Electronic Supplementary Information

Effect of Alkyl Chain Length of Ammonium in SEPC-CIL on Performance of Polymer Solar Cells†

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†SEPC-CIL: Surfactant-Encapsulated Polyoxometalate Complex as Cathode InterLayer.

1. Effect of TOA-SiW_{12} thickness on the device performance of ITO/PEDOT:PSS/PTB7:$PC_{71}BM$/TOA-SiW_{12}/Al.

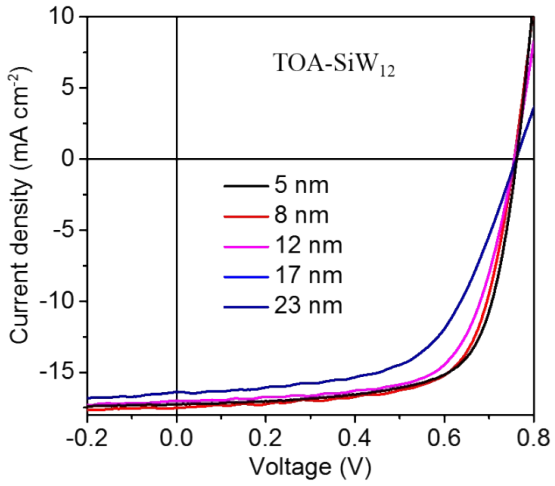

Figure S1. *J–V* characteristics of PTB7:$PC_{71}BM$ based PSCs with 5 nm, 8 nm, 12 nm, 17 nm or 23 nm TOA-SiW_{12} as a cathode interlayer under AM 1.5 G illumination at 100 mW cm^{-2}.

Table S1. Photovoltaic parameters of PTB7:$PC_{71}BM$ based PSCs with different thickness TOA-SiW_{12} as a cathode interlayer.

TOA-SiW_{12} concentration (mg/mL)	TOA-SiW_{12} thickness (nm)	V_{OC} (V)	J_{SC} (mA cm^{-2})	FF (%)	PCE (%)
0.25	5	0.760	17.13	69.4	9.04
0.50	8	0.755	17.50	69.3	9.15
1.0	12	0.760	17.06	70.2	9.09
1.5	17	0.755	17.04	67.6	8.70
2.0	23	0.760	16.60	59.0	7.44

2. Effect of TEA-SiW_{12} thickness on the device performance of ITO/PEDOT:PSS/PTB7:$PC_{71}BM$/TEA-SiW_{12}/Al.

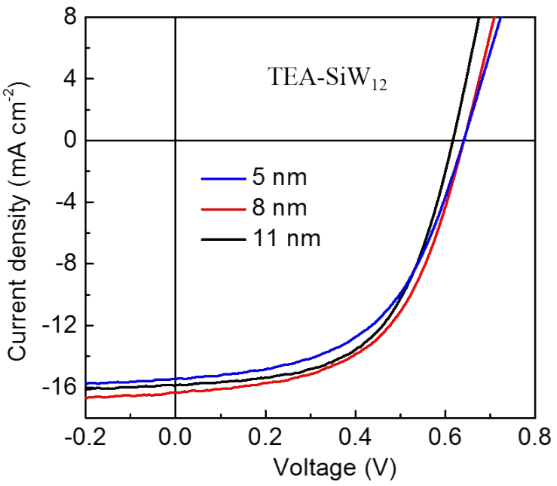

Figure S2. *J–V* characteristics of PTB7:$PC_{71}BM$ based PSCs with 5 nm, 8 nm or 11 nm TEA-SiW_{12} as a cathode interlayer under AM 1.5 G illumination at 100 mW cm^{-2}.

Table S2. Photovoltaic parameters of PTB7:$PC_{71}BM$ based PSCs with different thickness TEA-SiW_{12} as a cathode interlayer.

TEA-SiW_{12} concentration (mg/mL)	TEA-SiW_{12} thickness (nm)	V_{OC} (V)	J_{SC} (mA cm^{-2})	FF (%)	PCE (%)
0.33	5	0.640	15.48	52.9	5.24
0.5	8	0.640	16.35	55.2	5.78
1.0	11	0.615	15.89	57.0	5.57

