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Supporting Information

3D printed carbon aerogel microlattices for customizable supercapacitors with high areal capacitance

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Discussion S1. Assembly of The Fiber-Shaped Symmetrical Supercapacitor (FSSC)

Two fibrous CA electrodes were placed in parallel on a poly(ethylene terephthalate) (PET) substrate, silver paste was used to fix one end of the two electrodes and connected with two conductive copper wires. The semi-assembled device was placed in an oven to dry the silver paste. Then the poly(vinyl alcohol) (PVA)/H_2SO_4 was served as gel electrolyte, which was prepared by mixing 20 mL of H_2SO_4 (2 M) and 2 g of PVA powder with stirring continuously at 90 °C for 1 h. And two CA electrodes were coated with gel electrolyte to obtain an all-solid-state fiber-shaped symmetrical supercapacitor, which was named as CA-x FSSC.

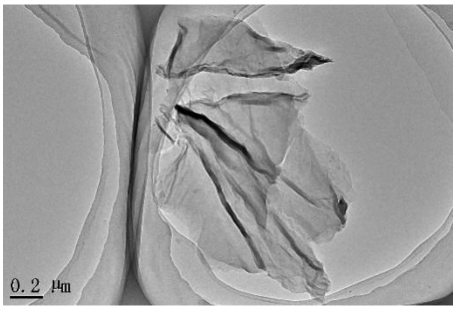

Figure S1. TEM image of GO sheets.

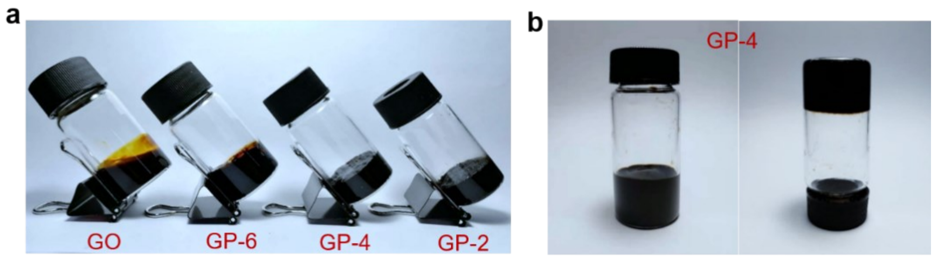

Figure S2. (a) Digital photo of GO and GP-x inks in inclined glass bottles. (b) Digital photo showing GP-4 ink in an inverted square bottle.

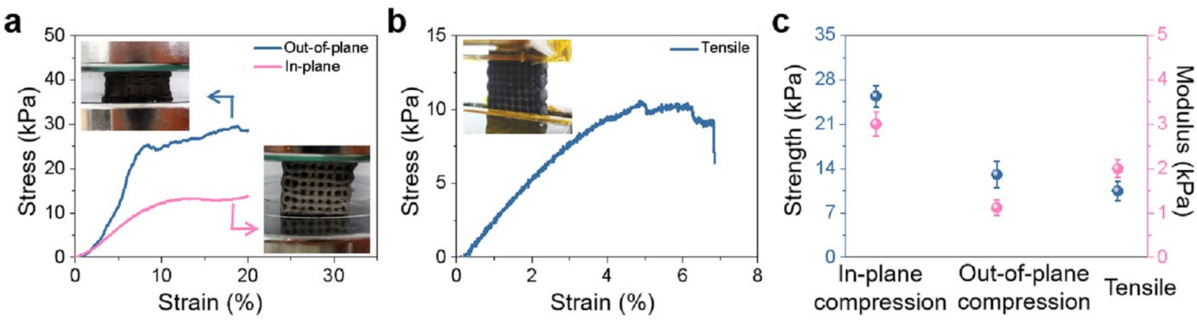

Figure S3. Mechanical properties of CA-4 microlattice. (a) The stress curves as a function of compressive strain. (b) The stress curves as a function of tensile strain. (c) The statistical data of the mechanical test.

