# Electronic Supporting Information

Two-dimensional assembly of ultrafine cobalt oxide nanocrystallites anchored on single-layer Ti$_3$C$_2$T$_x$ nanosheets with enhanced lithium storage for Li-ion batteries

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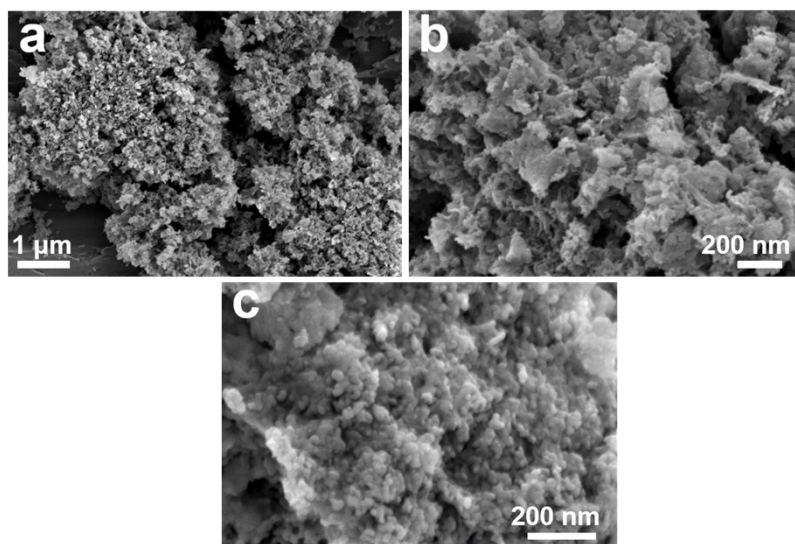School of Material Science & Engineering, University of Jinan, Jinan, 250022, P. R. China

