

Supplementary Information for

Full Pseudocapacitive Behavior Hypoxic Graphene for Ultrafast and Ultrastable Sodium Storage

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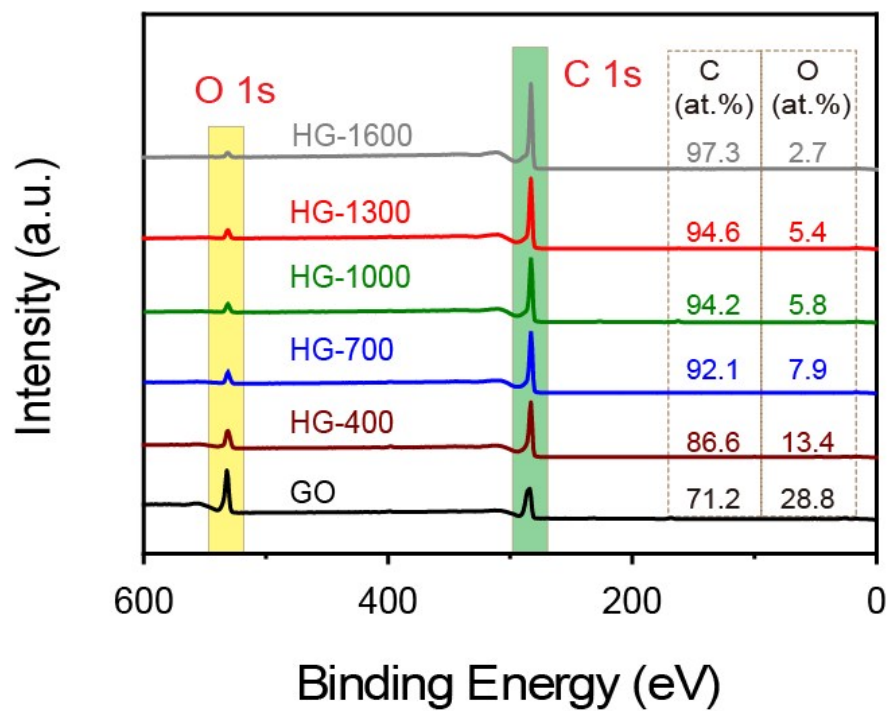


Fig. S1 The XPS spectra survey of GO, HG-400, HG-700, HG-1000, HG-1300, and HG-1600 materials.