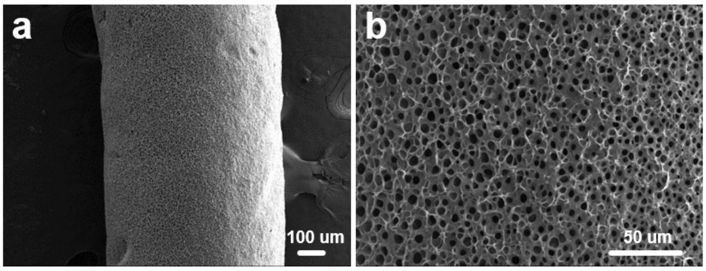

Figure S4. Surface morphology of single fibrous CA-4. (a) low magnification. (b) high magnification.

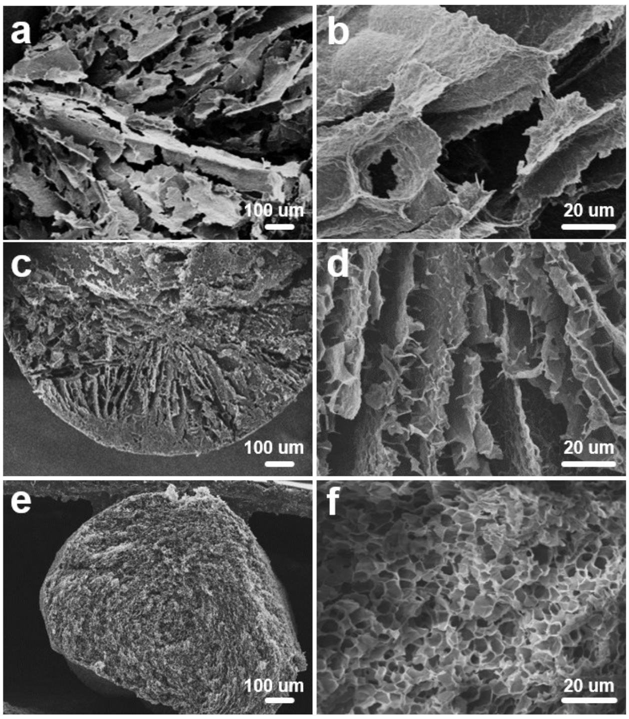

Figure S5. Cross-sectional SEM images of (a, b) CA, (c, d) CA-6 and (e, f) CA-2 fibers.