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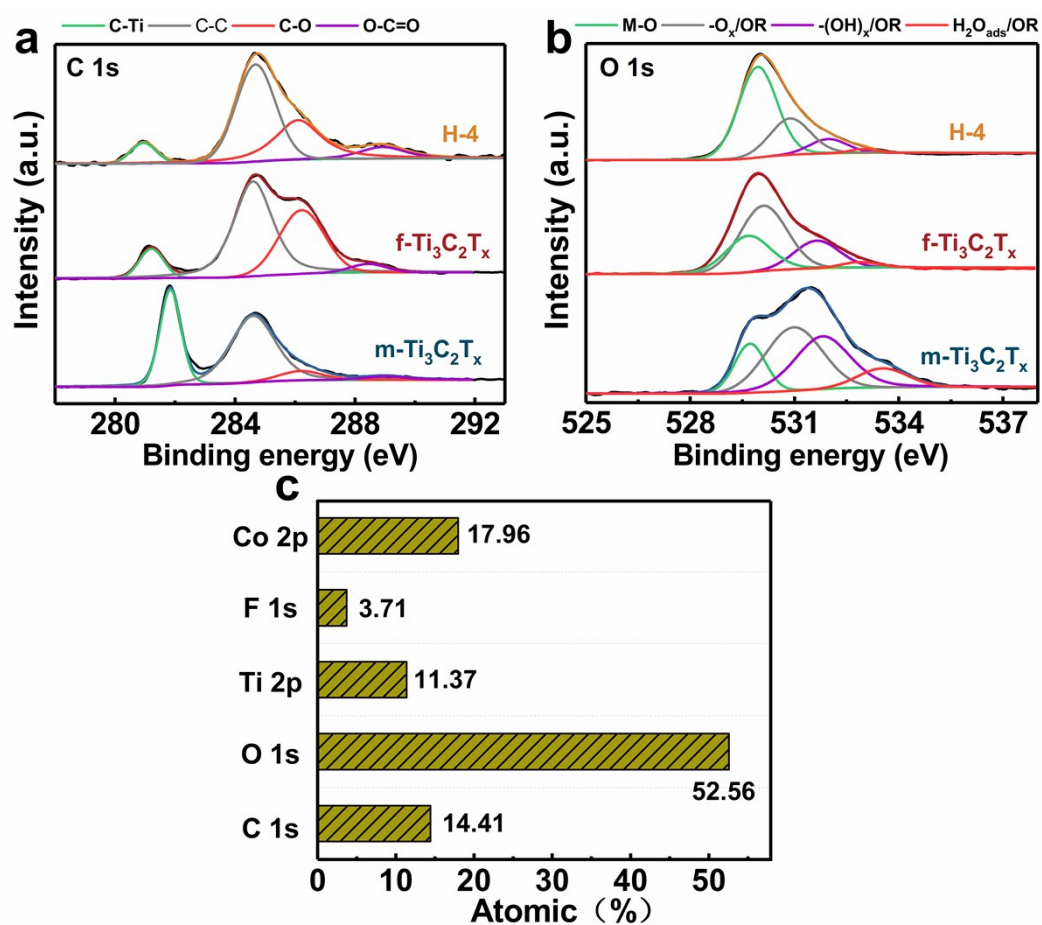
Fig. S1 High-resolution XPS spectra of (a) C 1s and (b) O 1s for the m-$Ti_3C_2T_x$, f-$Ti_3C_2T_x$, and H-4, and (c) corresponding atomic ratio of Co, F, Ti, O, C elements in H-4.
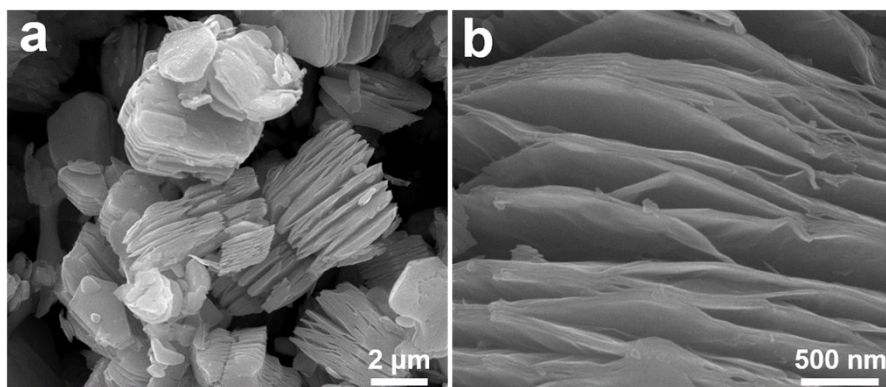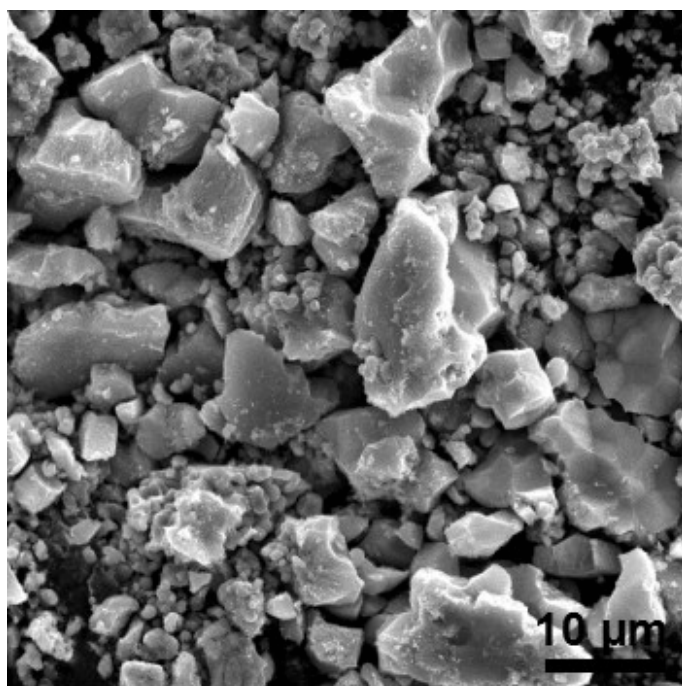
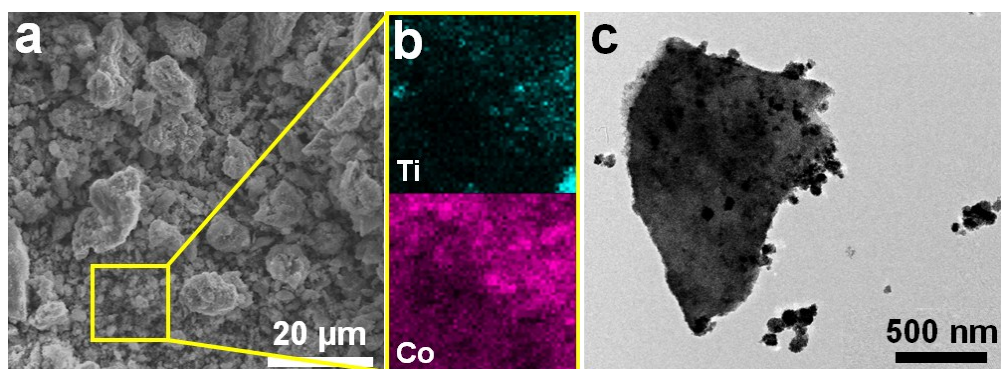**Fig. S2** (a) Low- and (b) high-resolution FESEM images of the m-Ti$_3$C$_2$T$_x$.

