Supporting Information

Single-Phase Brookite TiO_2 Nanoparticle Bridge Enhances the Stability of Perovskite Solar Cells

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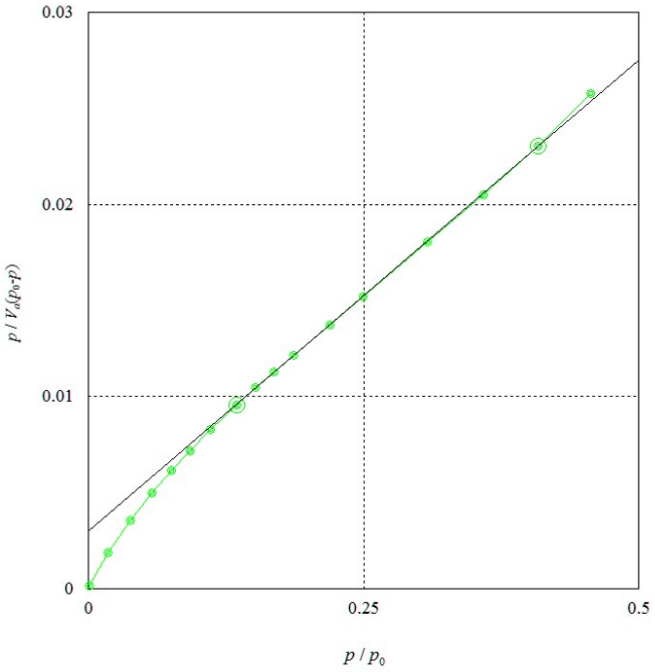

Figure S1. BET analysis of BK TiO_2 NPs.

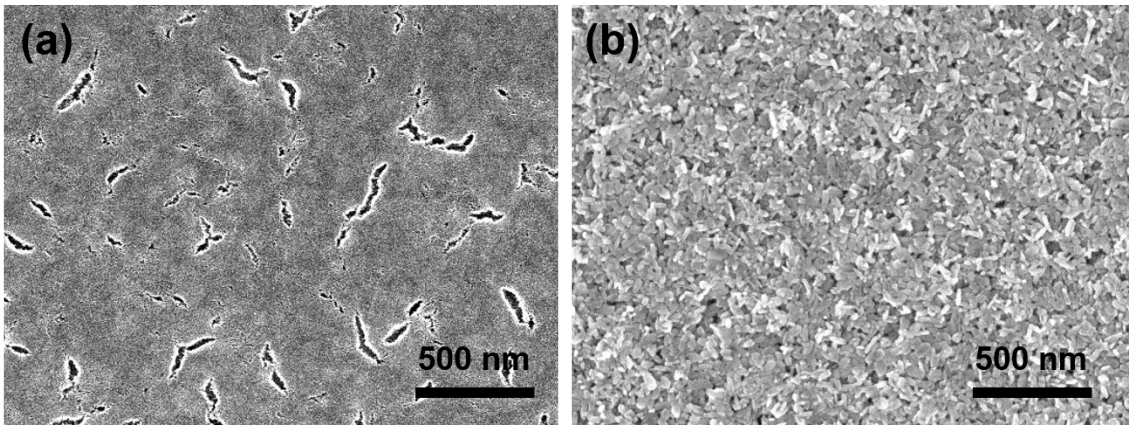

Figure S2. Top-view SEM images of (a) TiO_2 CL and (b) TiO_2/BK TiO_2 NPs.

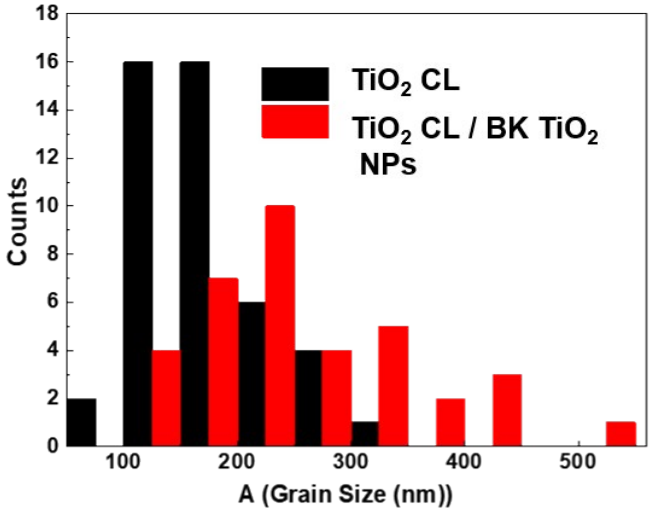

Figure S3: Domain size distribution of the perovskite without and with BK TiO_2 NPs.

