Electronic Supplementary Material

Bottom-up synthesis of 2D heterostructures enables effective polysulfides inhibition and conversion

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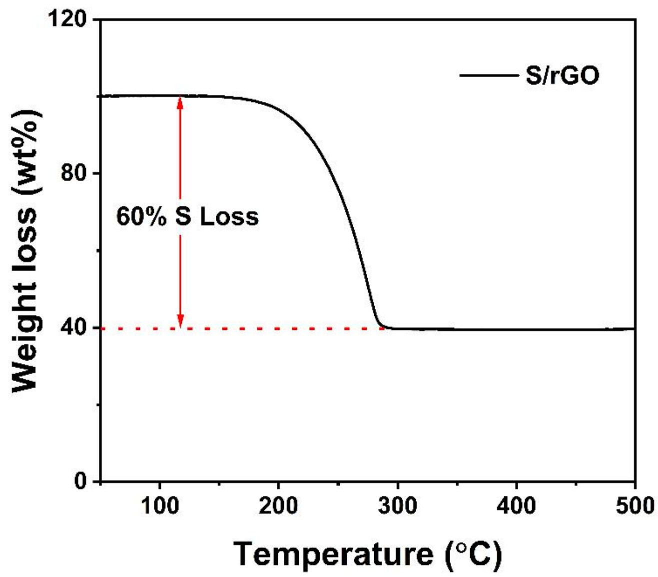

Figure S1 TG curve of the normal sulfur cathode.

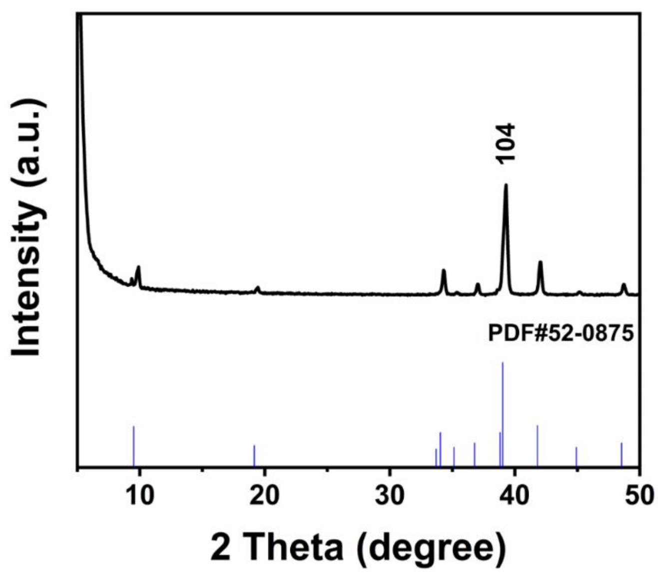

Figure S2 XRD patterns of the Ti_3AlC_2.

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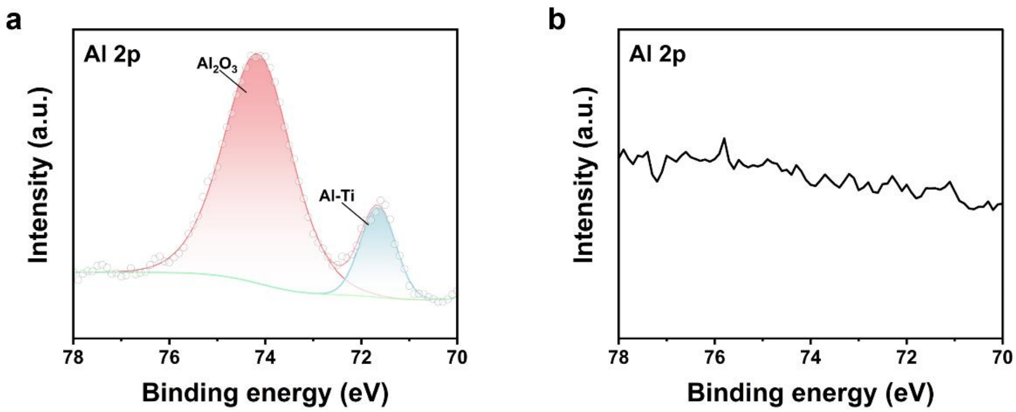

Figure S3 (a) Al 2p XPS spectra of Ti_3AlC_2 before etching, (b) Al 2p XPS spectra of Ti_3AlC_2 after etching.

