Supporting Information

Preparation of asphalt-based microporous organic polymers with sulfur bridge

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KEYWORDS: asphalt, sulfur, microporous polymers, supercapacitor

Table S1. Yield and Surface Area of SBP with different on reaction condition.

Reaction Conditions	yield (%)	S_{BET} (m^2 g^{-1})
300 ℃, 10 h	0	/
350 ℃, 5 h	24.75%	0
300 ℃, 5 h, 350 ℃, 5 h	87.17%	22 m^2 g^{-1}

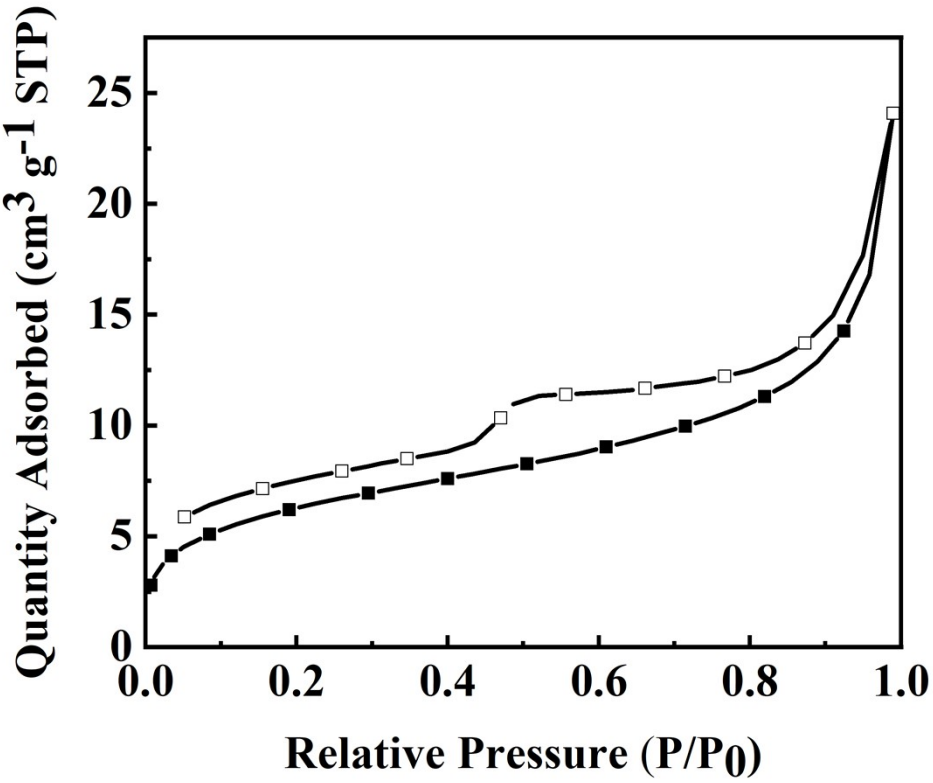

Figure S1. N_2 adsorption/desorption isotherm of SBP.

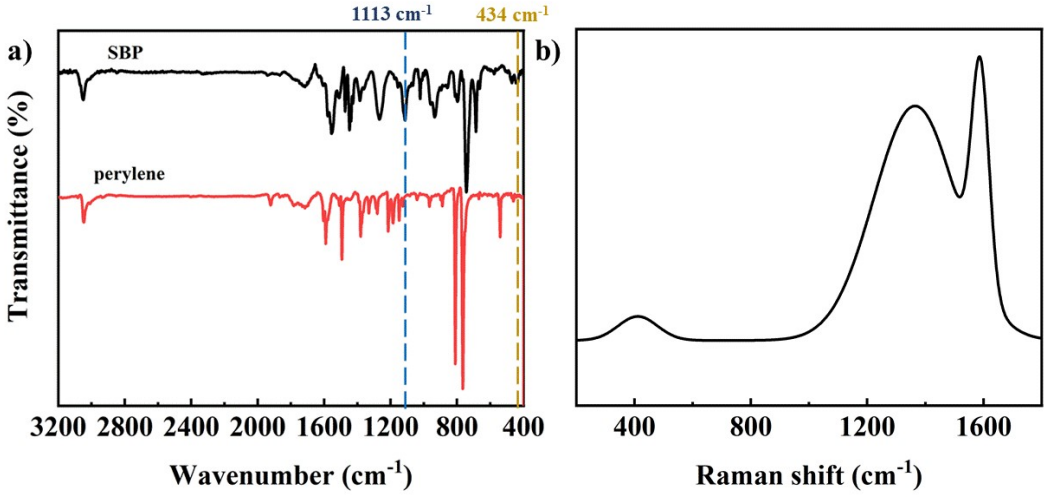

Figure S2. (a) FT-IR spectra of perylene and SBP, (b) Raman spectrum of SBP.