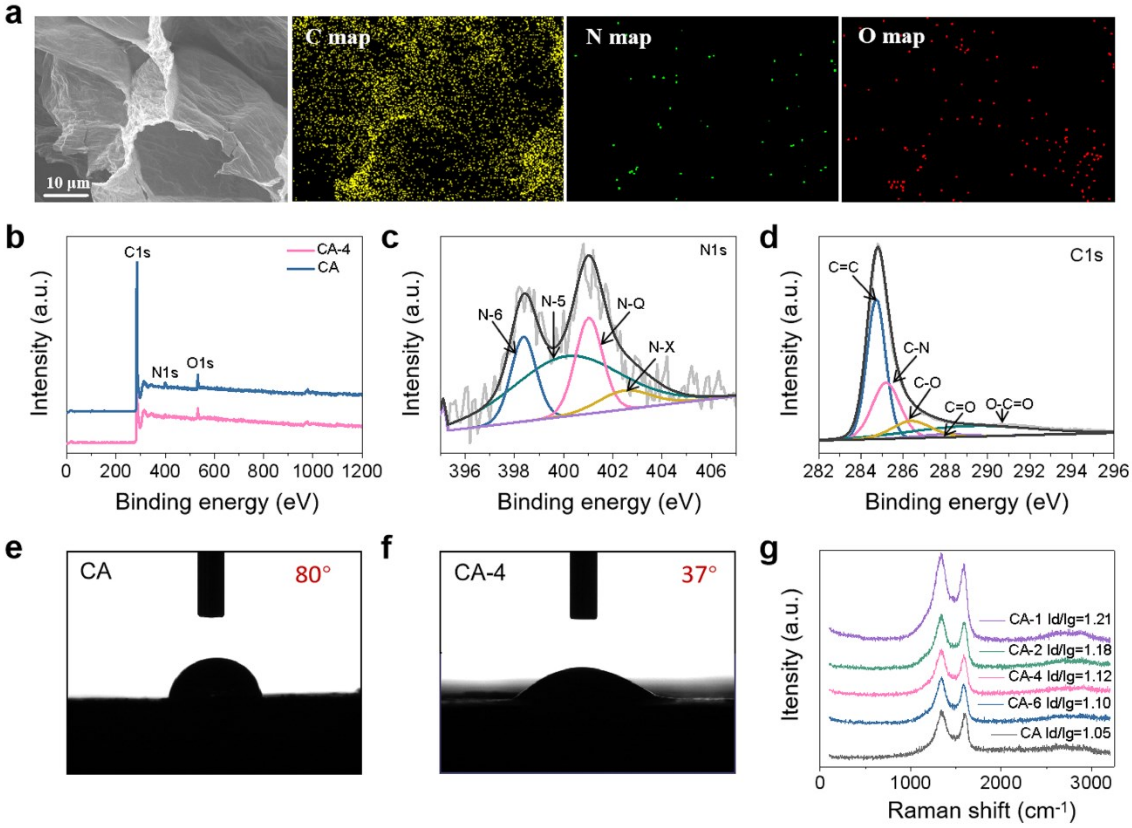

Figure S6. (a) SEM image and EDS elemental maps of carbon (C), nitrogen (N) and oxygen (O) element for CA-4. (b) XPS survey spectrum for the CA and CA-4. High-resolution XPS spectra of (c) C1s peak and (d) N1s peak of CA-4. (e) Contact angle of a water droplet on the surface of CA and (f) CA-4. (g) Raman spectra of CA and CA-x.

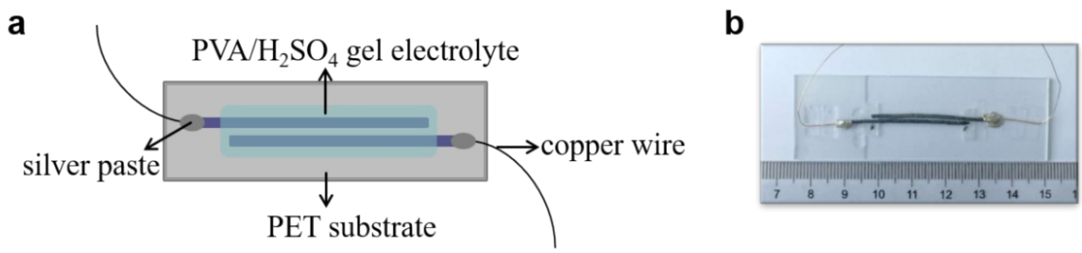

Figure S7. (a) Schematic of an all-solid-state fiber-shaped symmetric supercapacitor (FSSC). (b) Optical image of the CA-4 FSSC.

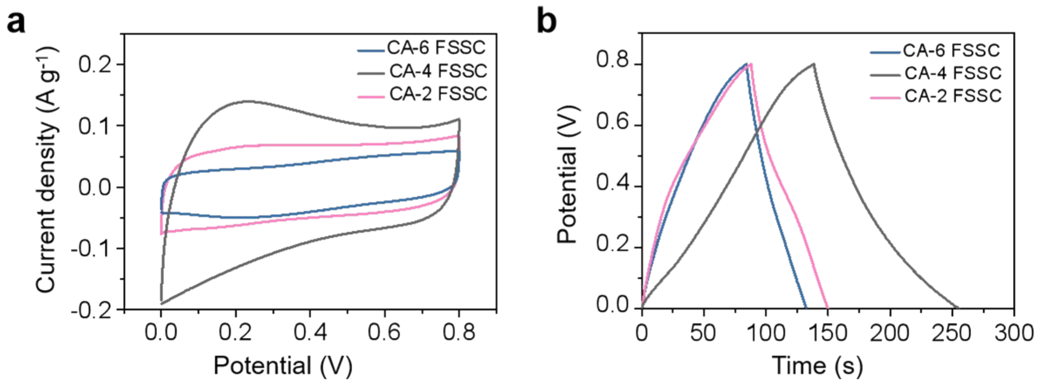

Figure S8. (a) CV curves of the CA-x FSSC (x = 2, 4, 6) at a scan rate of 100 mV s^{-1}. (b) Galvanostatic charge-discharge curves of the CA-x FSSC (x = 2, 4, 6) at a current density of 0.5 A g^{-1}.

