Electronic Supplementary Material (ESI) for CrystEngComm.

Supporting information

Effective control of crystal grain size in $CH_3NH_3PbI_3$ perovskite solar cells with a pseudohalide $Pb(SCN)_2$ additive

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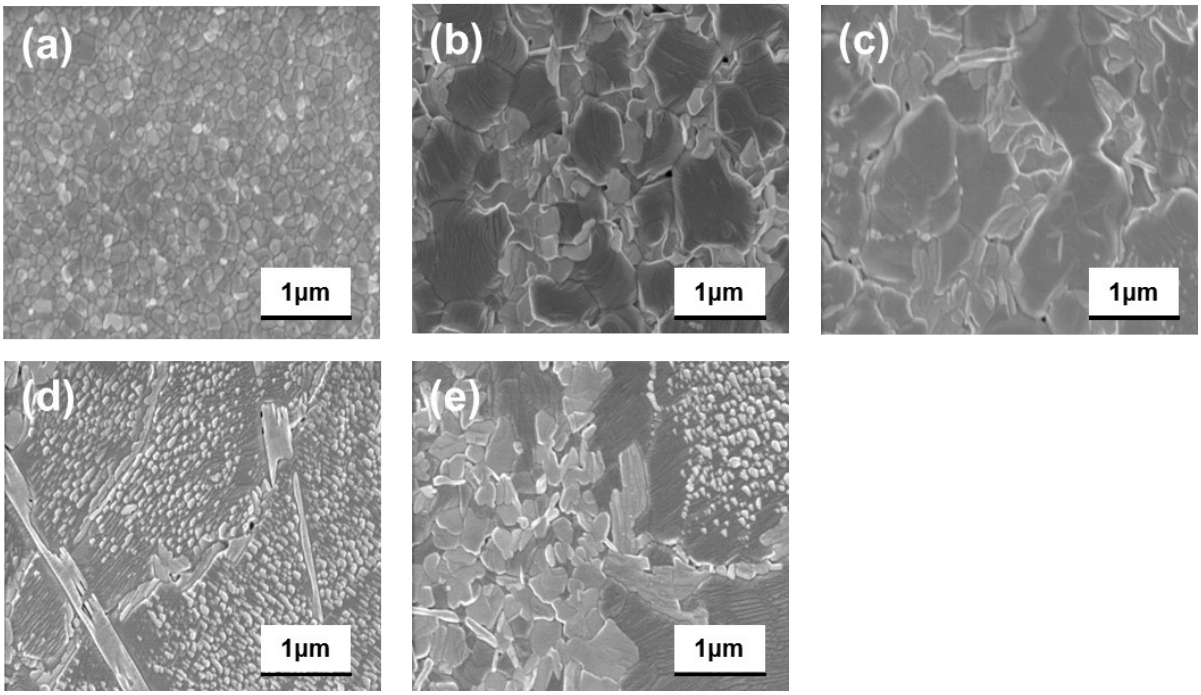

Figure S1. (a)-(e) Magnified plane view SEM images of perovskite films with different amounts of the $Pb(SCN)_2$ additive ((a) 0 mol, (b) 0.1 mol, (c) 0.12 mol, (d) 0.15 mol and (e) 0.18 mol).