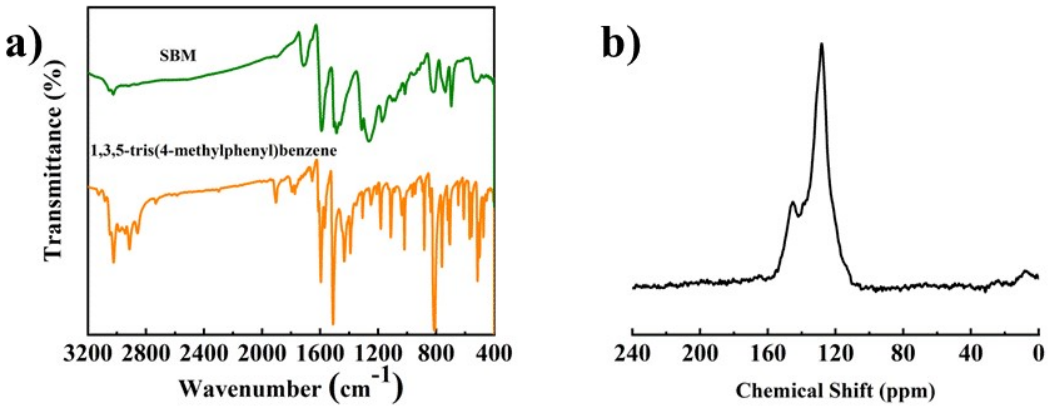

Figure S3. (a) FT-IR spectra of 1,3,5-tris(4-methylphenyl)benzene and SBM, (b) ^{13}C NMR spectrum of SBM.

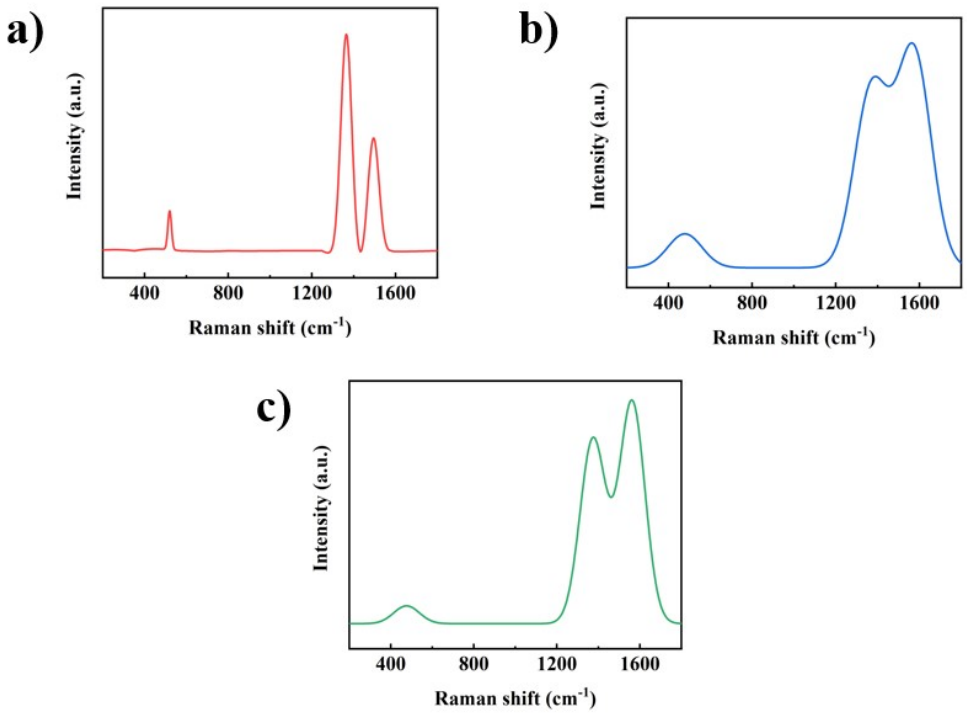

Figure S4. (a) Raman spectrum of SBA-82, (b) Raman spectrum of SBA-73, (c) Raman spectrum of SBA-64.

