Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supporting Information

Stabilizing BiOCl/$Ti_3C_2T_x$ Hybrids for Potassium-Ion Batteries via Solid Electrolyte Interphase Reconstruction

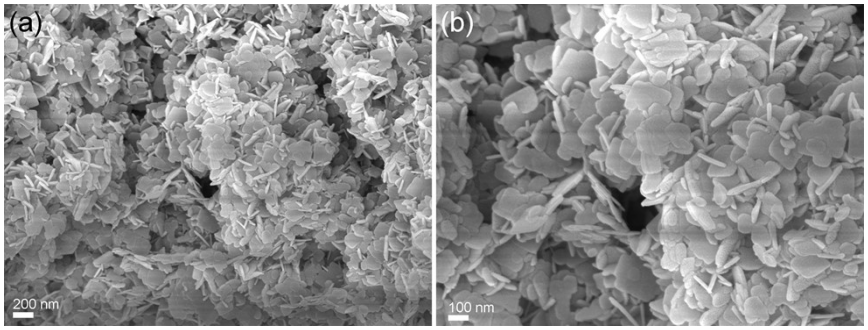

Figure S1. (a, b) SEM images of bare BiOCl nanosheets.

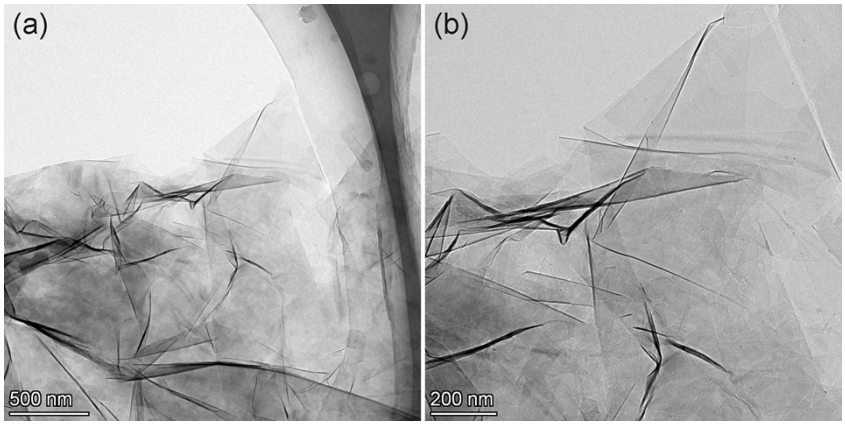

Figure S2. (a, b) TEM images of $Ti_3C_2T_x$ nanosheets.

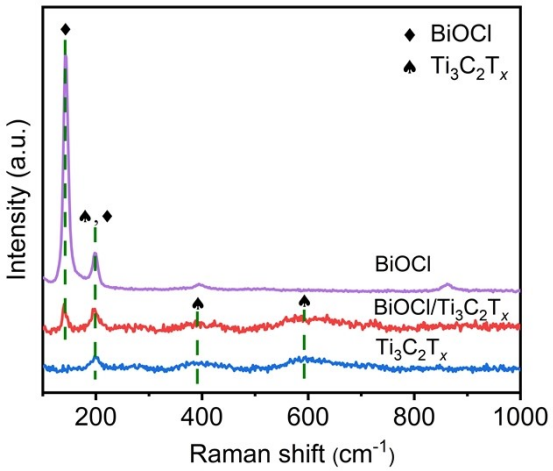

Figure S3. Raman spectra of BiOCl, BiOCl/$Ti_3C_2T_x$, and $Ti_3C_2T_x$.

