

Electronic Supplementary Information (ESI) for

**Enhanced Efficiency and Air-stability of NiO_x-based Perovskite
Solar Cells *via* PCBM Electron Transport Layer Modification
with Triton X-100**

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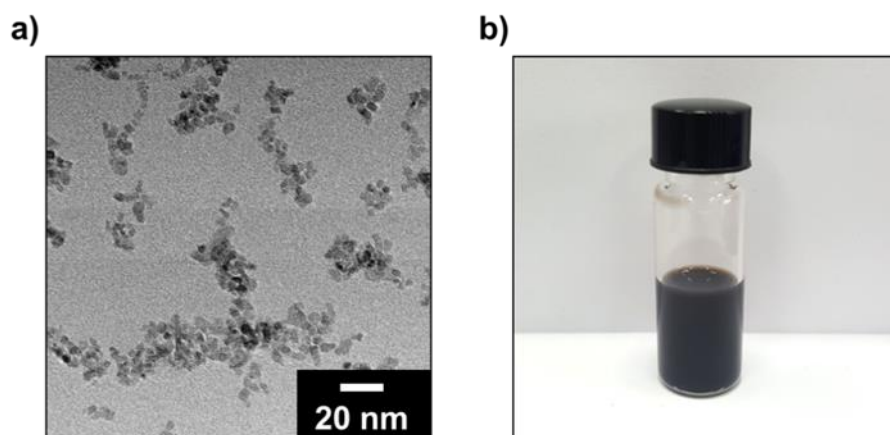


Figure S1. (a) Transmission electron microscopy image of NiO_x nanocrystals. (b) A digital photograph of NiO_x nanocrystal dispersed in deionized water.

