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Electronic Supporting Information

Template-free preparation of layer-stacked hierarchical porous carbons from coal tar pitch for high performance all-solid-state supercapacitors

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Contents:

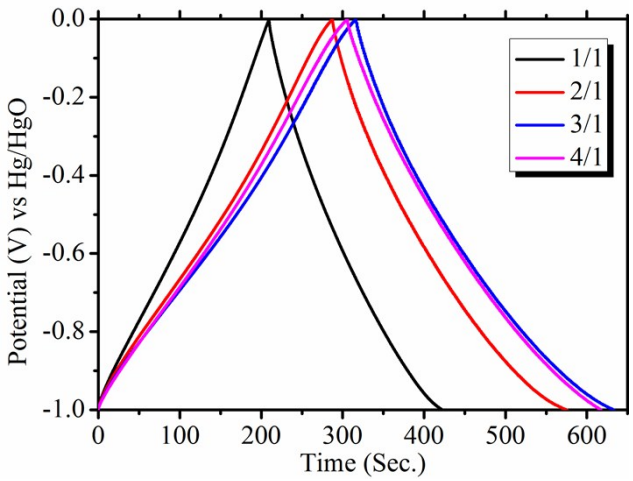

Fig. S1 Galvanostatic charge-discharge curves at a current density of 1 A g^{-1} in 6 M KOH electrolyte for the LHPCs activated by using different alkali-carbon ratios.

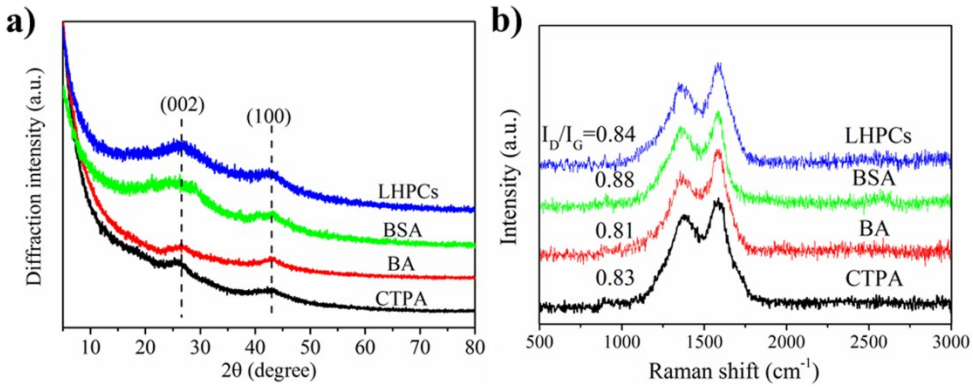

Fig. S2 XRD patterns (a) and Raman spectra (b) of CTPA, BA, BSA and LHPCs.

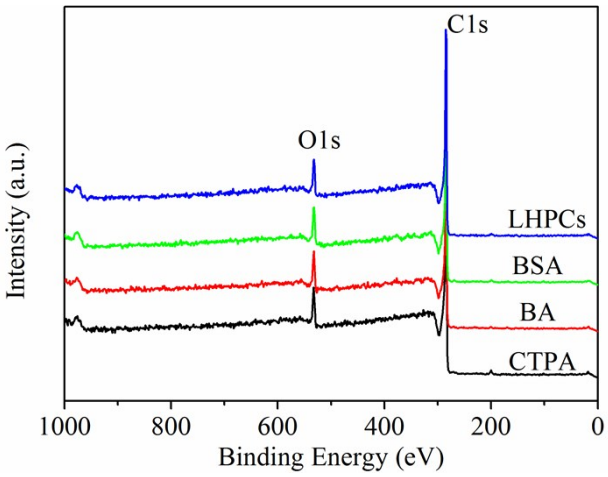

Fig. S3 XPS spectra of CTPA, BA, BSA and LHPCs.

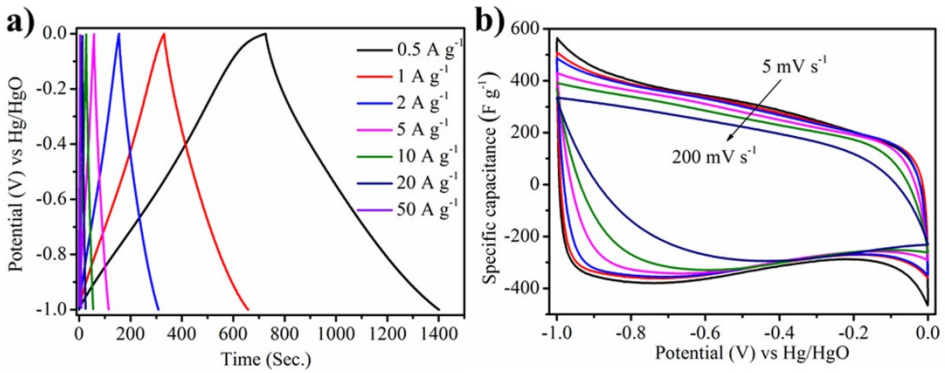

Fig.S4 Electrochemical performances of LHPCs in a three-electrode system in the 6M KOH electrolyte: galvanostatic charge/discharge curves at different current densities from 0.5 to 50 A g^{-1} (a) and CV curves at different scan rates from 5 to 200 mV s^{-1}(b).

