Supporting Information

Cost-Effective Conversion of "Stones" into High-Performance Capacitor Carbon through Solid-Solid Inorganic Chemical Reaction

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Fig. S1 The corresponding fine spectra of Si 2p of TC.



Fig. S2 XRD patterns of TC treated by 5 mol L^{-1} H₂SO₄ and 10 mol L^{-1} NaOH solutions, respectively.



Fig. S3 Component characterization of TC. a) FTIR analysis; b) Raman spectra. The data of YP50F are provided for comparison.

FT-IR spectral data of TC show two major adsorption bands at 1241 cm⁻¹ and 1589 cm⁻¹, corresponding to the backbone vibration of C=C and the stretching vibration of C-O-C, respectively. The presence of oxygen-containing groups on the surface of TC is demonstrated, which can improve the hydrophilicity of TC in aqueous/organic electrolytes. Typical D-peak (~1345 cm⁻¹) and G-peaks (~1586 cm⁻¹) can be observed, and the positions of the peaks approximately overlap with YP50F.



Fig. S4 Electrochemical performance of symmetric SCs using TC as electrodes in aqueous and organic electrolytes, respectively. a, b) CV curves at 0.01-0.5 V s⁻¹ in KOH/H₂O; c, d) CV curves at 0.02-0.5 V s⁻¹ in Et₄NBF₄/AN; e, f) GCD curves at different current densities (i.e., 1-50 A g⁻¹) in KOH/H₂O, respectively; g, h) GCD curves at 1-50 A g⁻¹ in Et₄NBF₄/AN. The data of YP50F are also provided for comparison.



Fig. S5 Characterizations of average particle size distribution. a) TC; b) TC_{1kg} . The inset is the corresponding SEM image.



Fig. S6 Electrochemical performance of symmetric SCs using TC_{1kg} as electrodes in 6.0 mol L⁻¹ KOH/H₂O electrolyte. a) CV curves at 0.01-0.5 V s⁻¹); b) GCD curves at 0.2-10 A g⁻¹); c) Nyquist plots.



Fig. S7 Cycling stability and Coulombic efficiency of YP50F at 5 A g^{-1} in 6.0 mol L⁻¹ KOH/H₂O electrolyte.

Various carbon	Samples	SSA	Electrolyte	Current density /Scan rate	C_{wt} (F g ⁻¹)	Note	Refs.
CaC ₂ -derived carbon	TC	1090	6 M KOH	1 A g ⁻¹	127	/	This study
	CDC-Zn	191	6 M KOH	1 mV s ⁻¹	105	/	1
	OACM	687	6 M KOH	0.15 A g ⁻¹	121	/	2
	CCDPC	525	1 M KOH	0.5 A g ⁻¹	116	/	3
	CCDC	612	6 M KOH	10 mV s ⁻¹	108	/	4
	CaC ₂ -CDC	800	6 M KOH	10 mV s ⁻¹	126	/	5
	Sample (850°C)	325	/	5 mV s ⁻¹	84	/	6
CaCO ₃	Carbon-DC	652	6 M KOH	1 A g ⁻¹	176	/	7
-derived	3-6-800	544	/	100 mV s ⁻¹	190	/	8
carbon	NPC4	1133	$1 \text{ M H}_2 \text{SO}_4$	0.5 A g ⁻¹	162	5.9 at. %	9
CO ₂ converted carbon	SHSG-8	709	1 M EMIMBF ₄	2 A g ⁻¹	172	/	10
	TC-1	1020	6 M KOH	1 A g ⁻¹	140	/	11
	CPC1_700	1262	6 M KOH	1 A g ⁻¹	270	0.45 at. % B-doped	12
Biomass -derived carbon	PGCS-1- 1100	540	6 M KOH	1 A g ⁻¹	213	/	13
	FC-0-8	479	6 M KOH	1 A g ⁻¹	84.3	/	14
	CNS/CF _{0.15}	1068	6 M KOH	0.5 A g ⁻¹	355	/	15
MOF -derived carbon	NHCSF-3	816	6 M KOH	1 A g ⁻¹	254	20 at. % N-doped	16
	HPCNFs-N	418	$2 \text{ M} \text{H}_2 \text{SO}_4$	5 A g ⁻¹	264	/	17
	MIL-101- NH ₂	2987	$1 \mathrm{M} \mathrm{H}_2 \mathrm{SO}_4$	0.1 A g ⁻¹	272	9.6 at. % N-doped	18
Carbon derived from others	MWCNT	130-410	6 M KOH	10 mV s ⁻¹	80-135	/	19
	GH-H	951	5 M KOH	1 A g ⁻¹	220	C/N= 36.7	20
	HGF-EC	2630	1 M EMIMIBF4	1 A g ⁻¹	298	/	21
	N/P-TRGO	152	6 М КОН	⁶ 0.1 A g ⁻¹	165	2.9 at. % N-doped + 4.3 at. % P-doped	22
	GNS/CB-2	586	6 M KOH	10 mV s ⁻¹	175	/	23

Table S1 Comparison of TC with carbon derived from CaC_2 , $CaCO_3$ and others on parameters and capacitance properties.

Samples	$R_{\rm s}\left(\Omega\right)$	$R_{\rm ct}\left(\Omega\right)$	$R_{ m w}\left(\Omega ight)$	$R_{\mathrm{ESR}}\left(\Omega ight)$
TC (KOH/H ₂ O)	0.27	0.67	1.88	2.82
TC _{1kg} (KOH/H ₂ O)	0.28	1.74	3.18	5.20
YP50F (KOH/H ₂ O)	0.21	2.44	2.82	5.47
TC (Et ₄ NBF ₄ /AN)	1.94	0.64	1.72	4.30
TC _{1kg} (Et ₄ NBF ₄ /AN)	1.72	0.69	3.61	6.03
YP50F (Et ₄ NBF ₄ /AN)	2.74	2.21	8.14	13.09

Table S2 Collection for the R_s , R_{ct} , R_w , and R_{ESR} of TC and YP50F in aqueous and organic electrolytes.

Table S3 Cost evaluation for the preparation of 1 kg of TC.

	Materials	Consumption	Price (RMB)	Total (RMB)	
Dorr motorials	CaC_2	1.3 kg	2.7	4	
Kaw materials	CaCO ₃	1 kg	0.5		
F	Ball milling	44 kWh	0.49	26.4	
Energy	Drying	10 kWh	0.49		
Auxiliary	HC1	25 kg	0.4	15 (
materials	N_2	1.25 L	4.5	15.6	

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