3. Effect of TBA-SiW_{12} thickness on the device performance of ITO/PEDOT:PSS/PTB7:$PC_{71}BM$/TBA-SiW_{12}/Al.

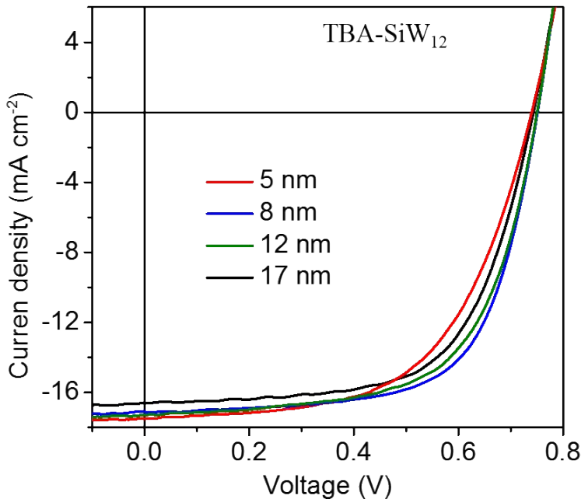

Figure S3. *J–V* characteristics of PTB7:$PC_{71}BM$ based PSCs with 5 nm, 8 nm 12 nm or 17 nm TBA-SiW_{12} as a cathode interlayer under AM 1.5 G illumination at 100

mW cm^{-2}.

Table S3. Photovoltaic parameters of PTB7:$PC_{71}BM$ based PSCs with different thickness TBA-SiW_{12} as a cathode interlayer.

TBA-SiW_{12} concentration (mg/mL)	TBA-SiW_{12} thickness (nm)	V_{OC} (V)	J_{SC} (mA cm^{-2})	FF (%)	PCE (%)
0.25	5	0.740	17.48	58.1	7.51
0.5	8	0.750	17.16	66.2	8.50
1.0	12	0.750	17.11	63.8	8.21
1.5	17	0.745	16.60	63.2	7.82

4. Effect of TDA-SiW_{12} thickness on the device performance of ITO/PEDOT:PSS/PTB7:$PC_{71}BM$/TDA-SiW_{12}/Al.

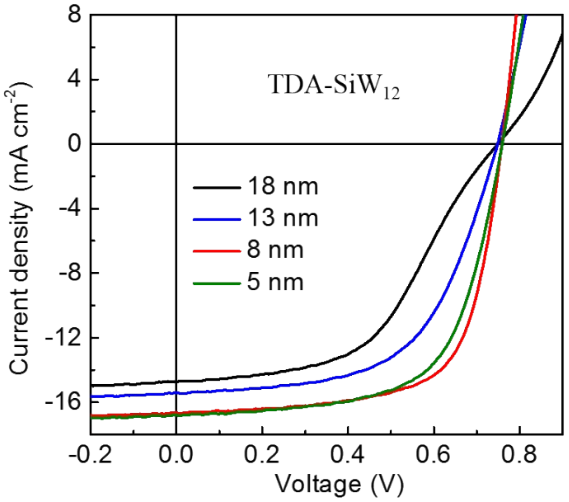

Figure S4. *J–V* characteristics of PTB7:$PC_{71}BM$ based PSCs with 5 nm, 8 nm 13 nm or 18 nm TDA-SiW_{12} as a cathode interlayer under AM 1.5 G illumination at 100 mW cm^{-2}.

Table S4. Photovoltaic parameters of PTB7:$PC_{71}BM$ based PSCs with different thickness TDA-SiW_{12} as a cathode interlayer.

TDA-SiW_{12} concentration (mg/mL)	TDA-SiW_{12} thickness (nm)	V_{OC} (V)	J_{SC} (mA cm^{-2})	FF (%)	PCE (%)
0.25	5	0.755	16.81	64.6	8.20
0.5	8	0.755	16.64	68.6	8.62
1.0	13	0.745	15.40	58.4	6.70
1.5	18	0.745	14.73	50.0	5.49