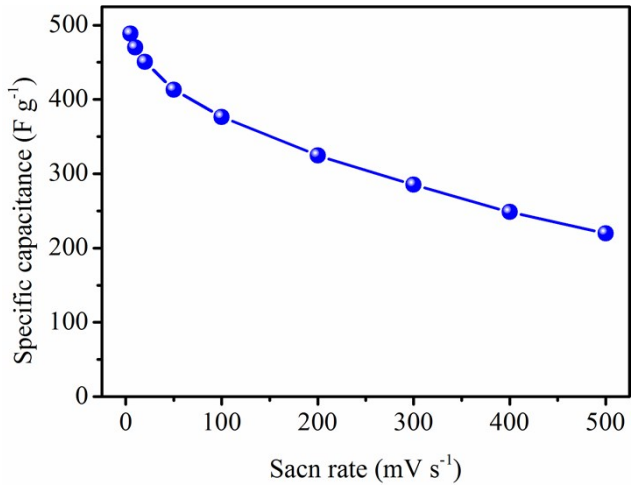

Fig.S5 Specific capacitance at different scan rates from 5 to 500 mV s^{-1}.

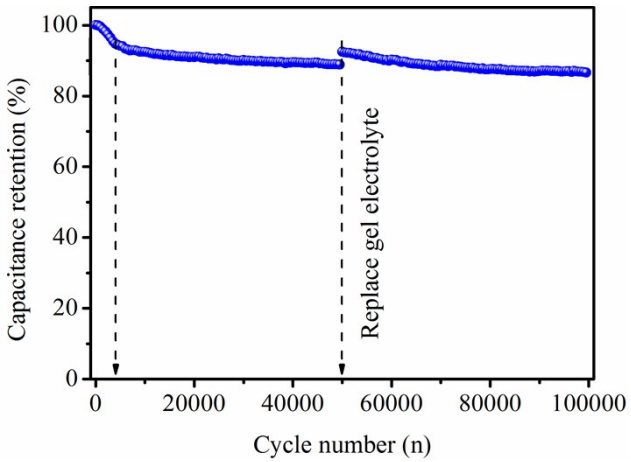

Fig. S6 Cycling stability measured for 100,000 cycles at a current density of 5 A g^{-1}.

Table S1 Element analysis and XPS analysis of CTP, B, BS and BSH.

Sample	Element analysis (wt%)					C/H[b]	XPS analysis (at. %)			
	C	H	N	S	O[a]		C	N	S	O
CTP	92.01	4.91	0.87	0.91	1.30	1.56	96.54	0.61	0.74	2.11
B	92.38	4.44	0.98	0.78	1.42	1.73	96.33	0.71	0.65	2.31
BS	74.14	2.93	0.87	5.91	16.15	2.11	81.10	0.73	1.85	16.32
BSH	77.54	2.04	0.88	5.53	14.01	3.17	83.45	0.68	1.42	14.45

[a] The difference; [b] Carbon/hydrogen atomic ratio.

Table S2 XRD parameters and XPS analysis of CTPA, BA, BSA and LHPCs.

Sample	XRD parameters		XPS analysis			
	d_{002}	L_c	C	N	S	O
CTPA	0.351	3.7	93.79	0.61	0.15	5.45
BA	0.347	3.9	94.81	0.53	0.11	4.55
BSA	0.401	1.9	93.06	0.17	0.47	6.30
LHPCs	0.388	2.3	93.15	0.30	0.28	5.27

Table S3 Specific surface area and porous parameters of CTPA, BA, BSA and LHPCs.

Sample	S_{BET} ($m^2\ g^{-1}$)	S_{micro} ($m^2\ g^{-1}$)	S_{meso} ($m^2\ g^{-1}$)	V_{total} ($cm^3\ g^{-1}$)	V_{micro} ($cm^3\ g^{-1}$)	V_{meso} ($cm^3\ g^{-1}$)	V_{macro} ($cm^3\ g^{-1}$)
CTPA	2535.6	680.9	855.7	1.34	0.22	0.53	0.59
BA	2520.2	1538.2	492.7	1.29	0.74	0.35	0.2
BSA	3256.1	915.0	1290.7	1.89	0.36	0.99	0.54
LHPCs	3114.2	1012.0	1090.9	1.98	0.51	1.04	0.43

S_{BET}: BET surface area was calculated by the BET equation over a relative pressure range from 0.1 to 0.3.

V_{total}: Total pore volume was obtained by the single point adsorption data at a relative pressure of 0.98.

S_{micro} and V_{micro}: Micropore surface area and corresponding pore volume were estimated by using the *t*-plot method.

S_{meso} and V_{meso}: Mesopore surface area and corresponding pore volume were calculated by the BJH method.

V_{macro}: Macropore volume was determined from the balance among V_{total}, V_{micro} and V_{meso} ($V_{macro} = V_{total} - V_{micro} - V_{meso}$).

Table S4 Comparison of electrochemical performance of various porous carbons from pitch.

Precursor	Structure	S_{BET} (m^2 g^{-1})	C (F g^{-1})	Electrolytes	Ref
CTP	Hierarchical porous carbon sheets	1604	290 (1 A g^{-1})	6M KOH	[4]
Sulfonated pitch	Hierarchical porous carbons	3548	277 (2 mVs^{-1})	6M KOH	[41]
Pitch-based cokes	--	983	276 (5 mVs^{-1})	1M H_2SO_4	[45]
graphene oxide/pitch oxide	Hierarchical porous carbons	2196	296 (0.1 A g^{-1})	6M KOH	[57]
CTP	Porous carbons	1409	287 (50 mV s^{-1})	6M KOH	[58]
CTP	Layer-stacked hierarchical porous carbons	3114	357 (0.5 A g^{-1})	6M KOH	This work
CTP	Layer-stacked hierarchical porous carbons	3114	484 (100 mV s^{-1})	6M KOH	This work