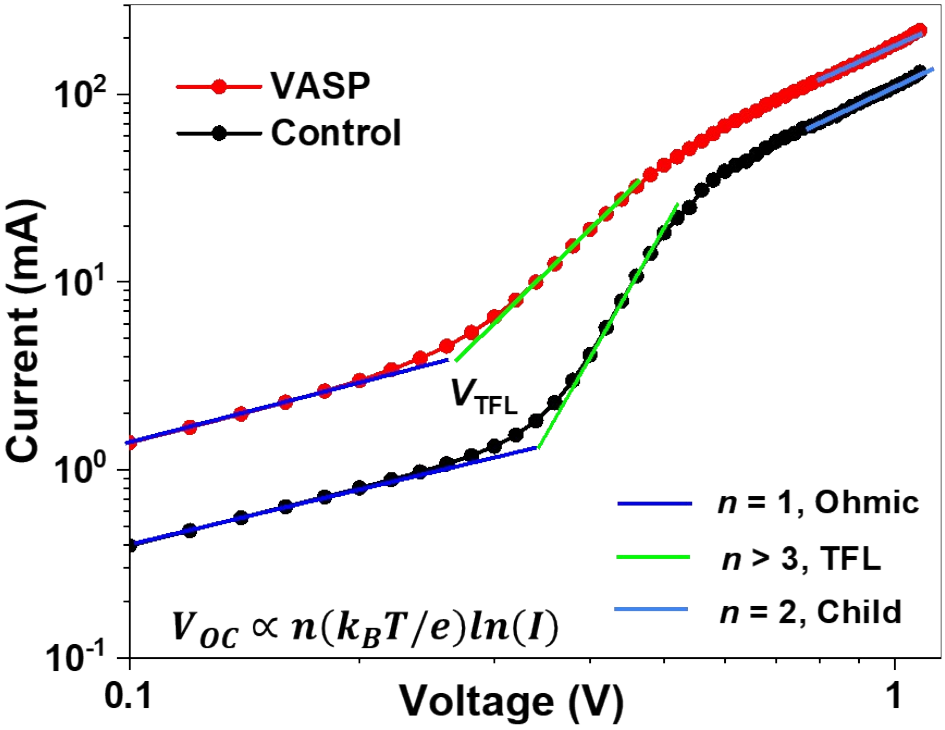

Fig. S1 Current-Voltage curves of hole-only device with perovskite layer fabrciated by VASP method and conventional spin-coating method. Note: n = 1 is the ohmic region (blue curve), n > 3 is the trap-filled limited region (green curve), and n = 2 is the SCLC region. Note:

1) hole trap density in Control film

$$n_t = \frac{2\varepsilon\varepsilon_0 V_{TFL}}{ed^2} = \frac{2 \times 48.2 \times 8.85 \times 10^{-12} \times 10^{-2} \times 0.35}{1.6 \times 10^{-19} \times (1.5 \times 10^{-5})^2} = 8.3 \times 10^{16}\ cm^{-3}$$

hole trap density in VASP film

$$n_t = \frac{2\varepsilon\varepsilon_0 V_{TFL}}{ed^2} = \frac{2 \times 48.2 \times 8.85 \times 10^{-12} \times 10^{-2} \times 0.259}{1.6 \times 10^{-19} \times (1.5 \times 10^{-5})^2} = 6.2 \times 10^{16}\ cm^{-3}$$

2) hole mobility of control film

$$\mu = \frac{J * 8d^3}{9\varepsilon\varepsilon_0 V^2} = \frac{8 \times 0.7 \times 0.7 \times 0.7 \times 10^{-12} \times 10^{-3} \times 0.11}{9 \times 3 \times 8.85 \times 10^{-14} \times 1 \times 0.1 \times 0.1} = 0.8\ cm^{-2}V^{-1}s^{-1}$$

hole mobility of VASP film

$$\mu = \frac{J * 8d^3}{9\varepsilon\varepsilon_0 V^2} = \frac{8 \times 0.7 \times 0.7 \times 0.7 \times 10^{-12} \times 10^{-3} \times 0.19}{9 \times 3 \times 8.85 \times 10^{-14} \times 1 \times 0.1 \times 0.1} = 1.3\ cm^{-2} V^{-1} s^{-1}$$