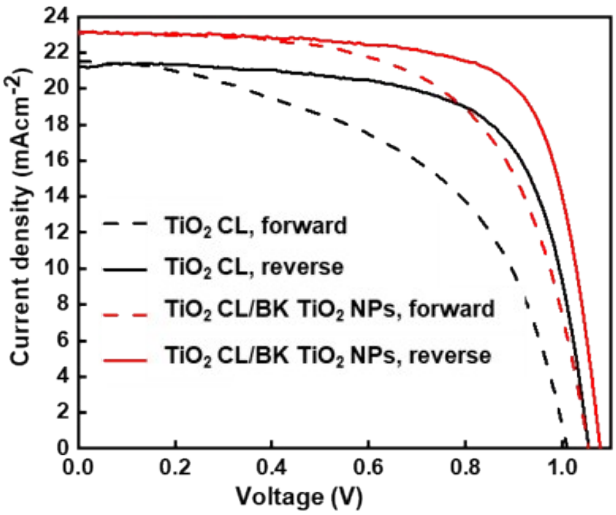

Figure S4. FS and RS *J–V* characteristics of the devices with a TiO_2 layer only and with TiO_2 CL/BK TiO_2 NPs layer.

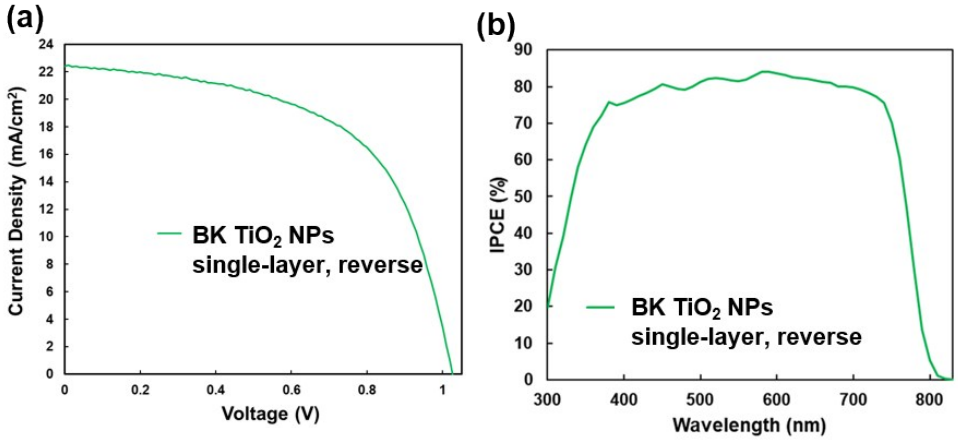

Figure S5. (a) FS and RS *J–V* characteristics of the devices with a BK TiO_2 NPs single-layer. (b) IPCE spectra of devices with a BK TiO_2 NPs single-layer.

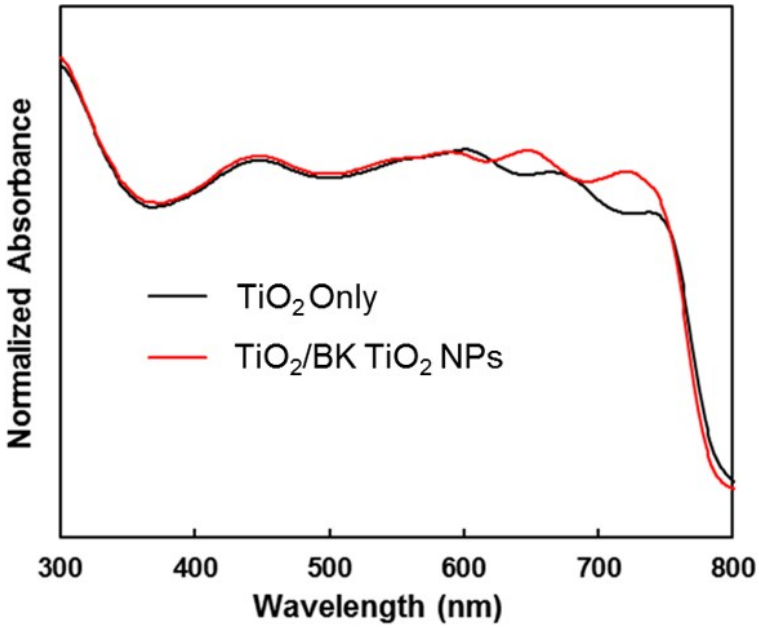

Figure S6. UV–vis characteristics of the perovskite with and without a BK TiO_2 NPs.