Fig. S3 FESEM images with different magnifications for the H-4 sample obtained by the refrigerator pre-freezing method.
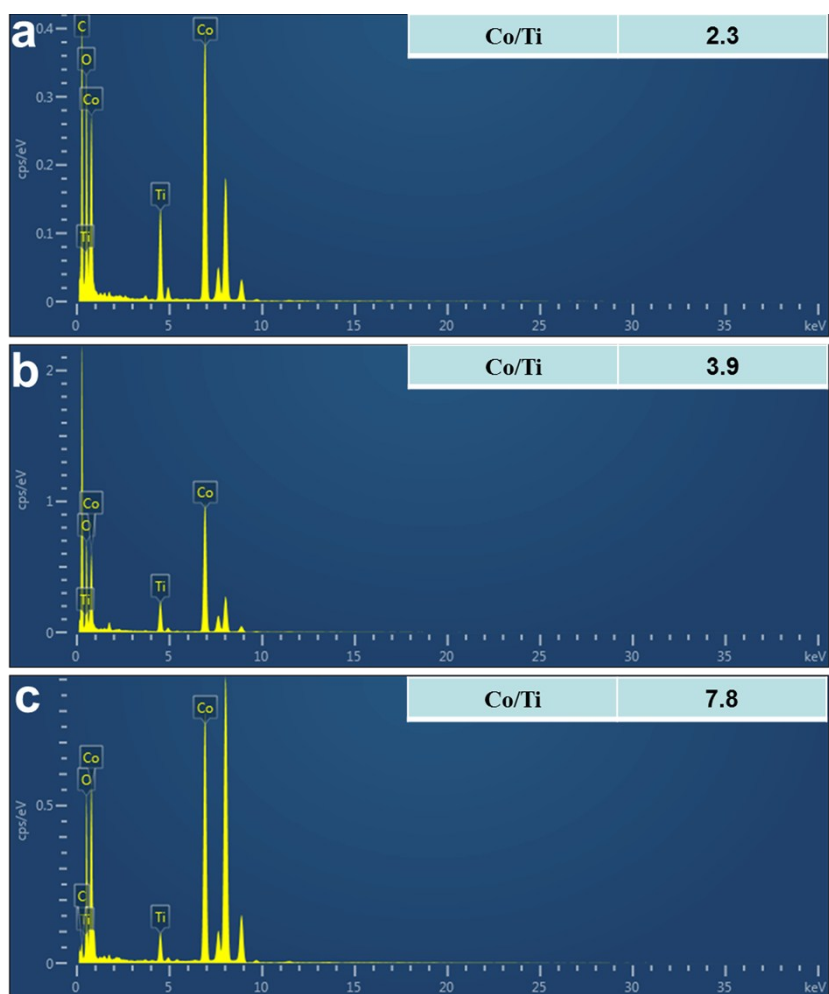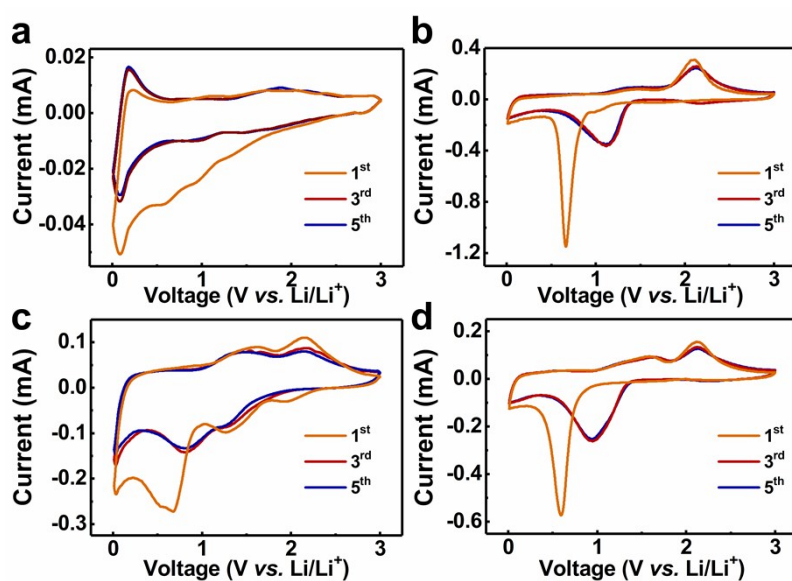
Fig. S4 EDS data and Co/Ti atomic ratio (the insets) for the (a) H-2, (b) H-4 and (c)

H-8 samples as indicated.