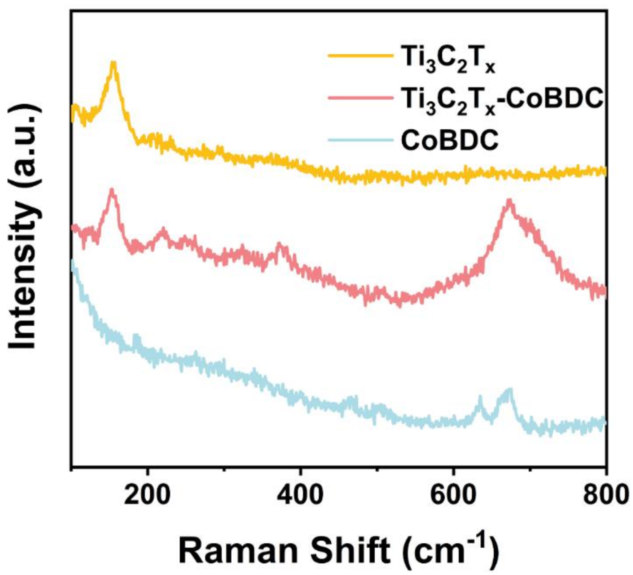

Figure S4 Raman spectra of $Ti_3C_2T_x$-CoBDC, $Ti_3C_2T_x$ and CoBDC.

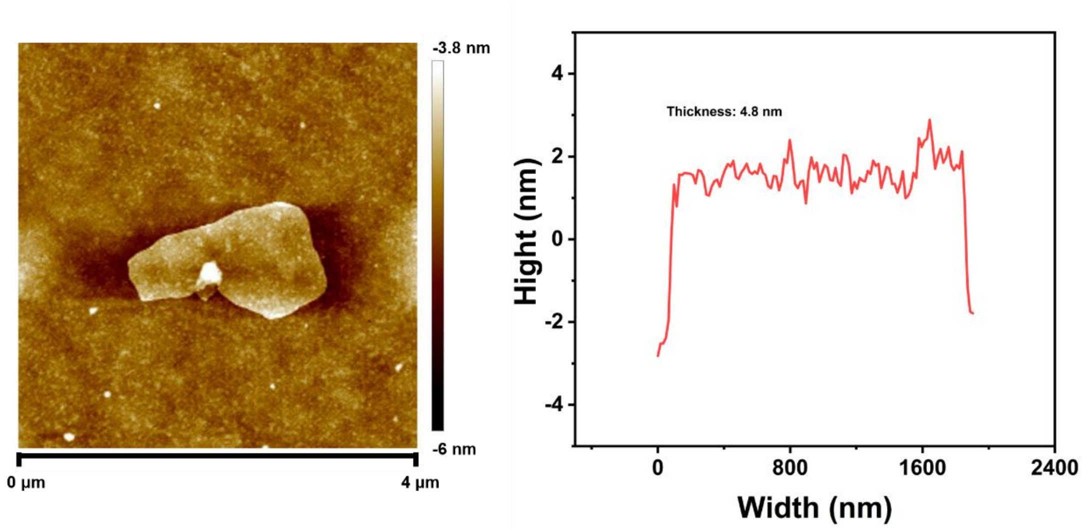

Figure S5 AFM of $Ti_3C_2T_x$-CoBDC nanosheet.