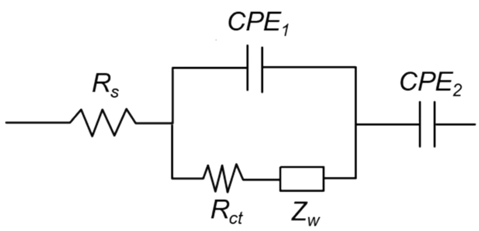

Figure S9. The corresponding equivalent circuit diagram.

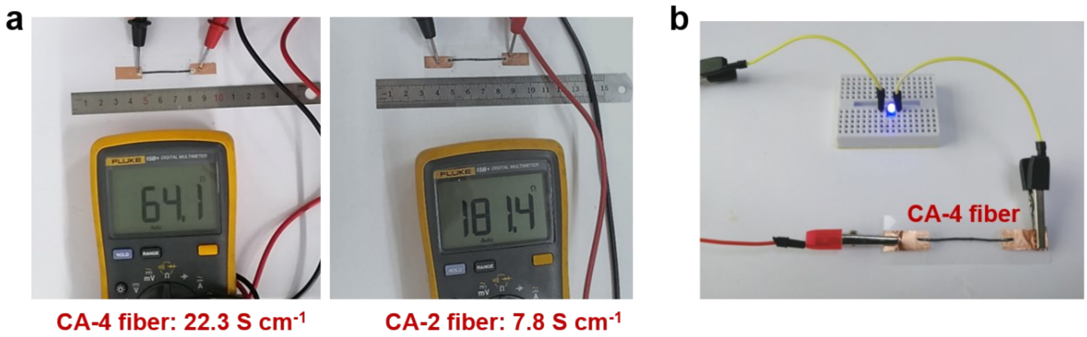

Figure S10. (a) Digital photo shows resistance value of single CA-4 and CA-2 fiber. (b) Optical image of a blue LED lighted by using CA-4 fiber as the conductor.