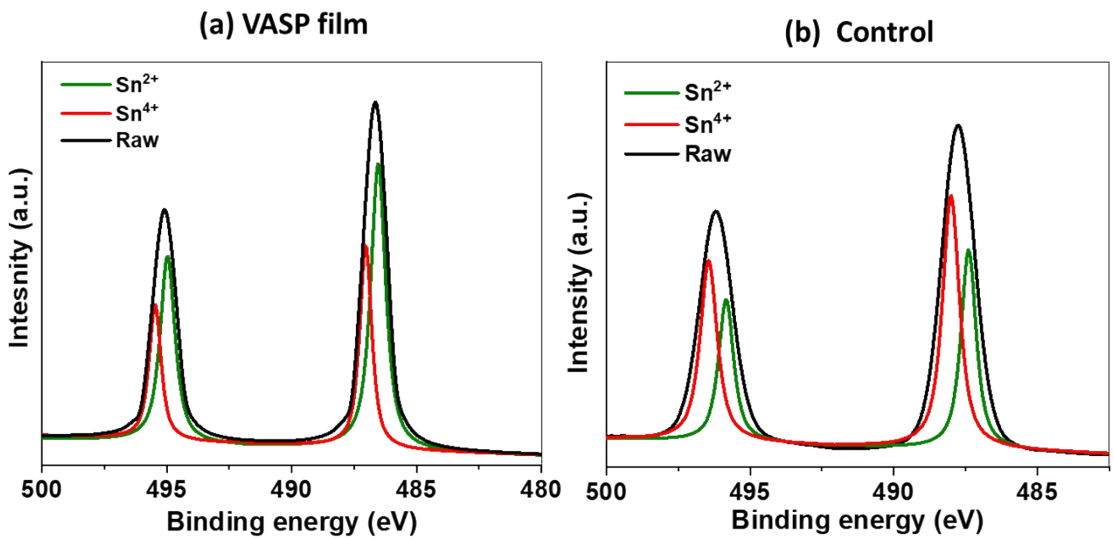

Fig. S2 XPS of fresh samples: (a) CsSnI3 fabricated with VASP method and (b) control. Note: the XPS can be deconvoluted into two components corresponding to Sn^{2+} (oliver) and Sn^{4+} (red) species; The two fitting peaks at 495.0 and 486.5 eV were assigned to 3d3/2 and 3d5/3 for Sn^{2+}, respectively; whereas the fitting peaks at 495.9 and 487.5 eV were ascribed to 3d3/2 and 3d5/3 of Sn^{4+}, respectively.

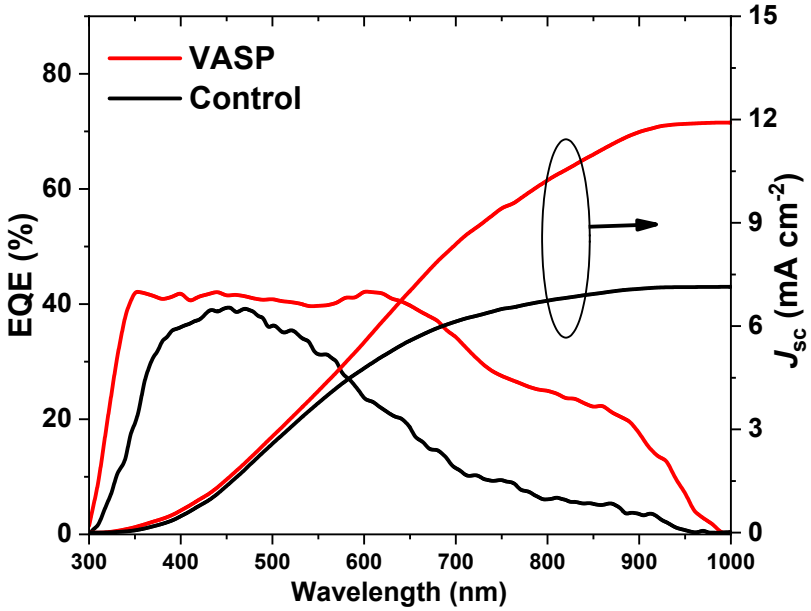

Fig. S3. External quantum efficiency of fresh VASP and control PSCs.

Table S1. Key photovoltaic parameters of $CsSnI_3$-based PSCs measured under AM 1.5 G illumination at 100 mW cm^{-2}.

PSCs	PCE (%)	J_{sc} (mA/cm$^{2)}$	FF (%)	V_{oc} (mV)
Control	F 1.1	F 7.9	F 38.0	F 367
	R 1.1	R 8.0	R 36.9	R 370
VASP	F 2.0	F 12.80	F 38.6	F 406
	R 2.0	R 12.70	R 38.5	R 407

Note: F: forward scan; R: reverse scan; scan speed: 20 mV s^{-1}.