Energy Materials

Supplementary Materials

Molecular engineering of coffee grounds via exogenous precursor-guided hydrothermal carbonization and activation for high-performance supercapacitor electrodes

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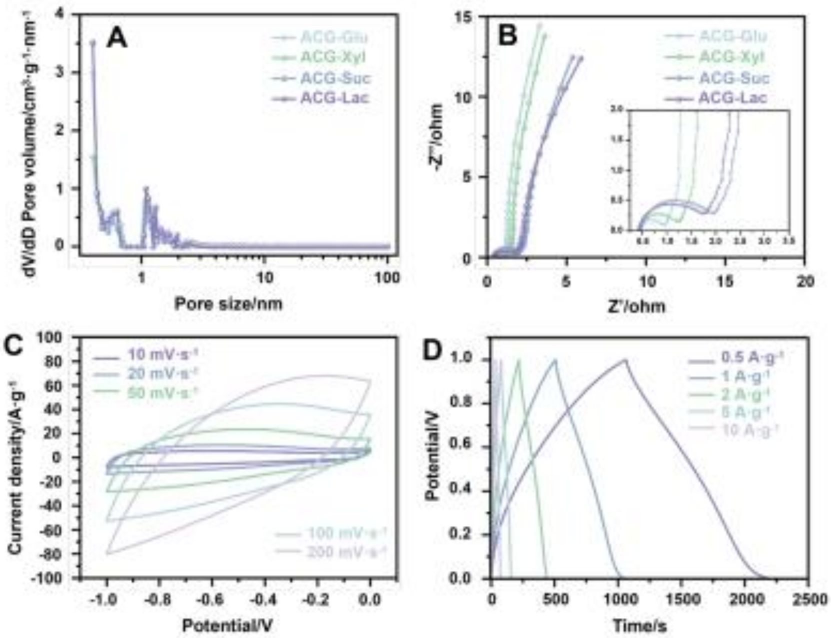

Figure S1. (A) Pore size distributions of ACG-Glu, ACG-Xyl, ACG-Suc and ACG-Lac. (B) Nyquist plots for ACG-Glu, ACG-Xyl, ACG-Suc and ACG-Lac electrodes. (C) CV curves at various scan rates and (D) GCD curves at various current densities for ACG-Lac electrode.