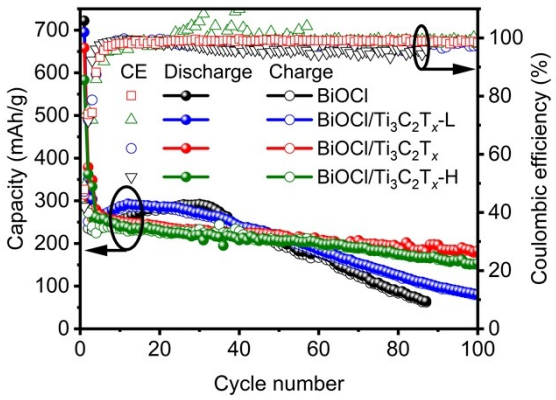

Figure S4. Cycling performances and Coulombic efficiencies of BiOCl/$Ti_3C_2T_x$ composites at 50 mA/g in the electrolyte of DME-KFSI-5.

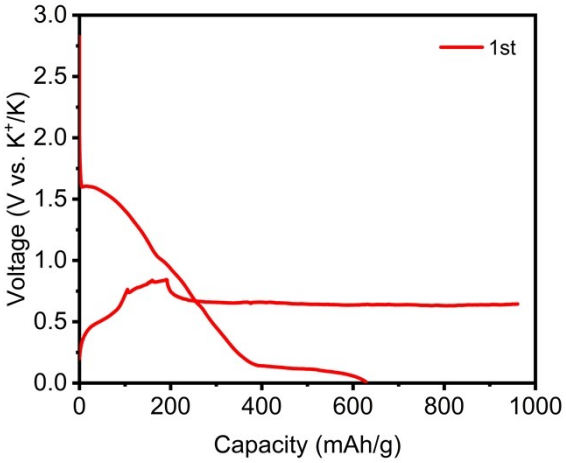

Figure S5. GCD curves of BiOCl/$Ti_3C_2T_x$ in the DME-KFSI-1 electrolyte.

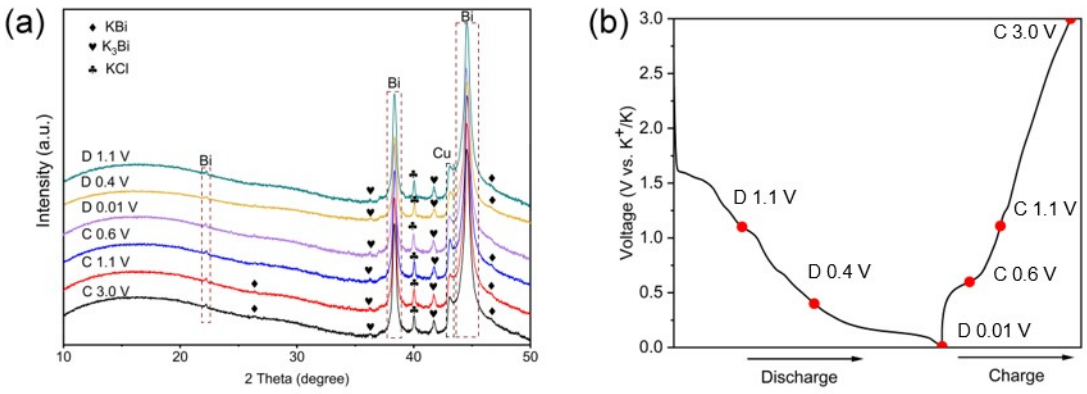

Figure S6. (a) *Ex-situ* XRD patterns of the BiOCl/$Ti_3C_2T_x$ electrodes at various discharge/charge states. (b) Discharge/charge profiles of BiOCl/$Ti_3C_2T_x$ in the first cycle.