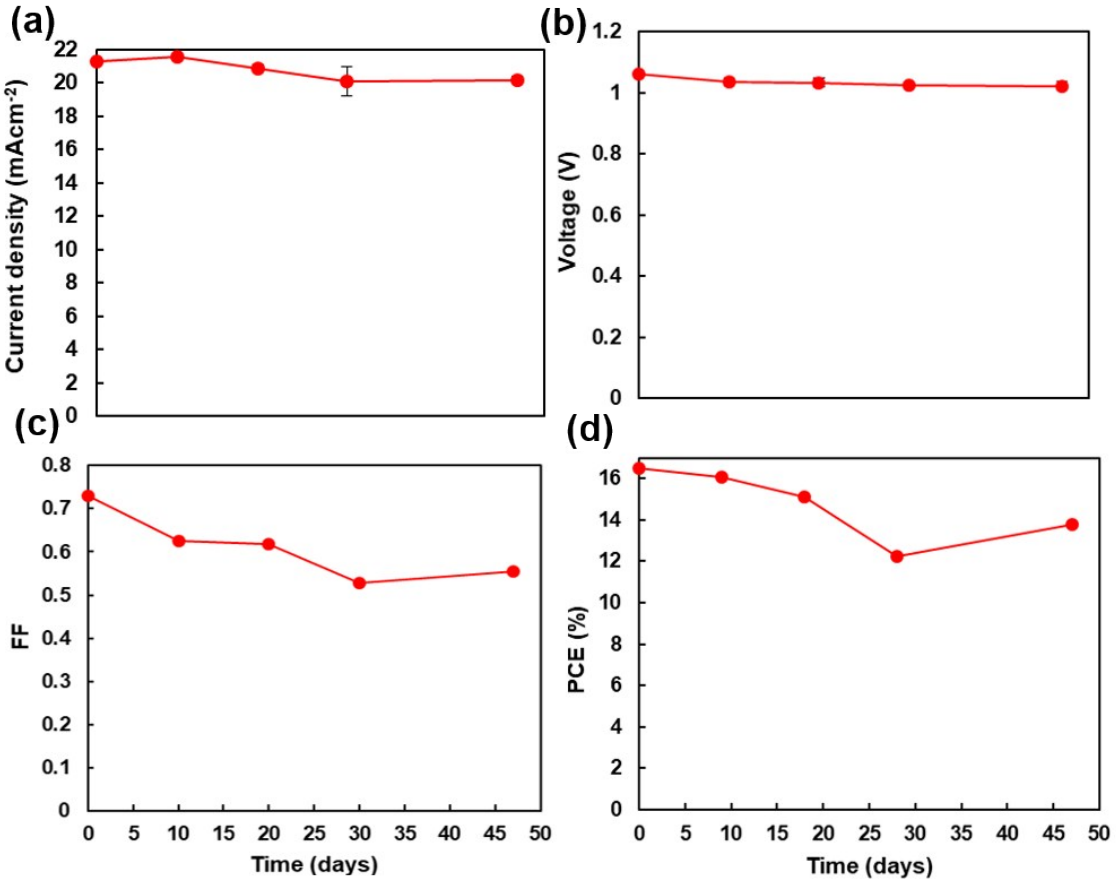

Figure S7. Averaged photovoltaic parameters of PSCs fabricated with TiO_2/BK TiO_2 NPs: (a) J_{sc}, (b) V_{oc}, (c) FF, and (d) PCE, as functions of degradation period.

Table S1. Peak parameters for calculating the mean crystalline size in perovskite thin films formed with and without a bilayer by the whole-pattern fitting method based on the Scherrer formula. (Instrument width FWHM = 0.139; Width = 0.150)

Parameters	**FTO/TiO_2 CL/perovskite**	**FTO/TiO_2/BK TiO_2 NPs/perovskite**
Peak intensity	51.1	54.2
FWHM (B)	0.11	0.10
Bragg angle (θ) primary peak	14.12	14.12
X-ray wavelength (λ)	1.54	1.54
Constant (K)	0.9	0.9
Crystalline size (nm)	351	670

Table S2. The fitted Electrical impedance spectroscopy values of PSCs.

Devices	R_s **(Ω)**	R_{rec} **(Ω)**
TiO_2 CL	54.27	5275
TiO_2 CL/BK TiO_2 NPs (bilayer CL)	23.65	18681

Table S3. Summary of cell performance characteristics of solar cells with different types of ETLs.

Compact layer	Scan direction	J_{sc} (mA cm^{-2})	V_{oc} (V)	FF	PCE (%)
TiO_2 CL Only	Reverse	21.18	1.05	0.69	15.37
	Forward	21.50	1.01	0.52	11.25
BK TiO_2 NPs Only	Reverse	22.41	1.02	0.58	13.25
	Forward	22.63	0.98	0.47	10.23
TiO_2 CL/BK TiO_2 NPs	Reverse	23.10	1.07	0.73	18.14
	Forward	23.10	1.05	0.62	15.07