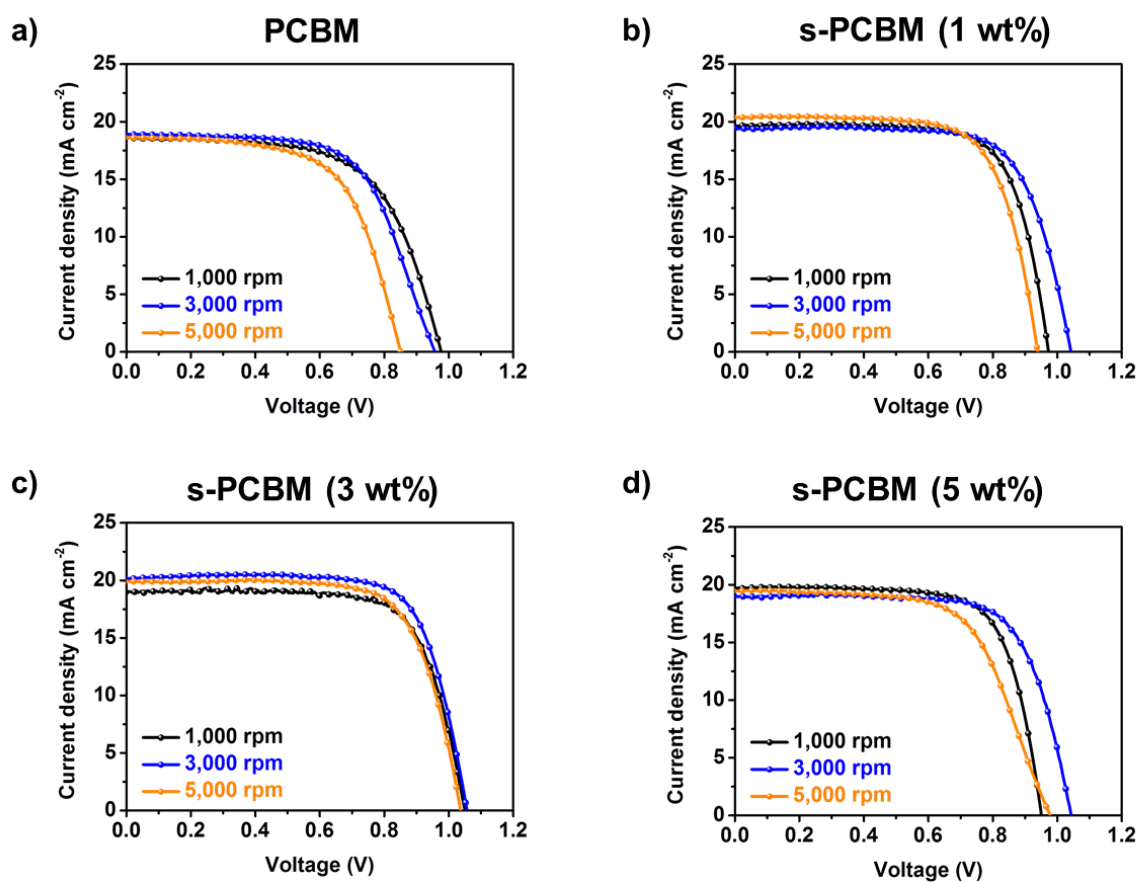


Figure S2. J - V curves of PSCs using (a) PCBM and (b-d) s-PCBM ETLs spin-coated with different spin rates: 1000, 3000, 5000 rpm.

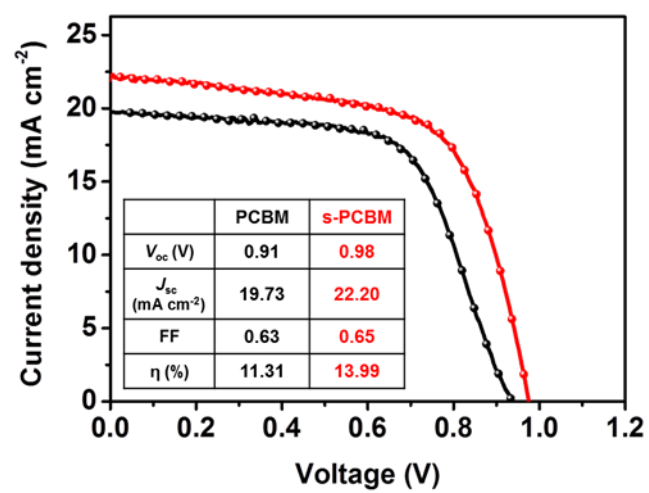


Figure S3. J - V curves of the PEDOT:PSS-based PSCs with PCBM and s-PCBM ETLs. Photovoltaic parameters are summarized in the inset table.