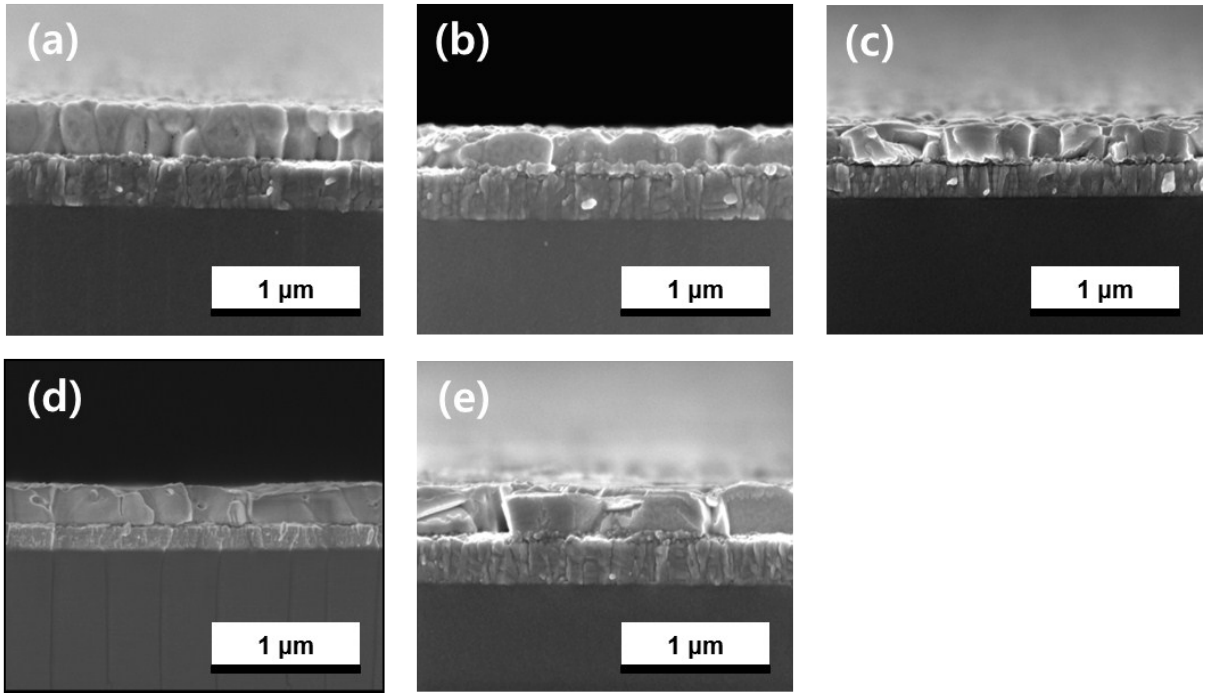

Figure S2. (a)-(e) Cross sectional SEM images of perovskite films with different amounts of the $Pb(SCN)_2$ additive ((a) 0 mol, (b) 0.1 mol, (c) 0.12 mol, (d) 0.15 mol and (e) 0.18 mol).