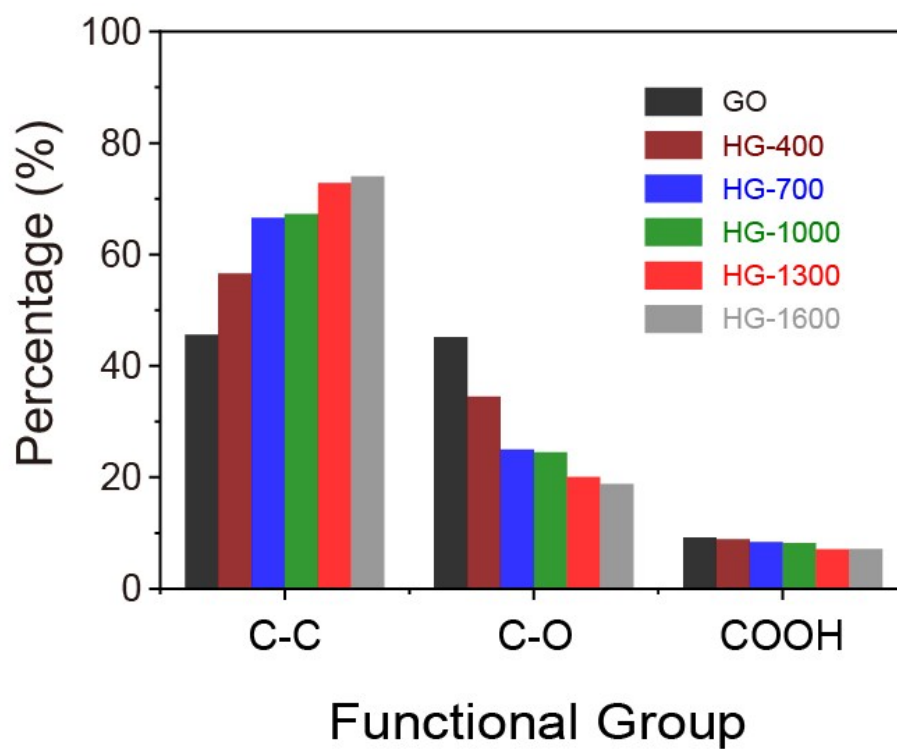


Fig. S2 The change of functional group content in materials of GO, HG-400, HG-700, HG-1000, HG-1300, and HG-1600 materials.

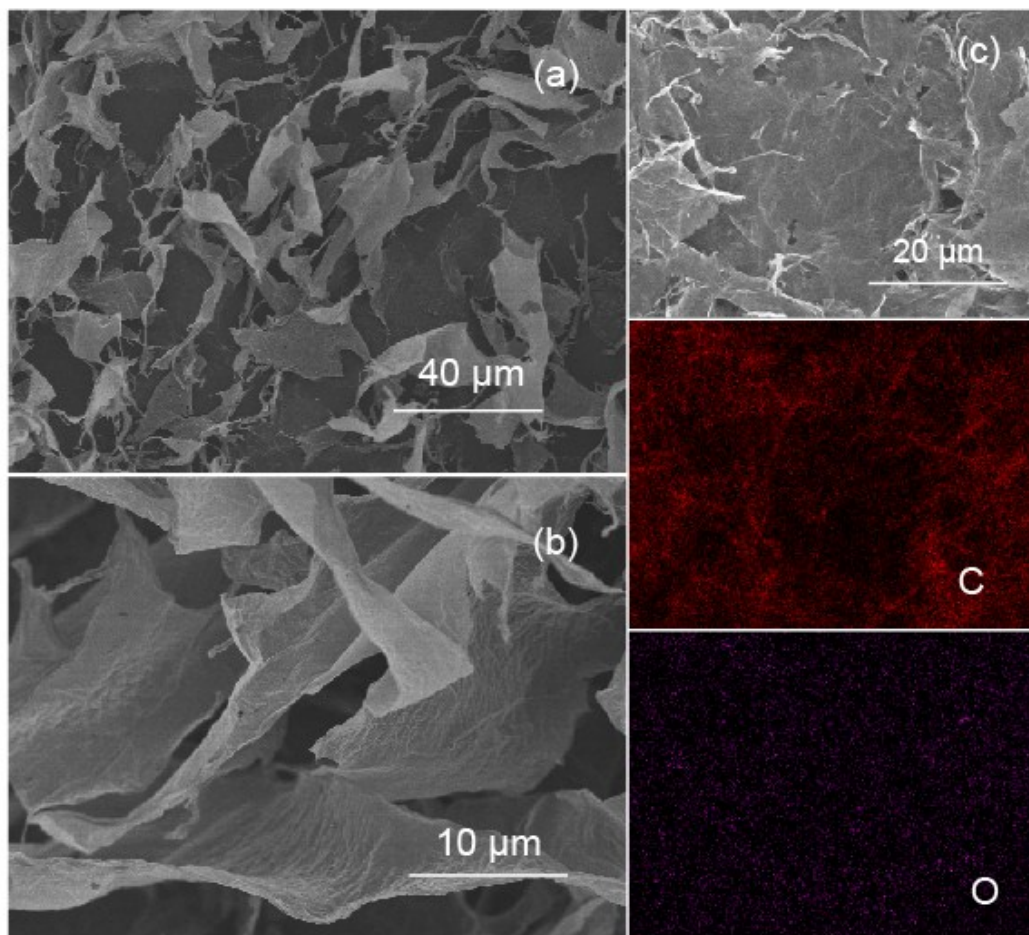


Fig. S3 (a and b) SEM images under different magnifications and (c) the elemental mapping images of the as-prepared HG-1300.