5. AFM images of TA-SiW_{12} on the PTB7:$PC_{71}BM$ film.

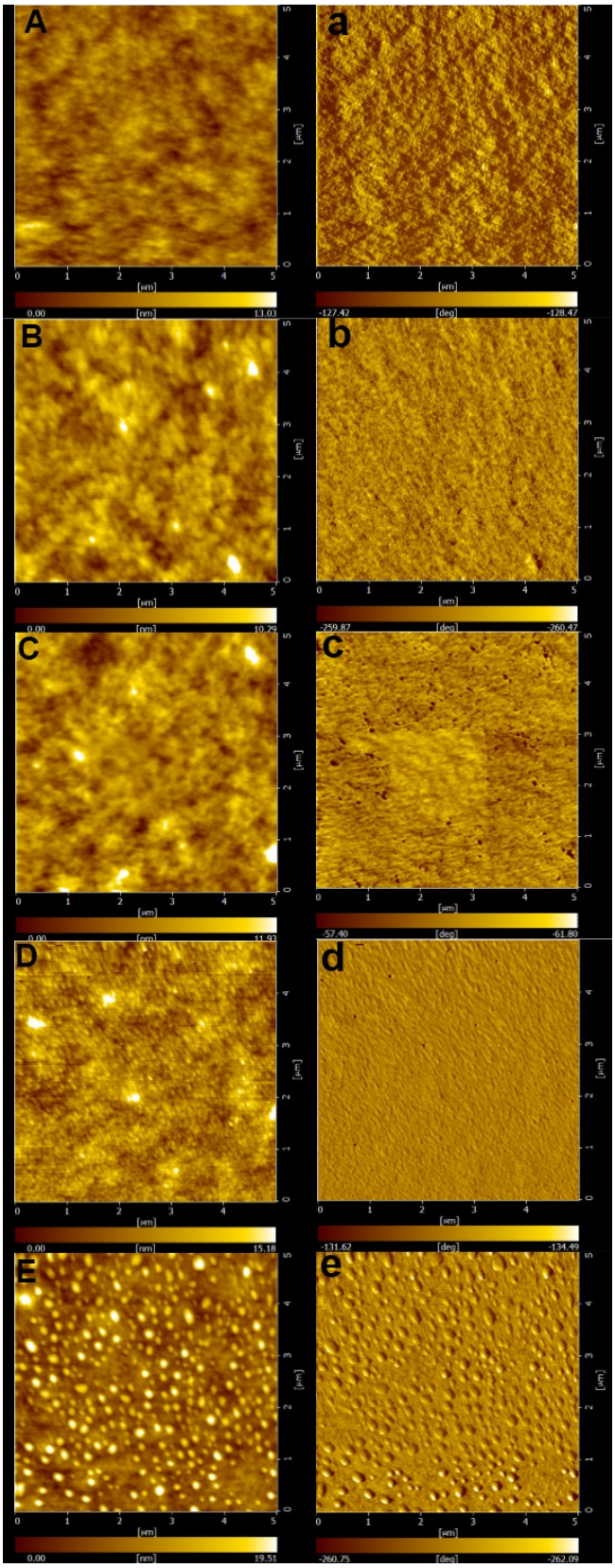

Figure S5. AFM height and phase images of bare PTB7:$PC_{71}BM$ film (A and a), 8 nm TEA-SiW_{12} (B and b), TBA-SiW_{12} (C and c), TOA-SiW_{12} (D and d) and TDA-

SiW_{12} (E and e) on PTB7:$PC_{71}BM$ in the scale of 5 μm × 5 μm.

6. AFM height image of 8 nm TDA-SiW_{12} on PTB7:$PC_{71}BM$.

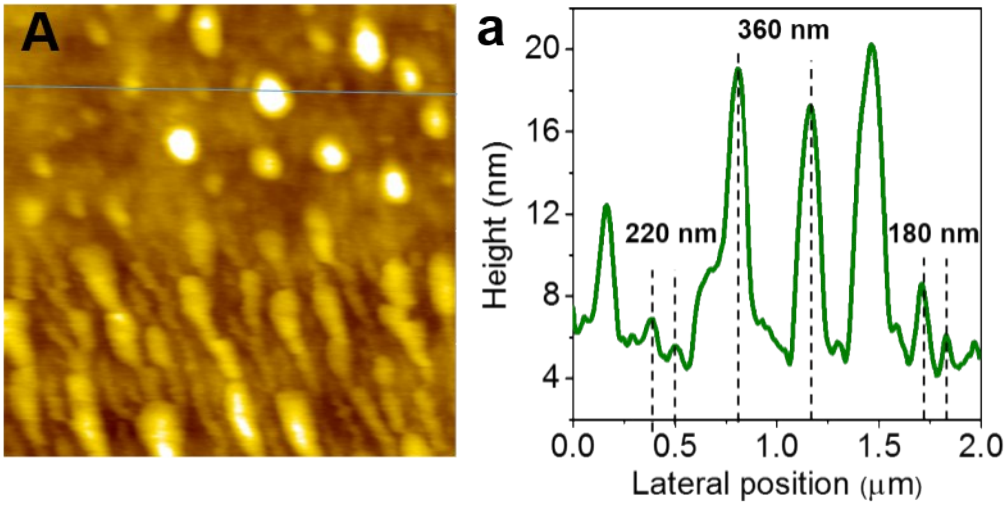

Figure S6. AFM height image of 8 nm TDA-SiW_{12} on PTB7:$PC_{71}BM$ in the scale of 2 μm × 2μm (A) and profile line (a) of (A).