Table S2. Elemental analyses of SBAs and cSBA-64.

Sample	C/wt%	H/wt%	S/wt%
asphalt-1	93.73	3.68	0.78
SBA-91	88.27	5.18	3.68
SBA-82	75.08	5.80	16.31
SBA-73	70.95	5.45	21.02
SBA-64	65.33	5.25	24.36
SBA-55	64.94	4.86	34.89
SBA-46	60.39	9.31	37.01
SBA-37	59.43	4.25	39.84
cSBA-64	61.85	5.20	8.80

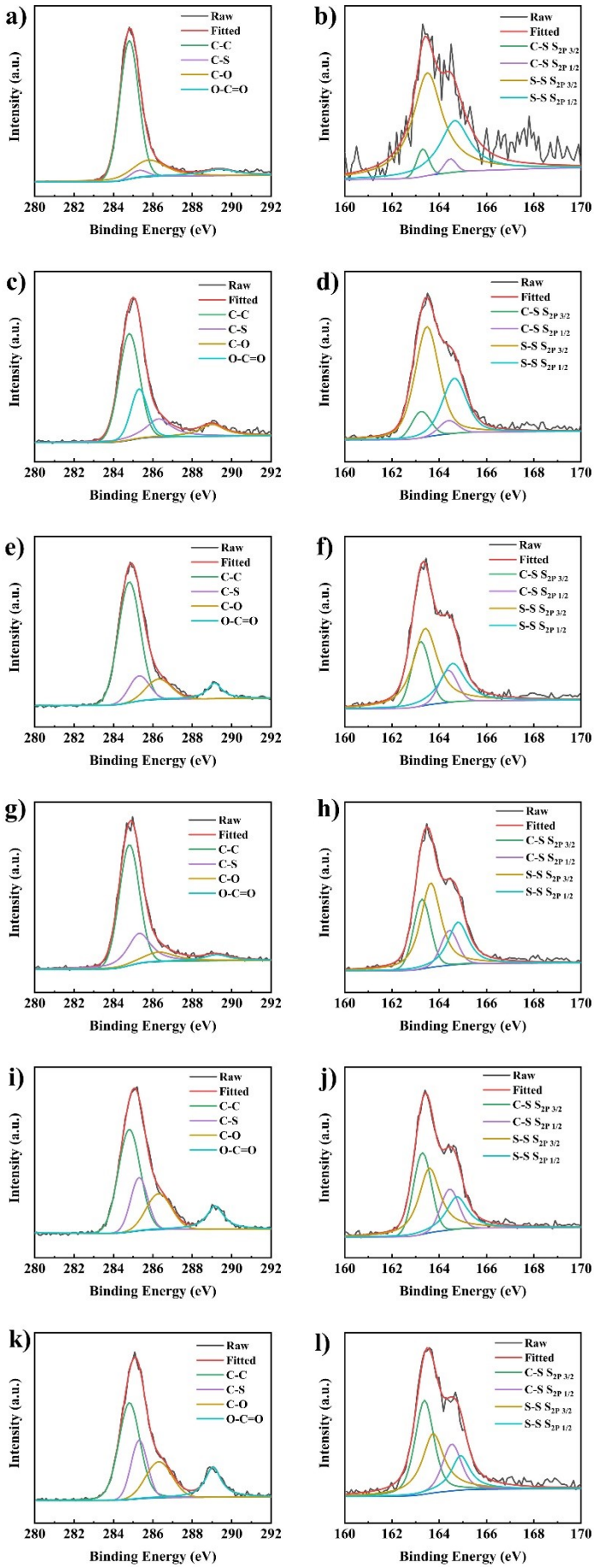
a)
Raw
Fitted
C-C
C-S
C-O
O-C=O
Intensity (a.u.)
280 282 284 286 288 290 292
Binding Energy (eV)
b)
Raw
Fitted
C-S S2P 3/2
C-S S2P 1/2
S-S S2P 3/2
S-S S2P 1/2
Intensity (a.u.)
160 162 164 166 168 170
Binding Energy (eV)
c)
Raw
Fitted
C-C
C-S
C-O
O-C=O
Intensity (a.u.)
280 282 284 286 288 290 292
Binding Energy (eV)
d)
Raw
Fitted
C-S S2P 3/2
C-S S2P 1/2
S-S S2P 3/2
S-S S2P 1/2
Intensity (a.u.)
160 162 164 166 168 170
Binding Energy (eV)
e)
Raw
Fitted
C-C
C-S
C-O
O-C=O
Intensity (a.u.)
280 282 284 286 288 290 292
Binding Energy (eV)
f)
Raw
Fitted
C-S S2P 3/2
C-S S2P 1/2
S-S S2P 3/2
S-S S2P 1/2
Intensity (a.u.)
160 162 164 166 168 170
Binding Energy (eV)
g)
Raw
Fitted
C-C
C-S
C-O
O-C=O
Intensity (a.u.)
280 282 284 286 288 290 292
Binding Energy (eV)
h)
Raw
Fitted
C-S S2P 3/2
C-S S2P 1/2
S-S S2P 3/2
S-S S2P 1/2
Intensity (a.u.)
160 162 164 166 168 170
Binding Energy (eV)
i)
Raw
Fitted
C-C
C-S
C-O
O-C=O
Intensity (a.u.)
280 282 284 286 288 290 292
Binding Energy (eV)
j)
Raw
Fitted
C-S S2P 3/2
C-S S2P 1/2
S-S S2P 3/2
S-S S2P 1/2
Intensity (a.u.)
160 162 164 166 168 170
Binding Energy (eV)
k)
Raw
Fitted
C-C
C-S
C-O
O-C=O
Intensity (a.u.)
280 282 284 286 288 290 292
Binding Energy (eV)
l)
Raw
Fitted
C-S S2P 3/2
C-S S2P 1/2
S-S S2P 3/2
S-S S2P 1/2
Intensity (a.u.)
160 162 164 166 168 170
Binding Energy (eV)