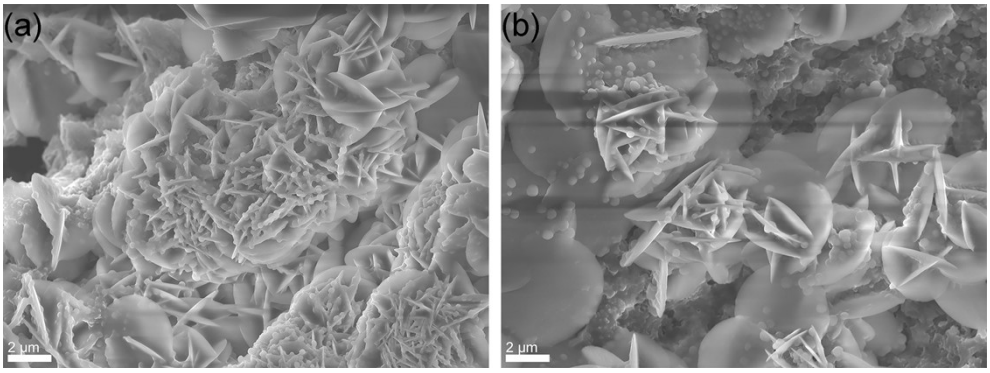

Figure S7. (a, b) SEM images of the BiOCl/$Ti_3C_2T_x$ electrode after 5 cycles.

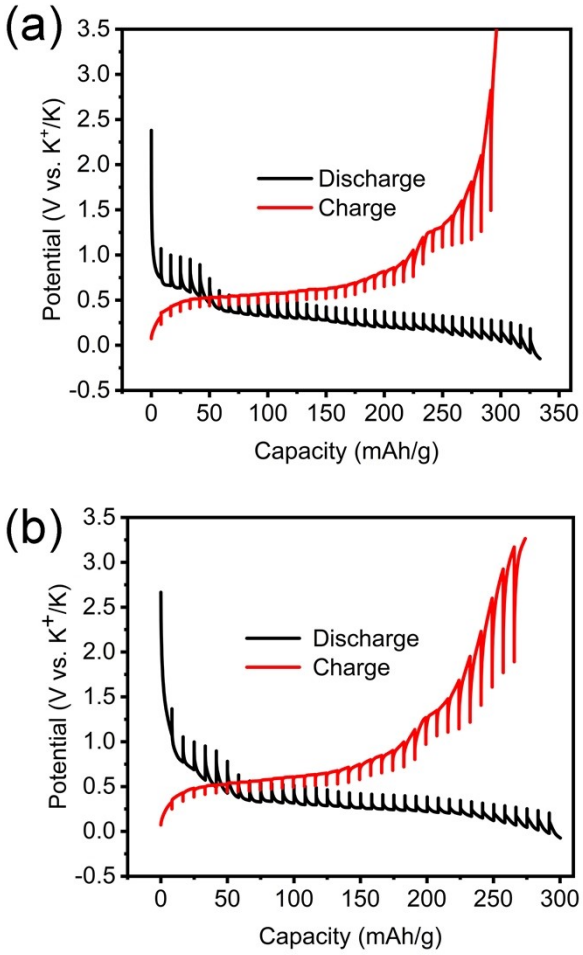

Figure S8. GITT curves of the cells with (a) BiOCl and (b) BiOCl/$Ti_3C_2T_x$ electrodes at a current density of 50 mA/g in the electrolyte of DME-KFSI-5.

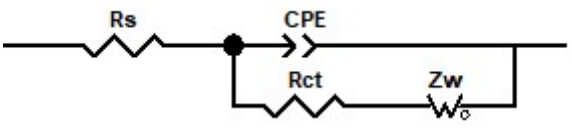

Figure S9. Electrochemical equivalent circuit model for fitting Nyquist plots.