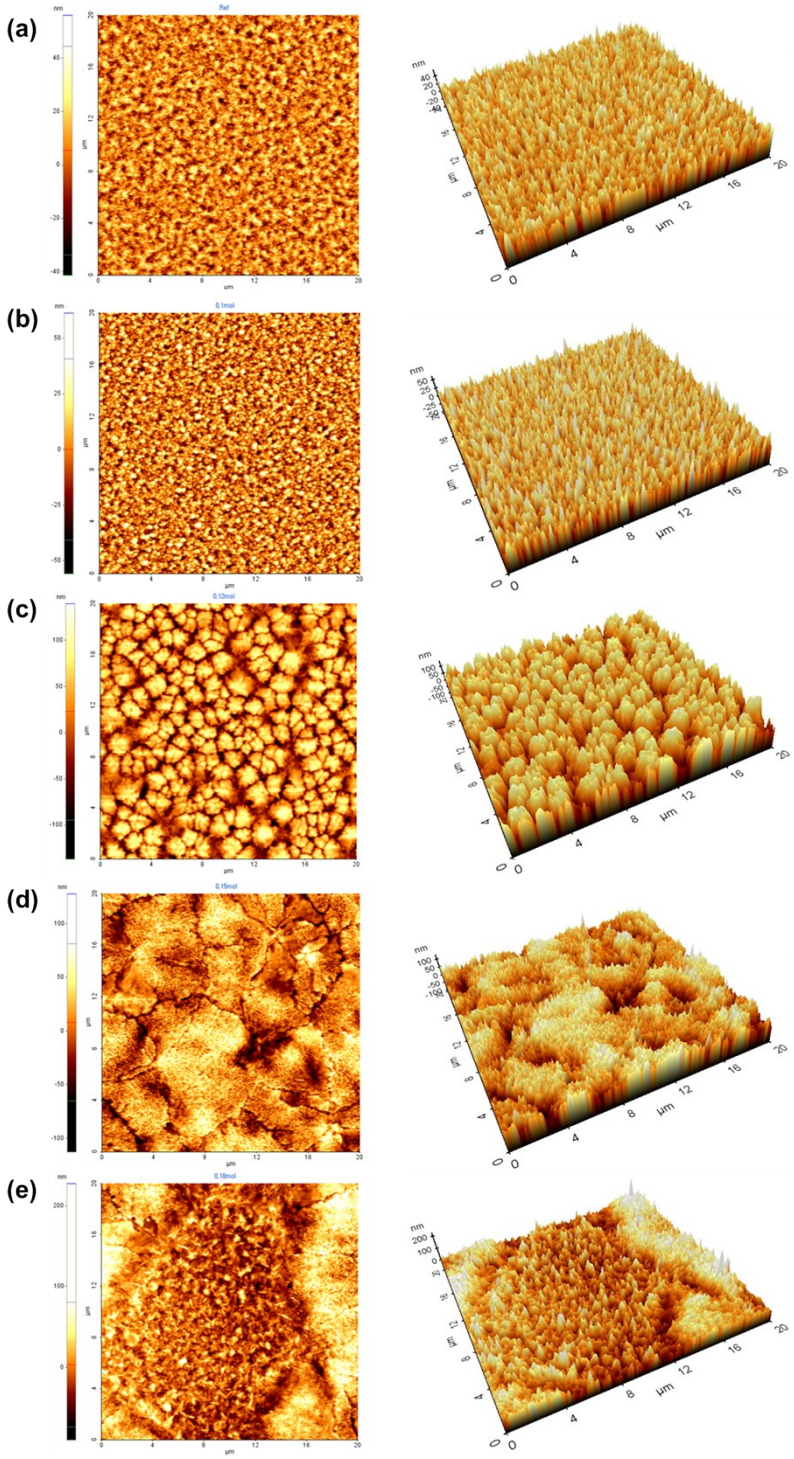

Figure S3. (a)-(e) AFM 2D topography and 3D images of perovskite films with different amounts of the $Pb(SCN)_2$ additive ((a) 0 mol, (b) 0.1 mol, (c) 0.12 mol, (d) 0.15 mol and (e) 0.18 mol).

$Pb(SCN)_2$	**RMS roughness (nm)**
0 mol	11.283
0.1 mol	14.405
0.12 mol	45.221
0.15 mol	25.770
0.18 mol	29.644

Table S1. Root mean square (RMS) roughness of perovskite films with different amounts of the $Pb(SCN)_2$ additive.

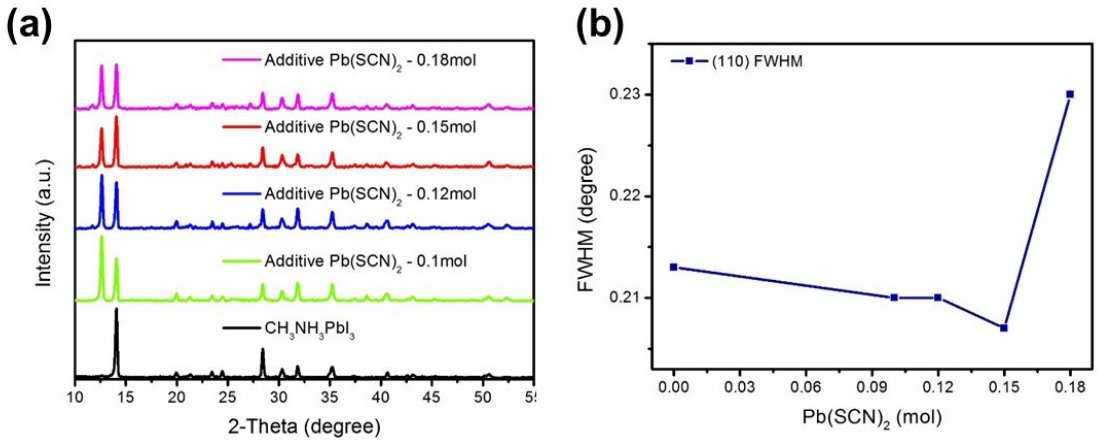

Figure S4. (a) XRD patterns of perovskite films with different amounts of the $Pb(SCN)_2$ additive. (b) FWHM of perovskite (110) plane peak vs. amount of the $Pb(SCN)_2$ additive.