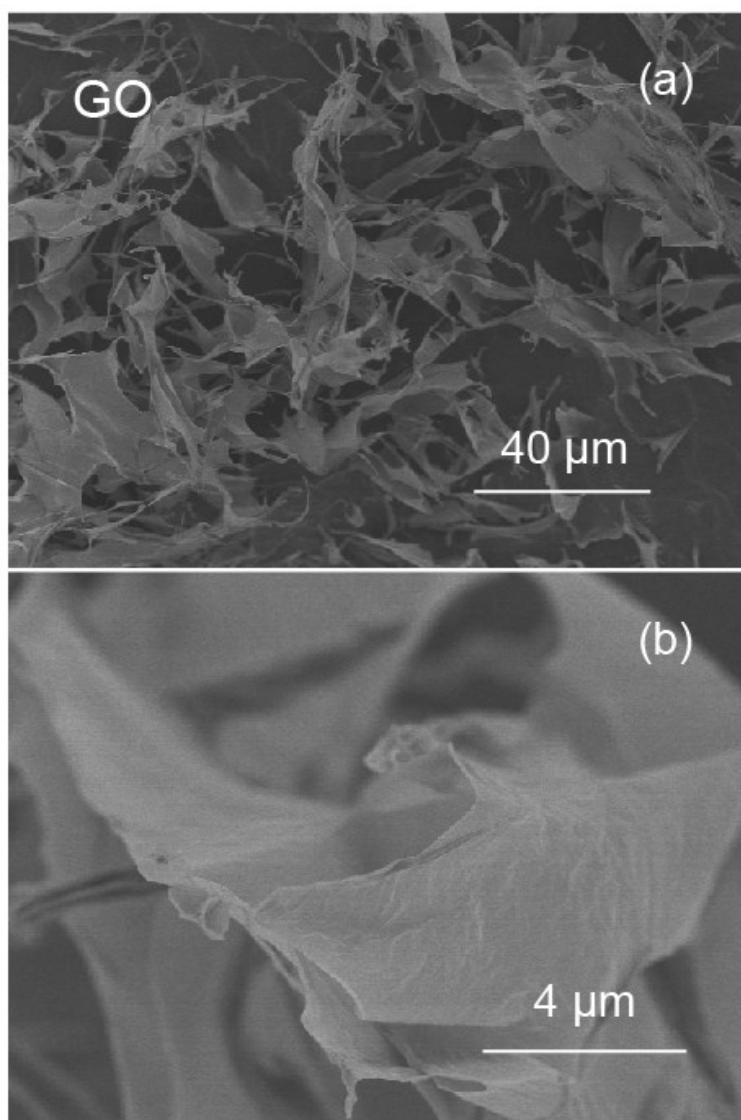


Fig. S4 (a and b) SEM images of GO under different magnifications.