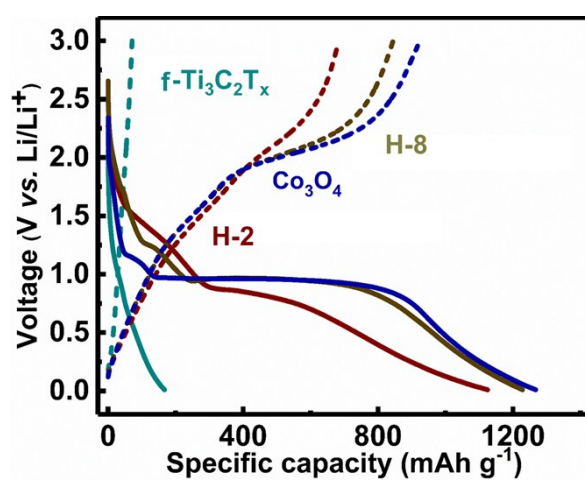**Fig. S5** FESEM image of the pure Co₃O₄ sample.

Fig. S6 (a) FESEM, (b) elemental (Ti, Co) mapping and (c) TEM images of the H-12 sample. The image in panel (b) is taken from the yellow rectangle in panel (a) as indicated.
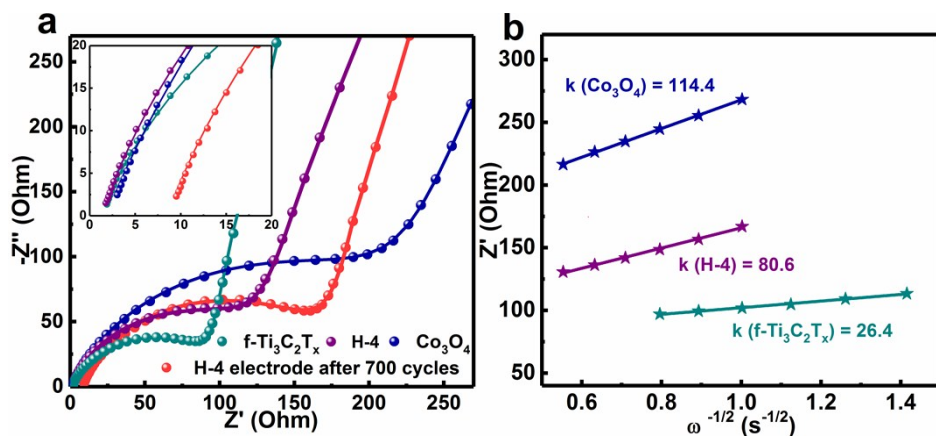
Fig. S7 The 1st, 3rd and 5th CVs curves (0.1 mV s^{-1}) for the (a) f-Ti$_3$C$_2$T$_x$, (b) Co$_3$O$_4$, (c) H-2 and (d) H-8 samples, respectively.

Fig. S8 The 1st galvanostatic charge-discharge plots (0.1 A g^{-1}) for the f-Ti$_3$C$_2$T$_x$, H-2, H-8 and Co$_3$O$_4$ samples, respectively.

Fig. S9 (a) EIS and corresponding fitted lines for fresh cells of the f-Ti$_3$C$_2$T$_x$, Co$_3$O$_4$, H-4 and the H-4 electrode after 700 cycles at 1 A g^{-1}. (b) Z' *vs.* $\omega^{-1/2}$ plots and the slopes of fitted lines for fresh cells of the f-Ti$_3$C$_2$T$_x$, Co$_3$O$_4$, H-4 in low-frequency region. The inset in panel (a) is the magnification of EIS profiles.

Table S1. Binding energy values of Ti 2p, C 1s and O 1s core levels for m-Ti$_3$C$_2$T$_x$ f-Ti$_3$C$_2$T$_x$ and H-4

Binding energy (eV)	m-Ti$_3$C$_2$T$_x$	f-Ti$_3$C$_2$T$_x$	H-4	Assigned to
Ti 2p	455.00/460.94	454.71/459.23	/	Ti
	455.92/461.50	455.90/461.62	/	Ti^{2+}
	457.46/462.92	457.94/463.90	458.01/463.98	Ti^{3+}
	459.57/465.72	458.74/464.80	459.09/464.75 459.78/465.50	Ti-O
C 1s	281.84	281.21	280.97	C-Ti
	284.60	284.60	284.60	C-C
	286.19	286.22	285.83	C-O
	289.02	288.43	288.71	O-C=O
O 1s	529.72	529.70	529.94	M-O (Ti-O and/or Co-O)
	530.87	530.14	530.87	-O$_x$/OR
	531.79	531.68	531.97	-(OH)$_x$/OR
	533.04	532.94	532.97	H$_2$O$_{ads}$/OR

Table S2. Corresponding EIS fitted data for the f-Ti$_3$C$_2$T$_x$, Co$_3$O$_4$, H-4 and H-4

anodes after 700 cycles at 1 A g^{-1}

Sample	R$_{ct}$ (Ohm)	R$_s$ (Ohm)
f-Ti$_3$C$_2$T$_x$	99.3	1.16
Co$_3$O$_4$	238.2	1.60
H-4	130.0	1.30
H-4 electrode after 700 cycles	175.4	8.87