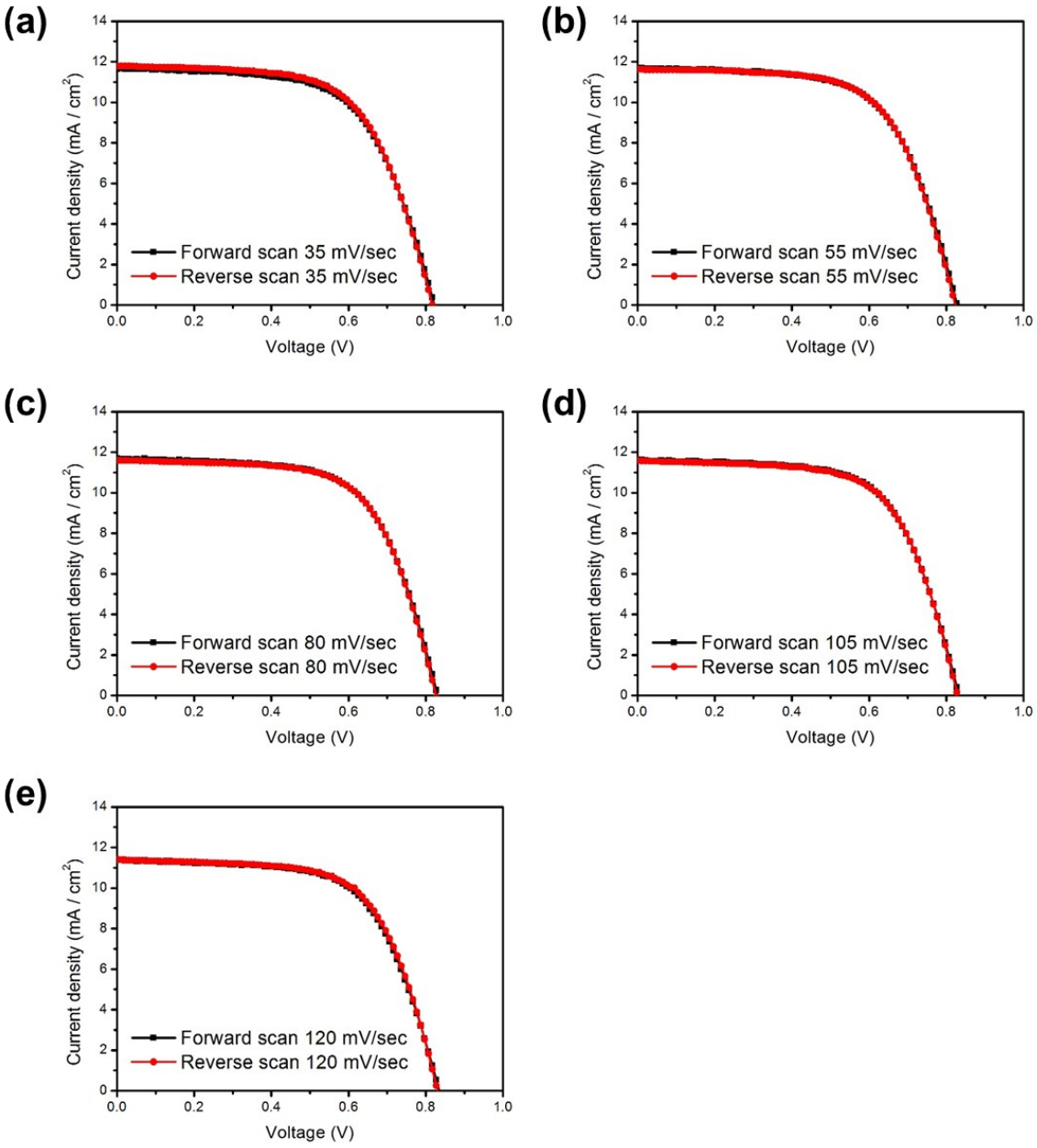

Figure S5. (a)-(e) Current density-voltage curves under forward and reverse scans of perovskite solar cells with 0 mol $Pb(SCN)_2$ (scan rate: (a) 35 mV/sec, (b) 55 mV/sec, (c) 80 mV/sec, (d) 105 mV/sec and (e) 120 mV/sec).