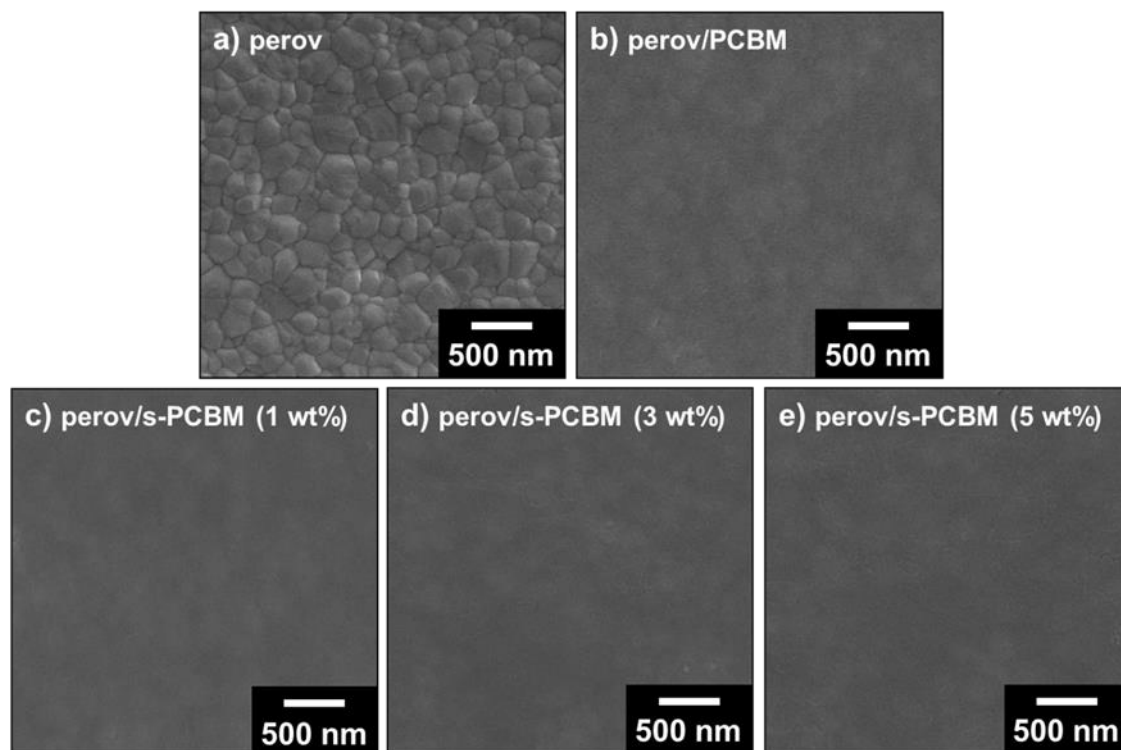


Figure S4. SEM images of (a) perovskite, (b) perovskite/PCBM, and perovskite/s-PCBM with different Triton X-100 concentrations: (c) 1, (d) 3, and (e) 5 wt%.

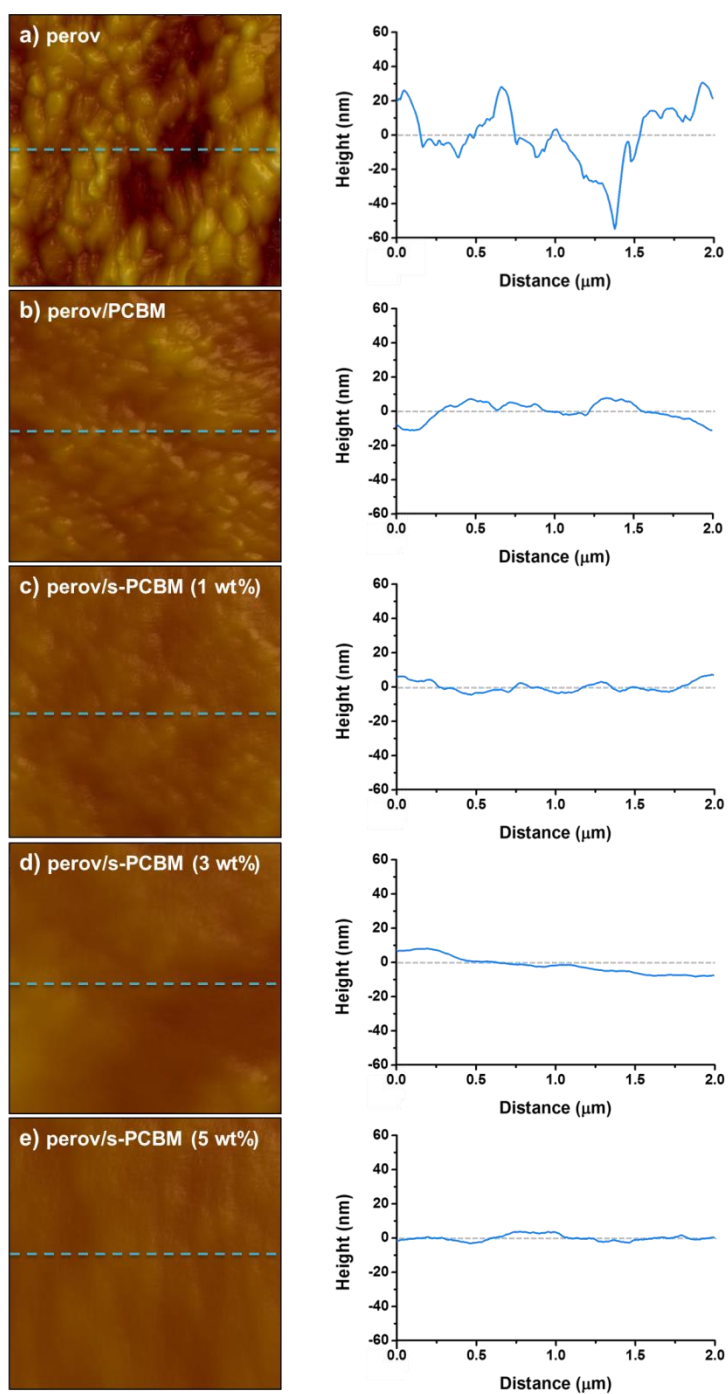


Figure S5. AFM two-dimensional topographic images ($2 \times 2 \mu\text{m}^2$ scale) and line profiles of (a) perovskite, (b) perovskite/PCBM, and perovskite/s-PCBM with different Triton X-100 concentrations: (c) 1, (d) 3, and (e) 5 wt%.