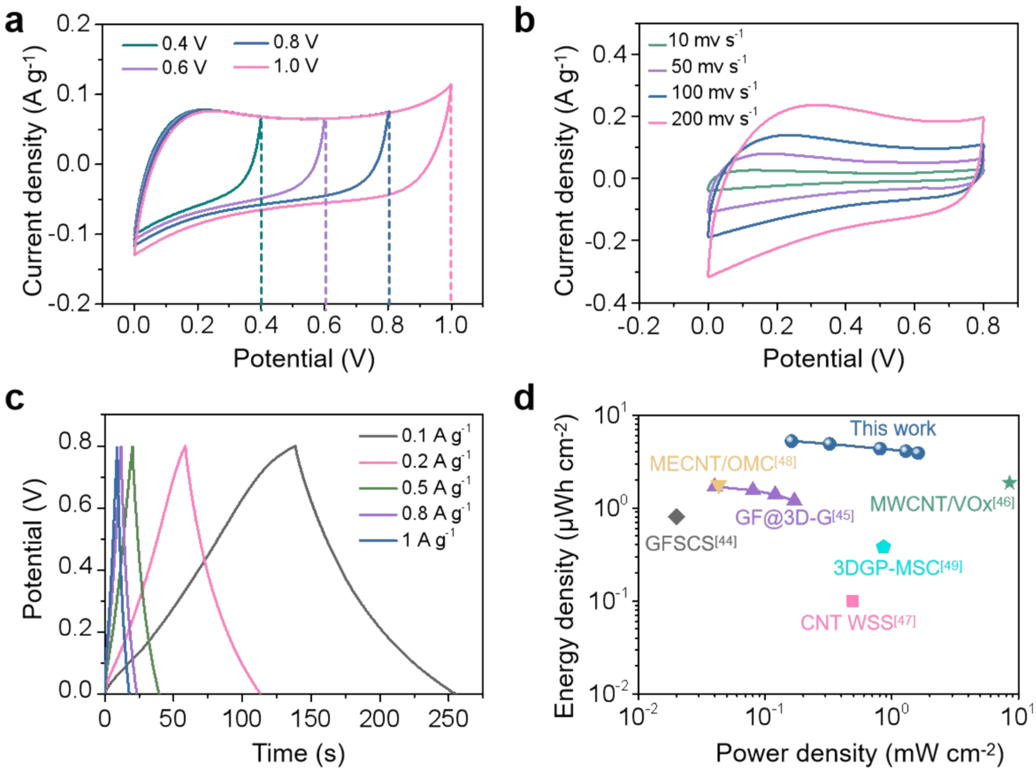

Figure S11. (a) Potential window measurement of CA-4 FSSC. (b) CV curves of the CA-4 FSSC at different scan rates. (c) GCD curves of the CA-4 FSSC at different current densities. (d) Ragone plots.

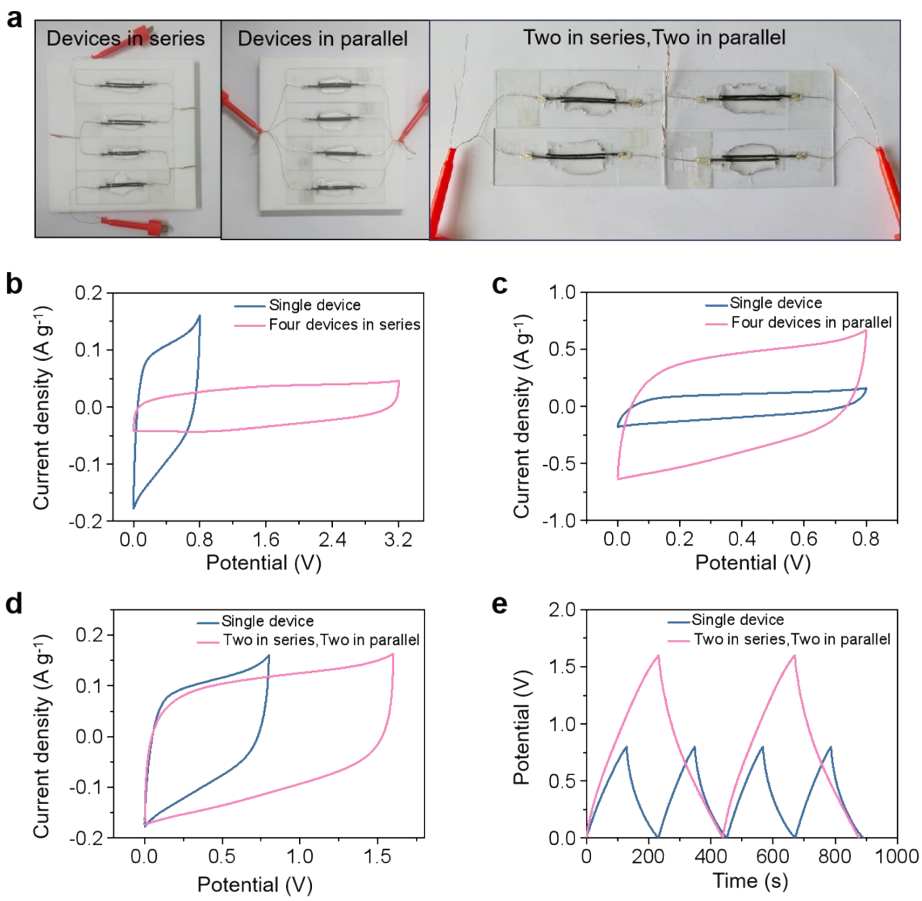

Figure S12. (a) Optical images of four CA-4 FSSC in series, four CA-4 FSSC in parallel, and two CA-4 FSSC in series and two in parallel, respectively. (b) CV curves of four devices in series. (c) CV curves of four devices in parallel. CV curves (d) and GCD curves (e) of an integrated device assembled by two CA-4 FSSC in series and two in parallel.