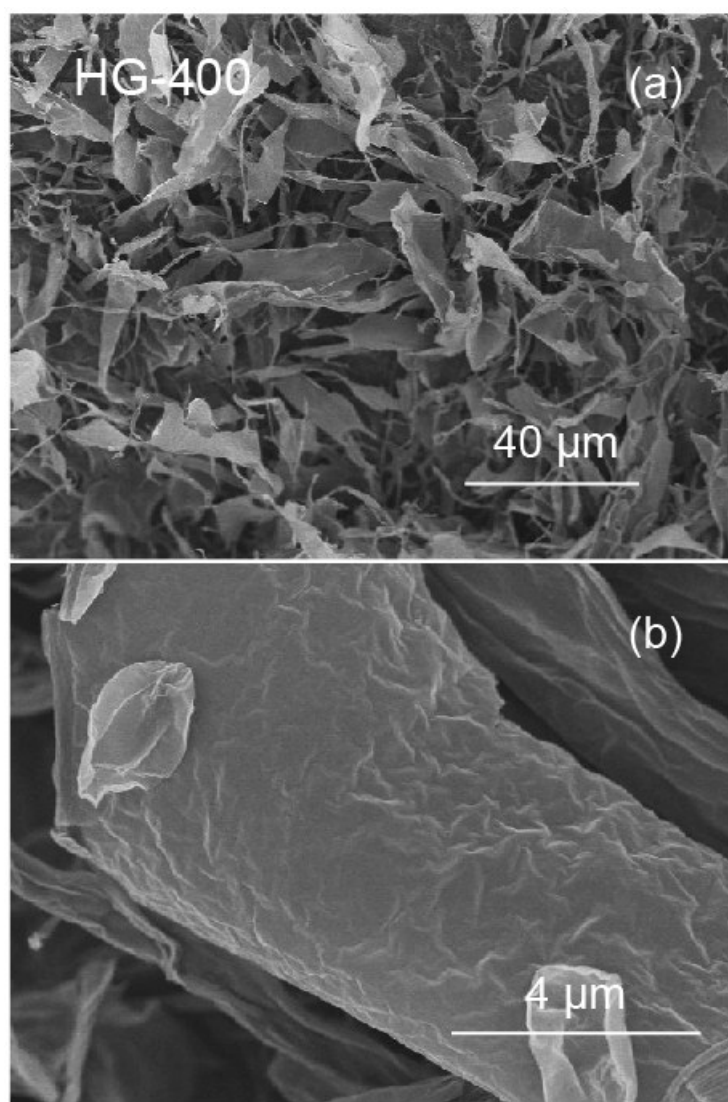


Fig. S5 (a and b) SEM images of HG-400 under different magnifications.

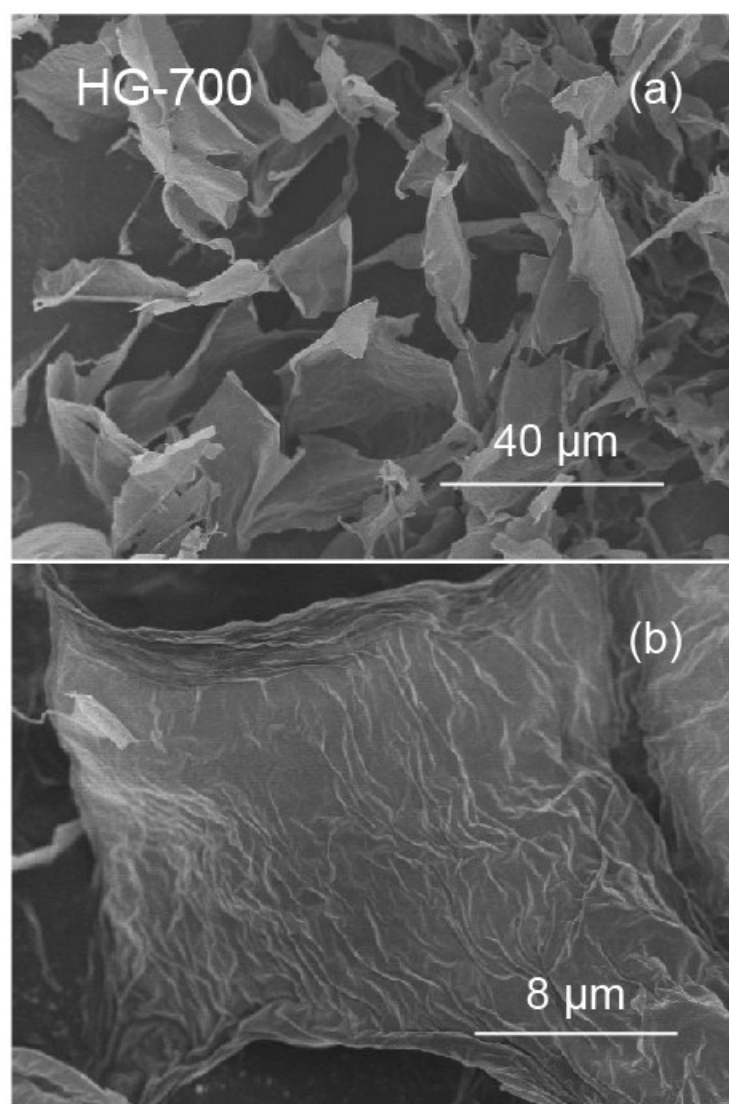


Fig. S6 (a and b) SEM images of HG-700 under different magnifications.