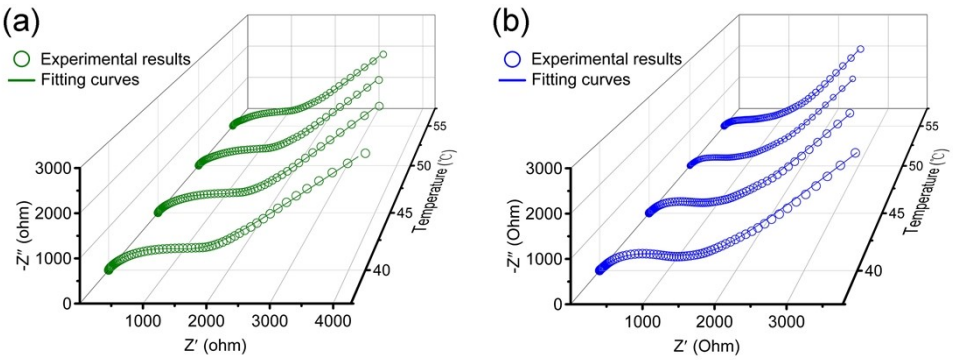

Figure S10. Temperature-dependent Nyquist plots for BiOCl/$Ti_3C_2T_x$ in (a) ED-KPF and DME-KFSI-3 electrolytes.

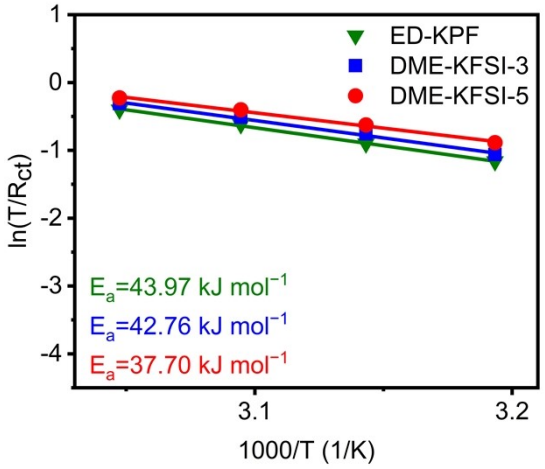

Figure S11. Plots of ln (T/R_{ct}) *vs.* 1000/T with the derived activation energies for BiOCl/$Ti_3C_2T_x$ in different electrolytes.

Table S1. Comparison of the electrochemical performance of reported anodes for PIBs.

Materials	Current density (mA/g)	Capacity (mAh/g)	Cycle number	Electrolyte system	Ref.
Bi@C	10	151	35	5 M KTFSI in DGM	1
BiOCl nanoflake	50	213	50	1 M KFSI in EC: DEC (1:1, v/v)	2
Bi/rGO	50	87	200	1 M KFSI in EC: DEC (1:1, v/v)	3
Sn foil	50	66	300	1 M KPF_6 in EC: DMC: EMC (4:3:2 v/v/v)	4
Nanoporous Ge	20	120	400	0.5 M KPF_6 in EC: DEC (1:1, v/v)	5
MXene nanosheet Ti_3C_2	100	50	100	1 M KPF_6 in PC: EC (1:1, w/w)	6
Titanium carbonitride Ti_3CNT_z	20	75	100	0.8 M KPF_6 in EC: DEC (1:1, v/v)	7
Reduced graphene oxide film	10	145	100	0.8 M KPF_6 in EC: DEC (1:1, v/v)	8
Sn_3P_4/C	50	10	120	0.8 M KPF_6 in EC: DEC (1:1, v/v)	9
BiOCl/$Ti_3C_2T_x$	50	184	100	5 M KFSI in DME	This work

Table S2. Calculated R_{ct} based on the equivalent circuits via fitting the impedance spectra at different temperatures.

Samples	Electrolyte system	R_{ct} (Ω)			
		40 °C	45 °C	50 °C	55 °C
BiOCl	5 M KFSI in DME	5449	4319	3194	2313
	0.8 M KPF_6 in EC: DEC (1:1, v/v)	1022	783.3	599.2	489.6
BiOCl/$Ti_3C_2T_x$	3 M KFSI in DME	905.2	678.4	539.5	477.3
	5 M KFSI in DME	759.4	594.6	483.1	411.2

Table S3. Density functional theory calculation results.

Electrolyte	Compound	LUMO (eV)	HOMO (eV)
DME	FSI^-	0.94	−7.14
	DME	2.30	−6.92
	PF_6^-	3.01	−8.99
EC: DEC	EC	0.83	−8.23
	DEC	1.02	−7.90

References

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