Figure S5. (a) C 1s and (b) S 2p XPS spectra of SBA-91; (c) C 1s and (d) S 2p XPS spectra of SBA-82; (e) C 1s and (f) S 2p XPS spectra of SBA-73; (g) C 1s and (h) S 2p XPS spectra of SBA-55; (i) C 1s and (j) S 2p XPS spectra of SBA-46; (k) C 1s and (l) S 2p XPS spectra of SBA-37.

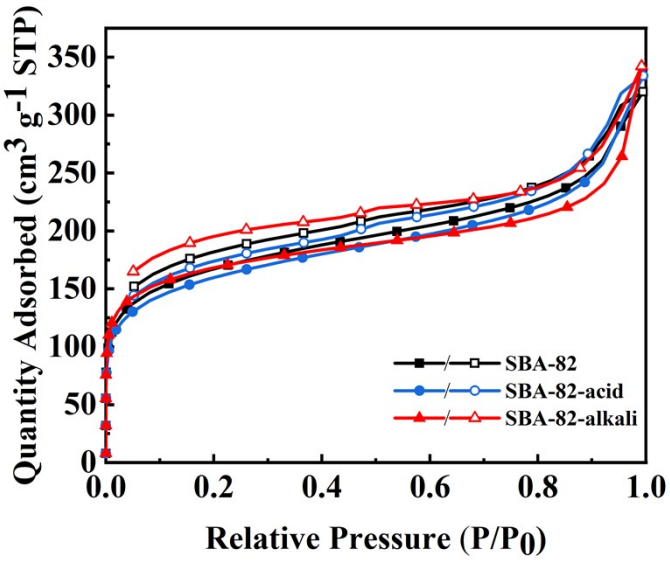

Figure S6. Nitrogen adsorption-desorption isotherms for SBA-82 before and after being soaked and stirred in 1 M HCl (blue) and 1 M NaOH (red) for 24 h, respectively.

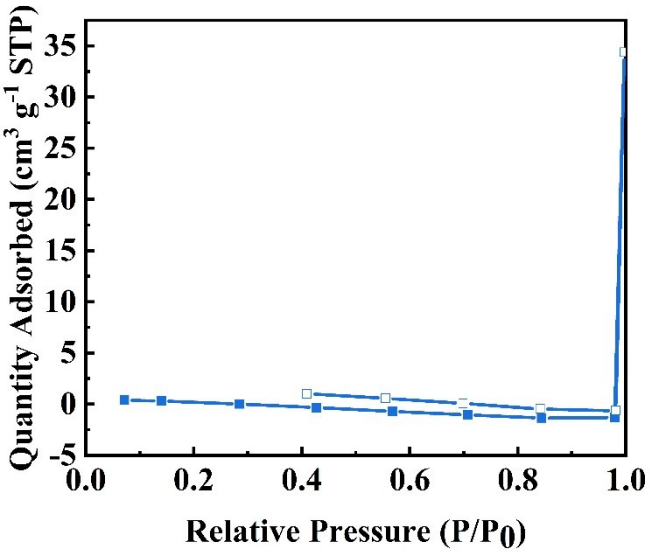

Figure S7. N_2 adsorption/desorption isotherm of SBA-82-WS.

