Electronic Supplementary Information

Solution-processed MoS_x thin-films as hole-transport layers for efficient polymer solar cells

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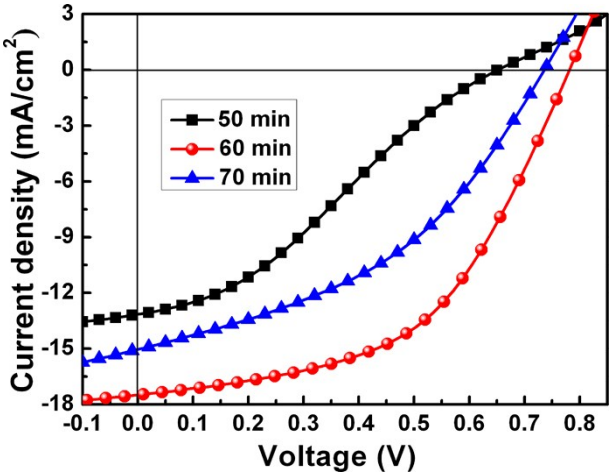

Figure S1 *J-V* characteristics of PSCs with MoS_x obtained after different annealing times.

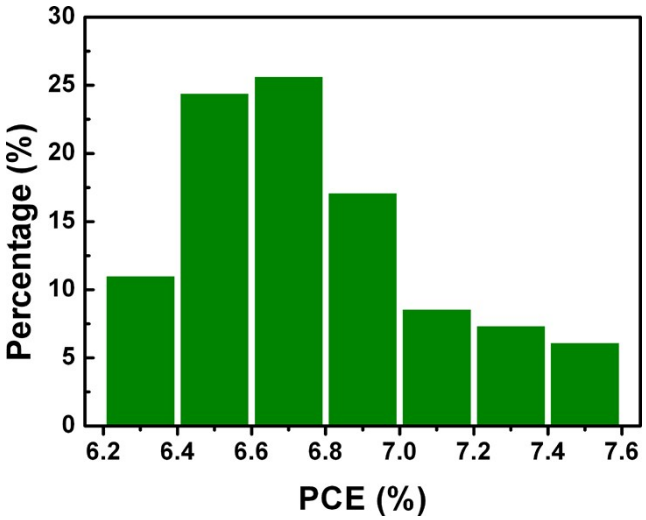

Figure S2 The PCE distribution of devices with MoS_x obtained at 300 °C.

Table S1 Device performance of PSCs with MoS_x obtained after different annealing times.

Annealing time (min)	V_{oc} (V)	J_{sc} (mA cm^{-2})	FF (%)	PCE (%) Best (average)[a]
50	0.65	13.15	30.73	2.63 (2.39)
60	0.77	18.16	53.56	7.50 (7.36)
70	0.74	15.04	41.69	4.61 (3.90)

[a]The average PCEs were based on eight devices.

Table S2 Summary of XPS analysis of valence states, peak positions and relative contents of different MoS_x films calculated from Mo 3d scan.

Temp (˚C)	Mo^{4+}			Mo^{5+}		
	Peak position		Relative content (%)	Peak position		Relative content (%)
	3d 5/2 (eV)	3d 3/2 (eV)		3d 5/2 (eV)	3d 3/2 (eV)	
200	229.03	232.23	31.28	231.18	234.38	68.72
250	229.76	232.96	30.11	231.67	234.87	69.89
300	229.53	232.73	32.51	231.24	234.44	67.49

Table S3 Device performance of PSCs with different MoS_x film thicknesses.

Spin-coating speed (rpm)	V_{oc} (V)	J_{sc} (mA cm^{-2})	FF (%)	PCE (%) Best (average)[a]
600	0.79	15.10	46.97	5.58 (5.33)
800	0.78	15.58	47.37	5.76 (5.38)
1000	0.79	15.72	47.96	5.93 (5.67)
1200	0.77	18.16	53.56	7.50 (7.36)
1400	0.73	15.59	43.45	4.95 (4.62)

[a]The average PCEs were based on eight devices.

Table S4 Device performance with different active layer thicknesses.

Spin-coating speed (rpm)	V_{oc} (V)	J_{sc} (mA cm^{-2})	FF (%)	PCE (%) Best (average)[a]
1000	0.69	16.56	47.13	5.37 (5.03)
1200	0.77	18.16	53.56	7.50 (7.36)
1400	0.75	16.24	52.57	6.42 (5.59)
1600	0.70	16.89	44.92	5.34 (5.04)

[a]The average PCEs were based on eight devices.