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Supporting Information

Supercritical CO₂ Mediated Incorporation of Sulfur into Carbon Matrix as Cathode Materials towards High-performance Lithium-Sulfur Batteries

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Fig. S1 SEM images (a-c) and volume changes (d) of MCMB, MCMB-CO₂ and MCMB@S samples, respectively.



Fig. S2 SEM images (a-c) and volume changes (d) of MWCNTs, MWCNTs-CO₂ and MWCNTs@S samples, respectively.



Fig. S3 (a-b) TEM and HRTEM images of MCMB sample. (c-d) TEM and HRTEM images of MCMB@S sample. (e-h) STEM, EDS spectrum and EDS mapping results of MCMB@S sample.



Fig. S4 (a-b) TEM and HRTEM images of MWCNTs sample. (c) HRTEM images of MWCNTs-CO₂ sample. (d) XRD patterns of MWCNTs, MWCNTs-CO₂ and MWCNTs@S samples. Inset is an enlarged view.



Fig. S5 Apparent densities of raw C, C-CO₂ and C@S samples.



Fig. S6 XRD pattern of the pristine sulfur after SC-CO₂ treatment.



Fig. S7 (a) XRD patterns of MCMB, MCMB-CO₂ and MCMB@S samples. Inset is an enlarged view of the squared area. (b) Raman spectra of MCMB, MCMB-CO₂ and MCMB@S samples. (c) N₂ adsorption-desorption isotherm curves and the corresponding pore size distributions (inset) of MCMB-CO₂ and MCMB@S samples.

Table S1 The proportion of C-S-S/C=S in AC/S-155 and AC@S calculated from XPS results

Sample	C-S-S/C=S
AC/S-155	15.3%
AC@S	29.5%



Fig. S8 (a) CV curves of AC@S sample washed by CS_2 at a scan rate of 0.1 mV s⁻¹. (b) HRTEM image of AC@S sample washed by CS_2 . (c) STEM image and EDS mappings of AC@S sample washed by CS_2 .



Fig. S9 Long-term cycling performance comparison of C@S and C/S-155 samples.

Synthetic strategy	Sample	Initial capacity (mA h g ⁻ ¹)	Cycle number (n)	Discharge capacity (mA h g ⁻¹)	Capacity retention (%)	Per cycle fading rate (%)	Average efficiency (%)
	AC@S	905	100	817	90.5	0.097	99.3
SC-CO ₂	MCMB@S	807	100	715	88.6	0.114	97.4
	MWCNTs@S	861	100	441	51.2	0.488	99.2
	AC/S-155	658	100	386	58.7	0.705	98.7
Heat-	MCMB/S-155	931	100	401	43.1	0.569	99.3
treatment	MWCNTs/S- 155	859	100	207	24.1	0.759	97.0

 Table S2 Electrochemical performance comparison of carbon matrices and synthetic strategies.



Fig. S10 N_2 adsorption-desorption isotherm curves and the corresponding pore size distributions (inset) of the cycled AC@S sample.