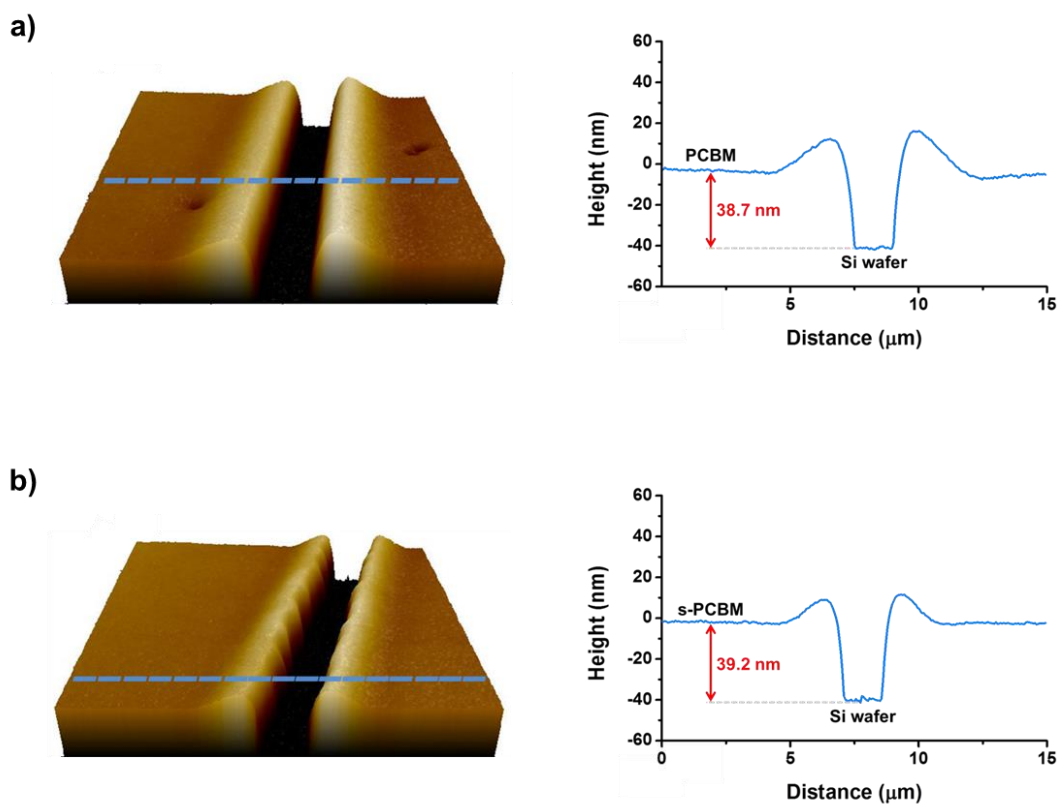


Figure S6. AFM three-dimensional topographic images ($15 \times 15 \mu\text{m}^2$ scale) and line profiles of (a) PCBM and (b) s-PCBM on Si wafer. PCBM and s-PCBM were spin-coated at 2000 and 4500 rpm, respectively.

Table S1. Photovoltaic parameters of PSCs using PCBM and s-PCBM ETLs spin-coated with different spin rates.

ETL for device	Spin rate (rpm)	V_{oc} (V)	J_{sc} (mA cm ⁻²)	FF	η (%)
PCBM	1,000	0.98	18.60	0.62	11.34
	3,000	0.96	18.89	0.64	11.51
	5,000	0.85	18.64	0.63	9.93
s-PCBM (1 wt%)	1,000	0.97	19.61	0.73	13.92
	3,000	1.04	19.42	0.71	14.10
	5,000	0.94	20.38	0.71	13.52
s-PCBM (3 wt%)	1,000	1.05	18.96	0.73	14.56
	3,000	1.06	20.16	0.74	15.78
	5,000	1.00	19.51	0.73	14.21
s-PCBM (5 wt%)	1,000	0.95	19.68	0.72	13.56
	3,000	1.04	19.01	0.71	14.13
	5,000	0.98	19.47	0.63	11.97