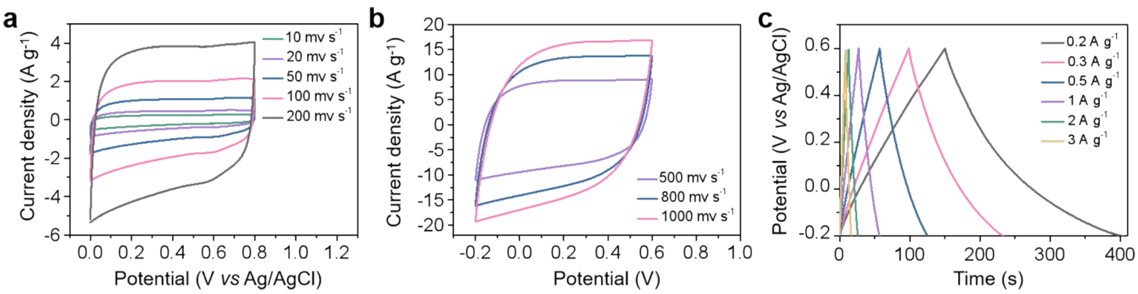

Figure S13. (a, b) CV of the CA-4 microlattice electrode with 6 layers at different scan rates. (c)

Galvanostatic charge-discharge curves of the CA-4 microlattice electrode with 6 layers at different current densities.