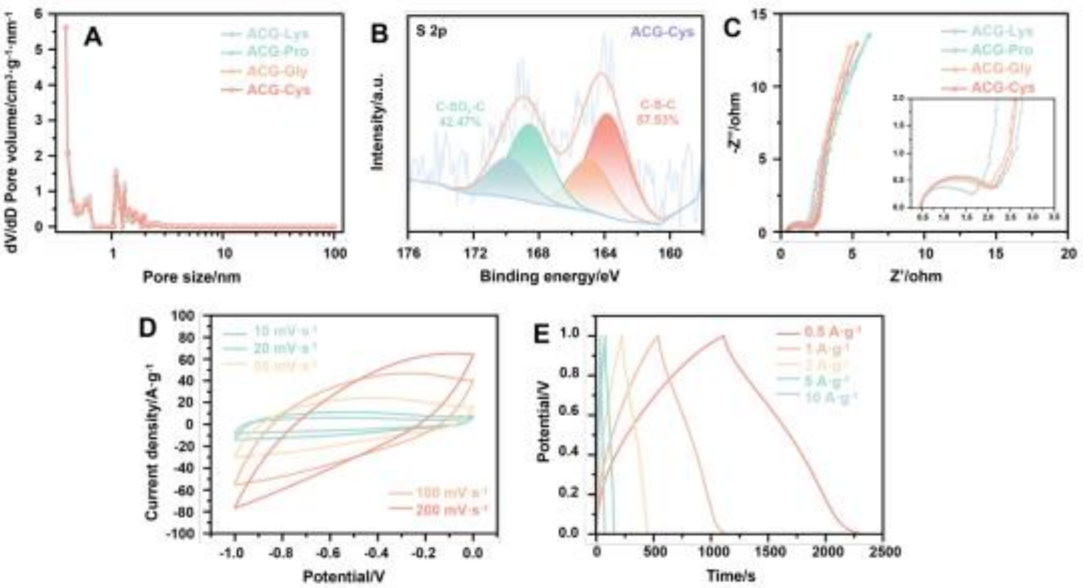

Figure S2. (A) Pore size distributions of ACG-Lys, ACG-Pro, ACG-Gly and ACG-Cys. (B) S 2p spectra of ACG-Cys. (C) Nyquist plots for ACG-Lys, ACG-Pro, ACG-Gly and ACG-Cys electrodes. (D) CV curves at various scan rates and (E) GCD curves at various current densities for ACG-Cys electrode.

Table S1. Specific capacitances of sugar-derived activated carbons at different current densities

Current density ($A \cdot g^{-1}$)	ACG-Xyl	ACG-Glu	ACG-Fru	ACG-Suc	ACG-Lac
0.5	394.26	447.76	459.12	473.76	564.25
1	375.78	434.22	441.40	455.04	547.06
2	342.19	395.15	405.17	382.17	446.61
5	324.62	375.88	379.44	353.13	407.84
10	313.17	364.54	363.84	336.66	384.42

Table S2. Hydrochar yield and activated carbon yield of all samples

Sample	Hydrochar yield (%)	Activated carbon yield (%)
ACG-Xyl	37.18	37.87
ACG-Glu	37.35	34.42
ACG-Fru	35.74	36.48
ACG-Suc	46.76	36.22
ACG-Lac	41.12	38.87
ACG-Pro	28.13	29.22
ACG-Lys	37.80	28.95
ACG-GluA	34.94	33.47
ACG-Gly	26.47	30.03
ACG-Cys	27.47	37.12

Table S3. Specific capacitances of amino-acid-derived activated carbons at different current densities

Current density ($A \cdot g^{-1}$)	ACG-Pro	ACG-Lys	ACG-GluA	ACG-Gly	ACG-Cys
0.5	467.31	522.86	569.61	572.36	602.72
1	447.08	502.92	538.80	555.76	592.54
2	386.73	428.71	442.46	450.73	456.35
5	361.55	399.86	405.94	419.76	407.41
10	345.29	379.91	382.22	394.99	382.46

Table S4. Capacitive-controlled and diffusion-controlled contributions of ACG-Cys at different scan rates determined by Dunn's method

Scan rates/$mV \cdot s^{-1}$	Capacitive-controlled contribution/%	Diffusion-controlled contribution/%
10	51.36	48.64
20	59.84	40.16
50	69.27	30.73
100	78.41	21.59
200	87.15	12.85

Table S5. Comparison of electrochemical performance of ACG-Cys with other biomass-derived porous carbons for symmetric supercapacitors in 6 M KOH electrolyte

Ref.	**Material**	**Electrolyte**	**Voltage (V)**	**Device**	**Capacitance ($F \cdot g^{-1}$)**	**Energy density ($Wh \cdot kg^{-1}$)**	**Power density ($W \cdot kg^{-1}$)**
46	NOHC600-KOH	6 M KOH	1.0	Symmetric	345 $F \cdot g^{-1}$ at 0.2 $A \cdot g^{-1}$	11.9	100
47	PMC-450	6 M KOH	1.0	Symmetric	317 $F \cdot g^{-1}$ at 0.5 $A \cdot g^{-1}$	7	1000
48	BN-PCS	6 M KOH	1.0	Symmetric	307 $F \cdot g^{-1}$ at 0.2 $A \cdot g^{-1}$	10.1	50
49	NOCN900	6 M KOH	1.0	Symmetric	168 $F \cdot g^{-1}$ at 1.0 $A \cdot g^{-1}$	6	250
50	K-3	6 M KOH	1.0	Symmetric	248 $F \cdot g^{-1}$ at 1.0 $A \cdot g^{-1}$	8.6	500