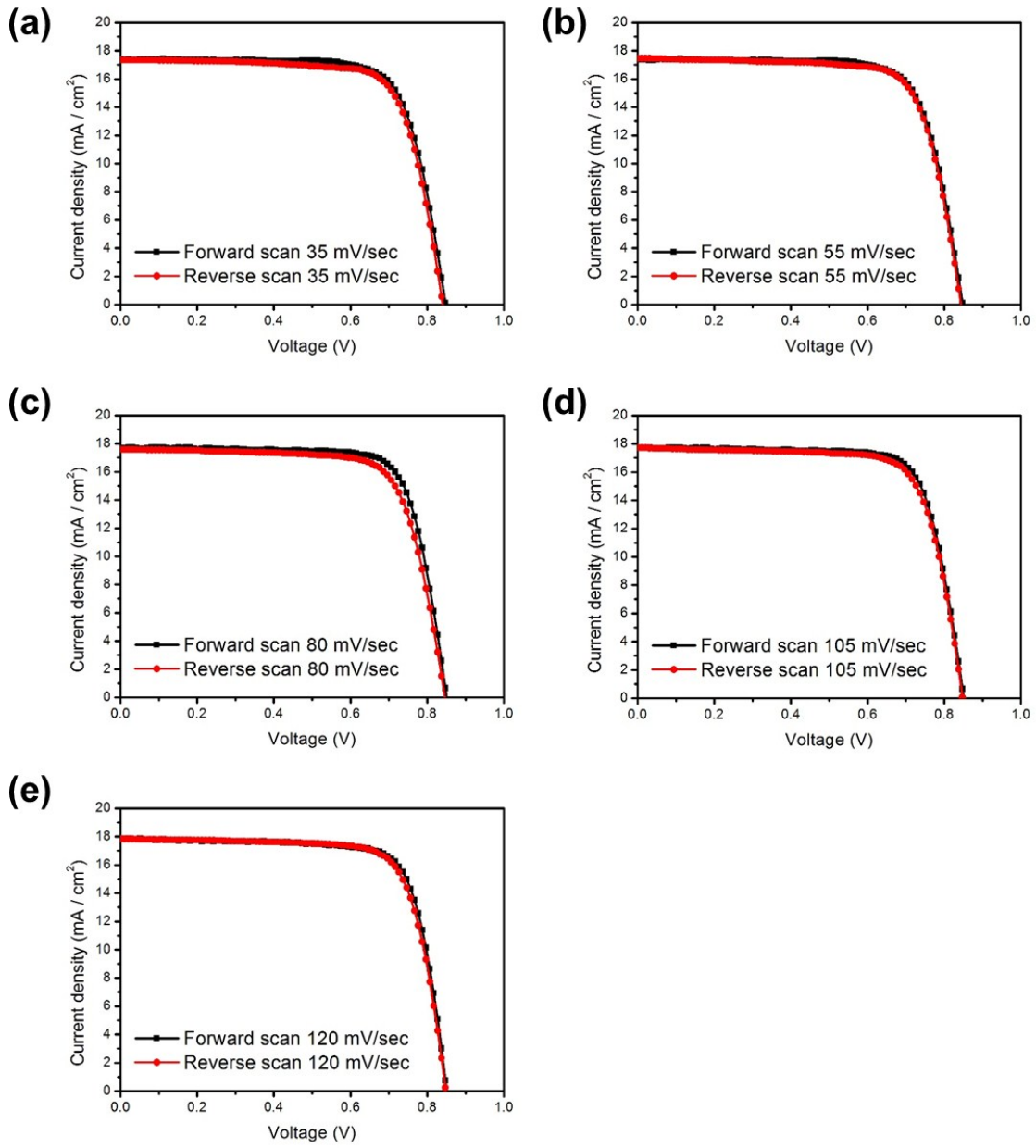

Figure S6. (a)-(e) Current density-voltage curves under forward and reverse scans of perovskite solar cells with 0.15 mol $Pb(SCN)_2$ (scan rate: (a) 35 mV/sec, (b) 55 mV/sec, (c) 80 mV/sec, (d) 105 mV/sec and (e) 120 mV/sec).

(a)

Scan rate / Bias direction	V_{oc} (V)	J_{sc} (mA/cm^2)	FF (%)	PCE (%)
35 mV/sec / Forward	0.83	11.37	63.68	6.04
35 mV/sec / Reverse	0.83	11.44	64.34	6.11
55 mV/sec / Forward	0.83	11.60	64.34	6.21
55 mV/sec / Reverse	0.83	11.61	64.41	6.20
80 mV/sec / Forward	0.83	11.66	64.00	6.19
80 mV/sec / Reverse	0.83	11.62	64.55	6.19
105 mV/sec / Forward	0.83	11.68	63.08	6.10
105 mV/sec / Reverse	0.83	11.80	63.08	6.11
120 mV/sec / Forward	0.82	11.65	62.20	5.96
120 mV/sec / Reverse	0.82	11.80	62.60	6.03

(b)

Scan rate / Bias direction	V_{oc} (V)	J_{sc} (mA/cm^2)	FF (%)	PCE (%)
35 mV/sec / Forward	0.85	17.85	76.51	11.61
35 mV/sec / Reverse	0.85	17.88	75.45	11.44
55 mV/sec / Forward	0.85	17.68	76.68	11.53
55 mV/sec / Reverse	0.85	17.75	74.74	11.24
80 mV/sec / Forward	0.85	17.58	75.10	11.21
80 mV/sec / Reverse	0.85	17.60	73.93	11.01
105 mV/sec / Forward	0.85	17.41	75.00	11.07
105 mV/sec / Reverse	0.84	17.46	74.55	10.97
120 mV/sec / Forward	0.85	17.26	74.75	10.92
120 mV/sec / Reverse	0.84	17.34	74.51	10.85

Table S2. (a) Hysteresis of perovskite solar cells with 0 mol $Pb(SCN)_2$. (b) Hysteresis of perovskite solar cells with 0.15 mol $Pb(SCN)_2$.