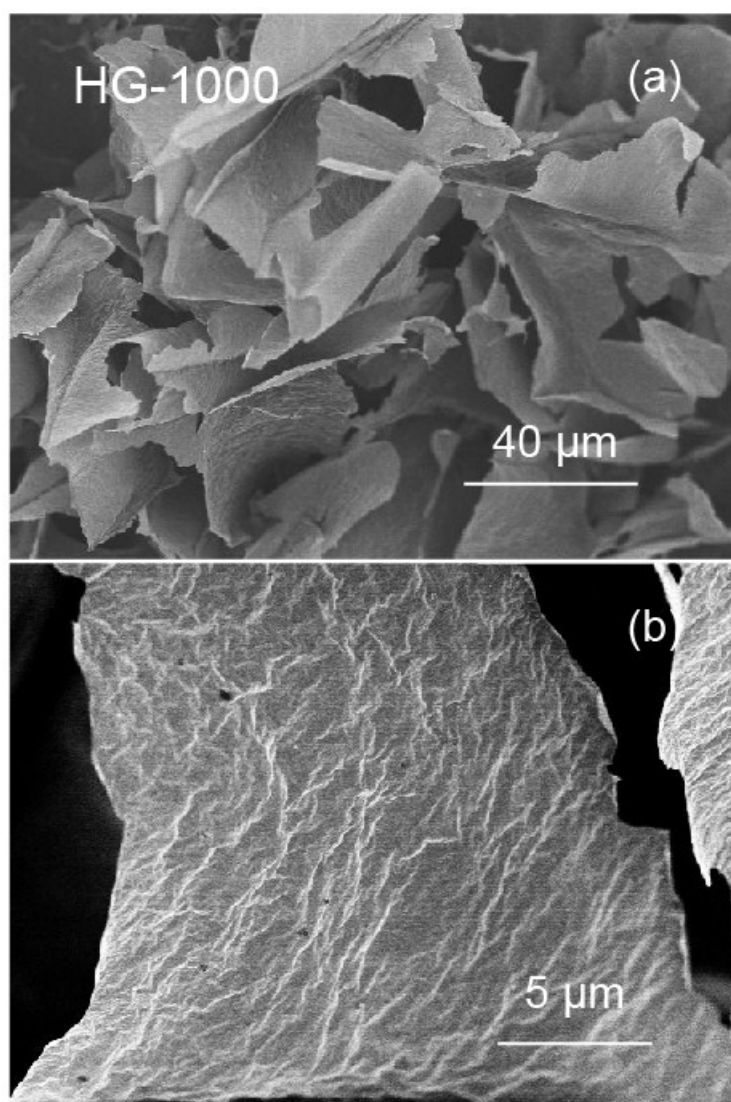


Fig. S7 (a and b) SEM images of HG-1000 under different magnifications.