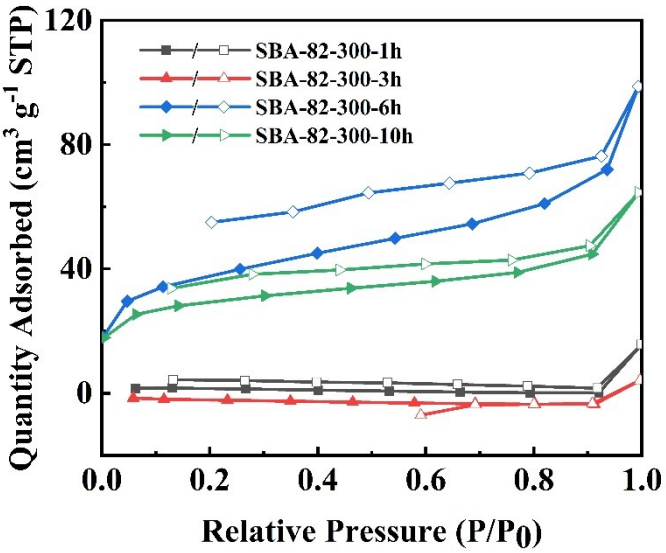

Figure S8. N_2 adsorption/desorption isotherms of SBA-xy-z-t (x and y stand for the mass feeding ratio of asphalt-1 and sulfur, respectively; z denotes reaction temperature and t represents reaction time). With the increasing of reaction time, the surface area of corresponding product is 0, 0, 134 and 103 m^2 g^{-1}.

Table S3. Components with different molecular weight in asphalt samples.

Sample	Relative molecular weight	percentage(%)
Asphalt-1	274	61
	453	12
	963	21
MQ215	161	5
	193	67
	566	16
MQ250	274	11
	679	58
	963	14
MQ270	274	21
	566	15
	679	38
	792	12

Table S4. BET surface areas of different feeding ratio of asphalts and sulfur.

Sample	S_{BET}[a] (m^2 g^{-1})		
	8: 2	7: 3	6: 4
SBMQ215	598	517	396
SBMQ250	324	284	195
SBMQ270	152	134	76

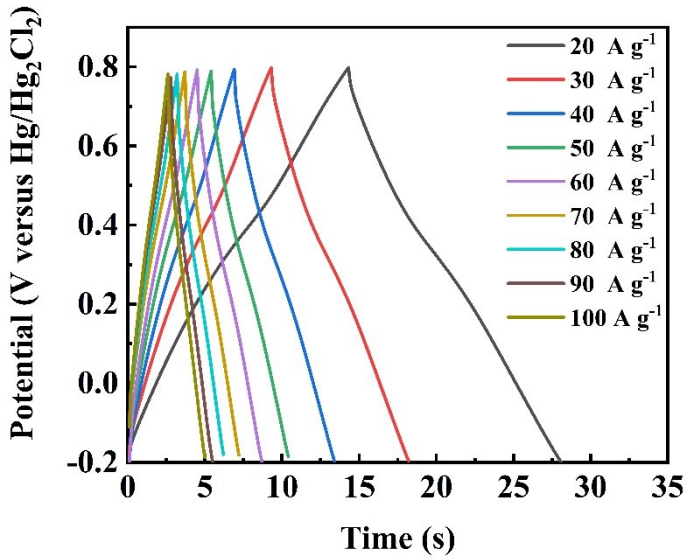

Figure S9. GCD curves of three-electrode system at high current density.

Table S5. Comparison of specific capacitance of cSBA-64 and other sulfur-doped carbon materials.

carbon materials	S_{BET} (m^2 g^{-1})	sulfur content (wt%)	specific capacitance (F g^{-1})	current density (A g^{-1})	Ref.
NS-GA-5	242.5	1.28	203.2	1	40
DHGH-12	251	2.43	252	0.5	41
SP-AG	409	＜13.2	208	1	42
cSBA-64	1756	8.80	372	0.5	this work