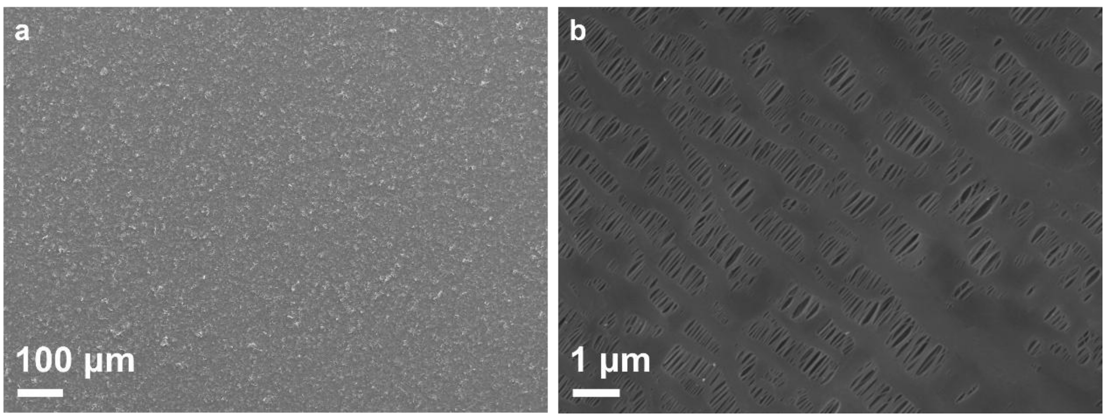

Figure S6 (a) SEM of $Ti_3C_2T_x$-CoBDC@PP separator, (b)PP separator.

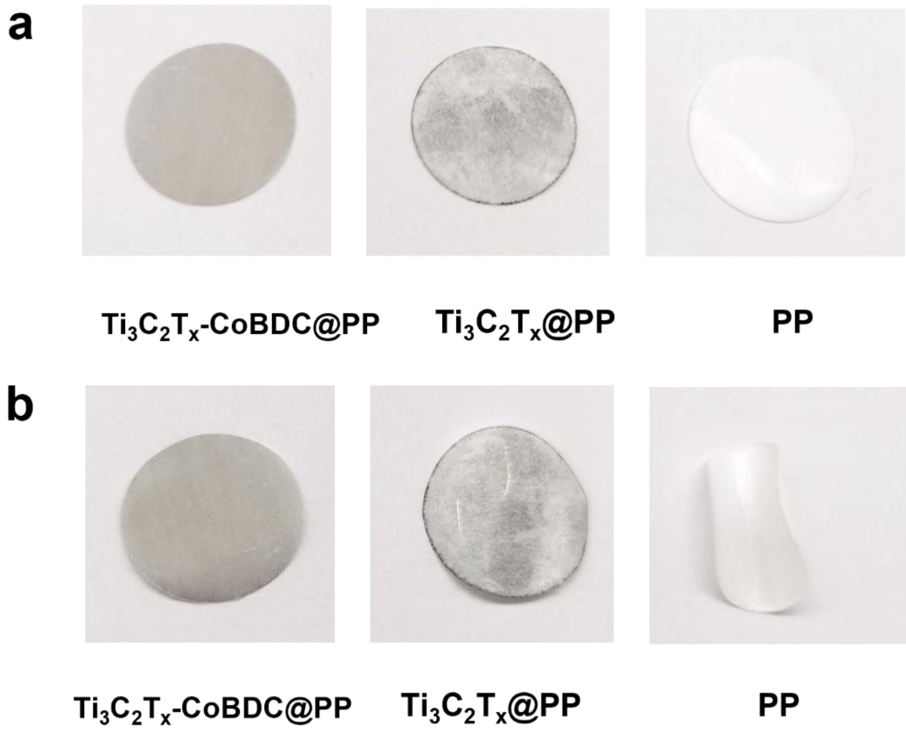

Figure S7 The optical pictures of $Ti_3C_2T_x$-CoBDC@PP, $Ti_3C_2T_x$@PP and PP separators before and after thermal treatment at 120 °C.