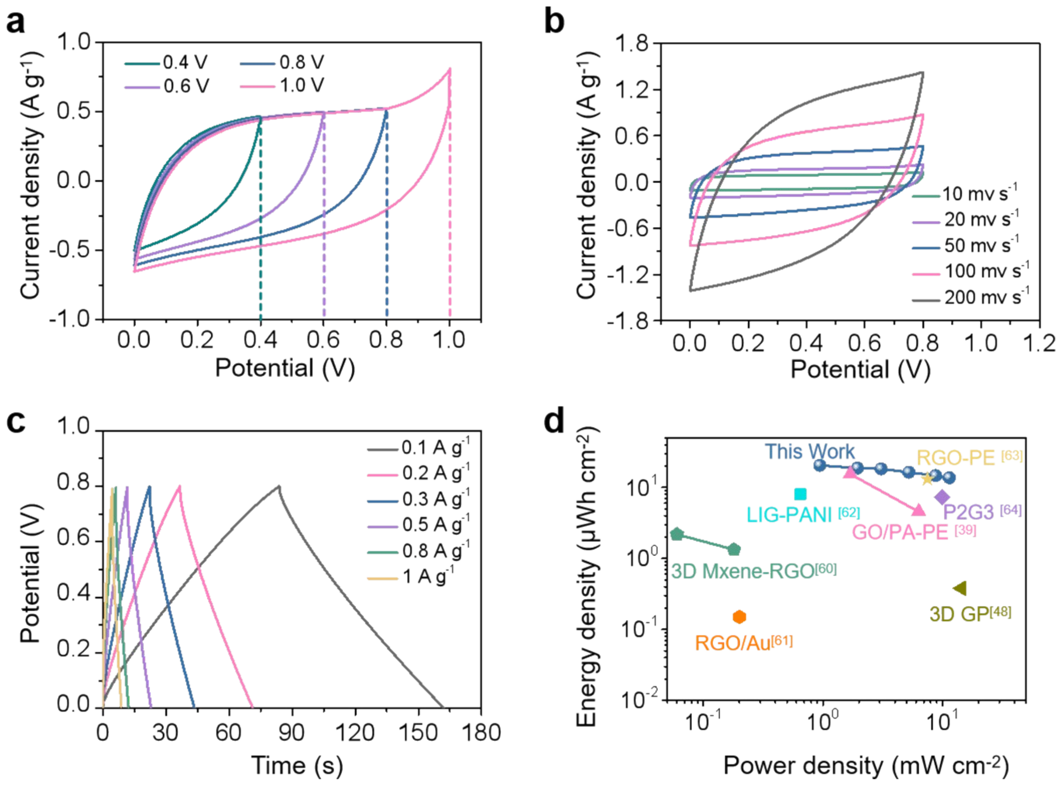

Figure S14. (a) Potential window measurement, (b) CV curves at different scan rates and (c) GCD curves at different current densities of a symmetric supercapacitor assembled by CA-4 microlattice with 6 layers. (d) Ragone plots.

Table S1. The atomic composition of the CA and CA-4 by XPS.

Samples	**Element content (at.%)**		
	C	N	O
CA	96.6	0	3.4
CA-4	92.6	2.3	5.1

Table S2. Equivalent circuit parameters of the fitting results for each component of the equivalent circuit fitted with the Nyquist plots.

Samples	R_s (Ω)	CPE_1 ($S \cdot sec^n$)	R_{ct} (Ω)	W ($S \cdot sec^{0.5}$)	CPE_2 ($S \cdot sec^n$)	n
CA-6 FSSC	34.8	0.001	14.5	0.01	0.001	0.75
CA-4 FSSC	32.3	0.002	6.1	0.003	0.005	0.89
CA-2 FSSC	62.5	0.001	9.4	0.001	0.0006	0.78
microlattice electrode (2 layers)	0.8	0.009	1.6	0.147	0.021	1.0
microlattice electrode (4 layers)	1.0	0.015	1.1	0.187	0.041	0.81
microlattice electrode (6 layers)	1.5	0.049	0.9	0.125	0.056	0.79
microlattice electrode (8 layers)	1.8	0.051	1.4	0.252	0.072	1.0
symmetric supercapacitor (6 layers)	1.8	0.301	2.4	0.103	0.247	0.26

Table S3. The electrochemical performance of representative carbon-based electrodes.

Materials	Electrolyte	Mass loading (mg cm^{-2})	C_s (mF cm^{-2})	C_v (F cm^{-3})	C_g (F g^{-1})	Ref
G/PANI-paper	1 M HCl	1	355.6 (0.5 mA cm^{-2})	/	/	[50]
MVNN/CNT	0.5 M $NaSO_4$	4	178 (1.1 mA cm^{-2})	/	/	[51]
Active CC	1 M H_2SO_4	12.6	88 (10 mV cm^{-2})	/	8.8 (10 mV cm^{-2})	[52]
3D GA	3M LiCl	12.8	12.6 (5 mA cm^{-2})	0.063 (5 mA cm^{-2})	2 (5 mA cm^{-2})	[53]
EACC	5M LiCl	11.3	756 (6 mA cm^{-2})	/	/	[54]
3D GCA	3M KOH	3.25	206.7 (10 A g^{-1})	1.3 (0.75 mA cm^{-3})	44 (10 A g^{-1})	[55]
GO/PA-PE	PVA-H_3PO_4	2.8	307.2 (5 mV s^{-1})	38.4 (5 mV s^{-1})	/	[39]
RTG	3 M KCl	8.5	820 (5 mA cm^{-2})	/	96.5 (5 mA cm^{-2})	[56]
MnO_2/CNF	1 M $NaSO_4$	9	525 (3 mA cm^{-2})	/	110 (3 mA cm^{-2})	[57]
GF/CNT/MnO_2	0.5 M Na_2SO_4	8.4	215 (10 mV s^{-1})	/	215 (10 mV s^{-1})	[58]
Graphene hydrogel	1 M H_2SO_4	2	372 (1A g^{-1})	/	186 (1A g^{-1})	[59]
CA Microlattice	1M H_2SO_4	15.3	870.3 (4.6 mA cm^{-2})	1.73 (9.4 mA cm^{-3})	56.8 (0.3 A g^{-1})	This work