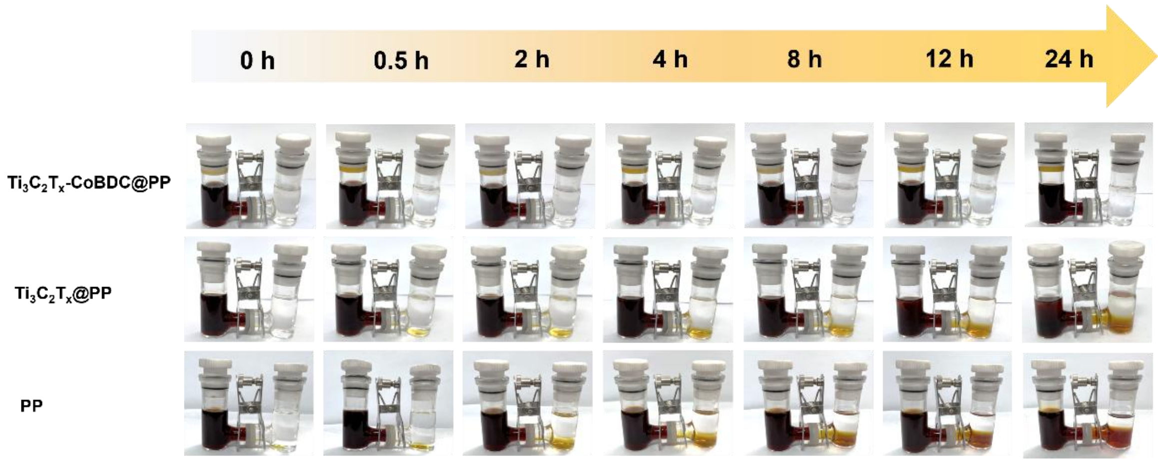

Figure S8 Shuttle test with a double-L device for $Ti_3C_2T_x$-CoBDC@PP, $Ti_3C_2T_x$@PP and PP separators.

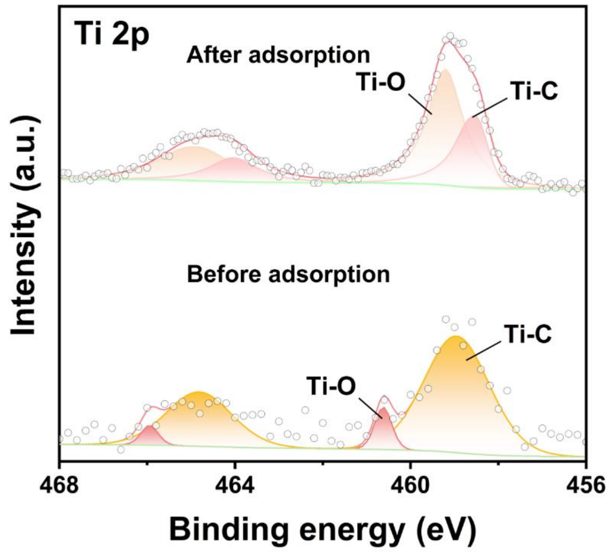

Figure S9 Ti 2p XPS spectra before and after Li_2S_6 adsorption.

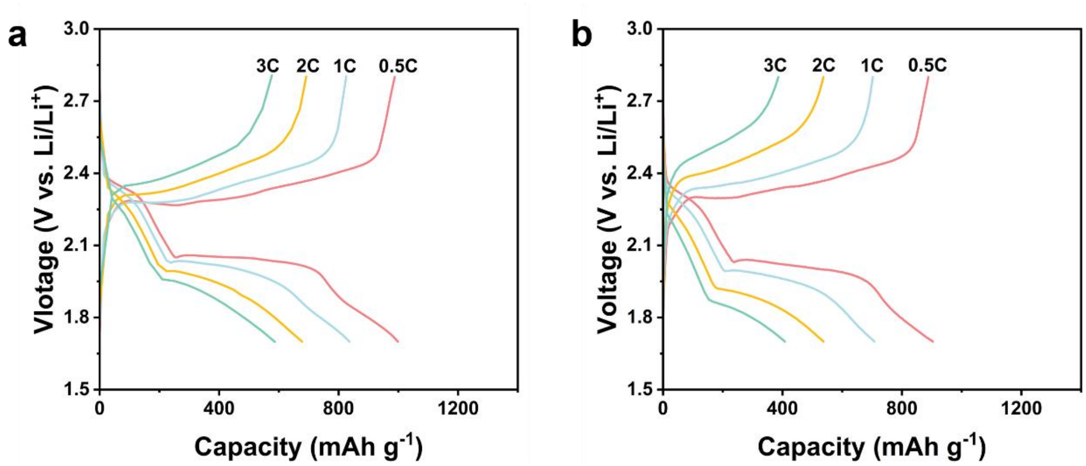

Figure S10 Galvanostatic charge-discharge profiles of the Li-S cell with (a) $Ti_3C_2T_x$@PP and (b) PP separators at different rates, respectively.

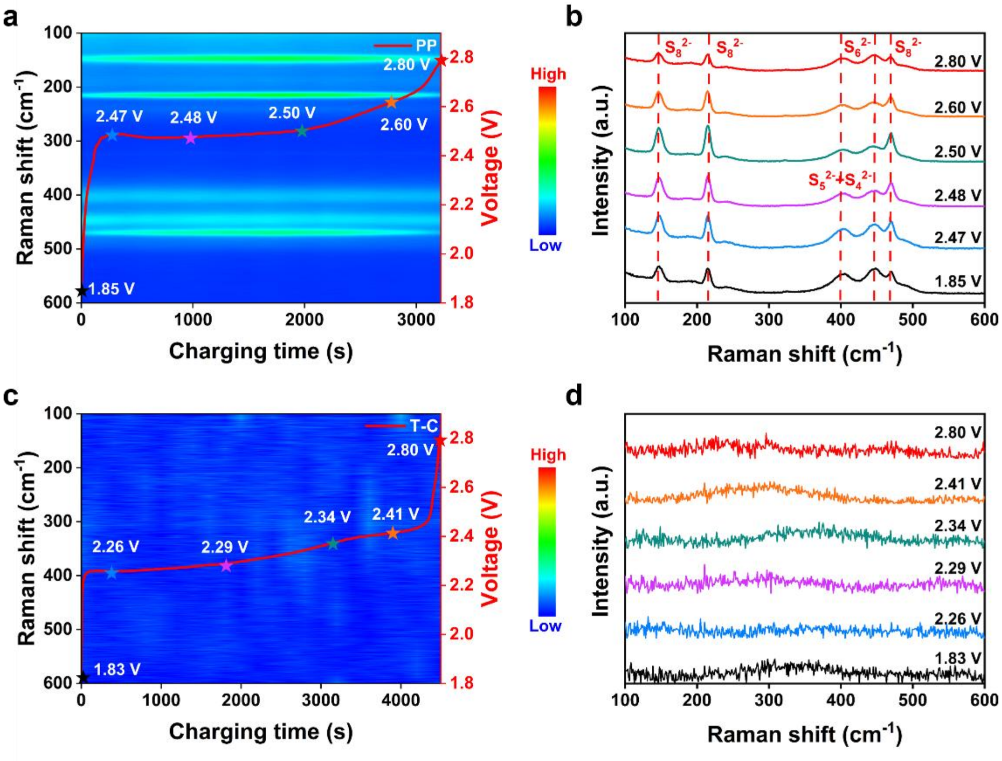

Figure S11 *In situ* Raman spectra and in situ time-resolved Raman spectra tested during the charging processes of the cells with PP (a-b) and (c-d) $Ti_3C_2T_x$-CoBDC@PP separators.

Table S1 Detailed information of Li-S batteries fabricated with MXene based separators

MXene materials	0.5 C Capacity (m Ah g^{-1})	High sulfur loading (mg cm^{-2})	Cycle performance		Ref
			Cycle number	Fading rate(%)	
TiN/G	954	3.1	600	0.047	[1]
PM (4.0M)	1105	2.42	500	0.07	[2]
N-MX-CoS_2	1060	2.5	700	0.052	[3]
CM/MoS_2	1001	5	500	0.056	[4]
TiB_2	1000	4.5	300	0.05	[5]
$Ti_3C_2T_x$ MXene	848.7	2.8	500	0.062	[6]
PCNS-TiO_2	889	3	300	0.063	[7]
$Ti_3C_2T_x$-CoBDC	1255	7.5	600	0.01	This work

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