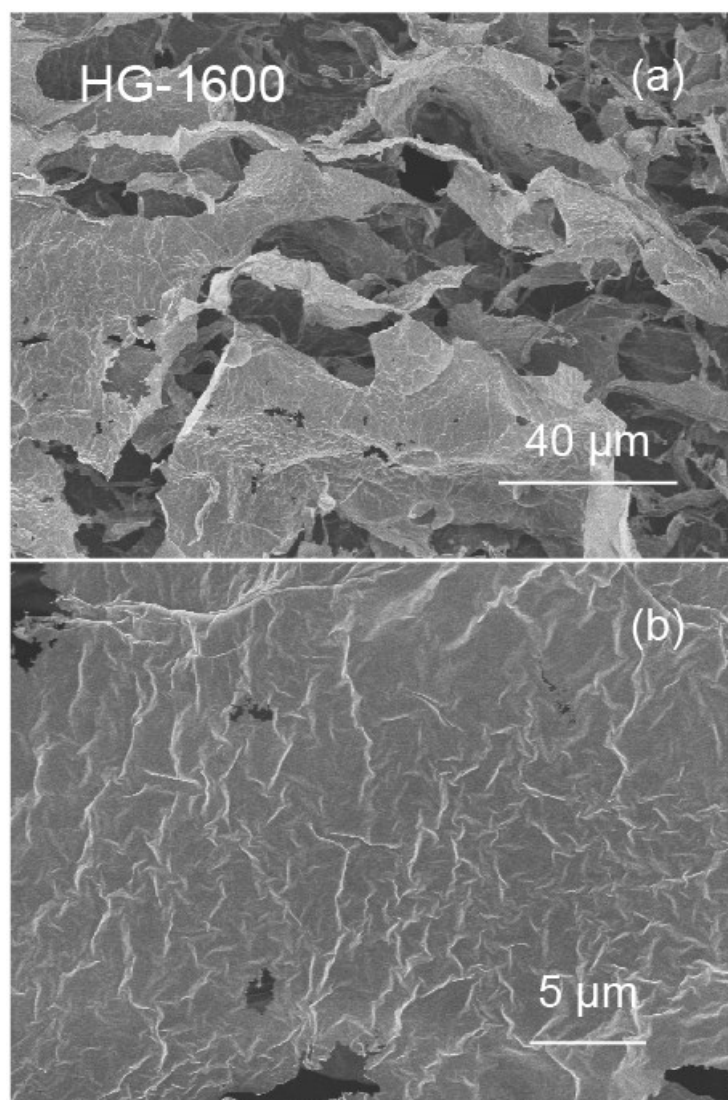


Fig. S8 (a and b) SEM images of HG-1600 under different magnifications.

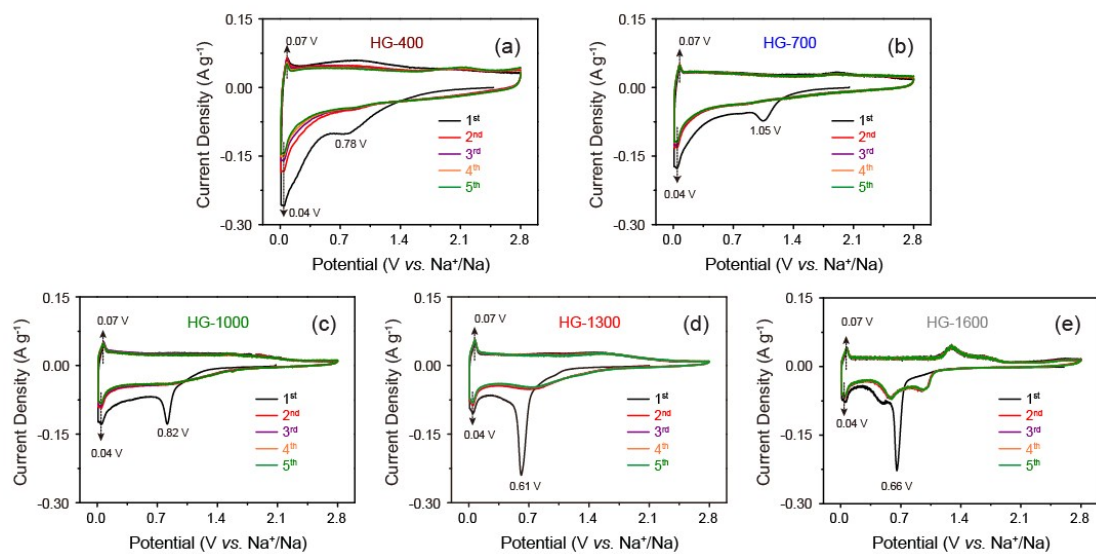


Fig. S9 CV curves of the initial 5 cycles for the HG-400, HG-700, HG-1000, HG-1300, and HG-1600 electrodes in the potential range of 0.01-2.8 V at a scan rate of 0.1 mV s⁻¹.

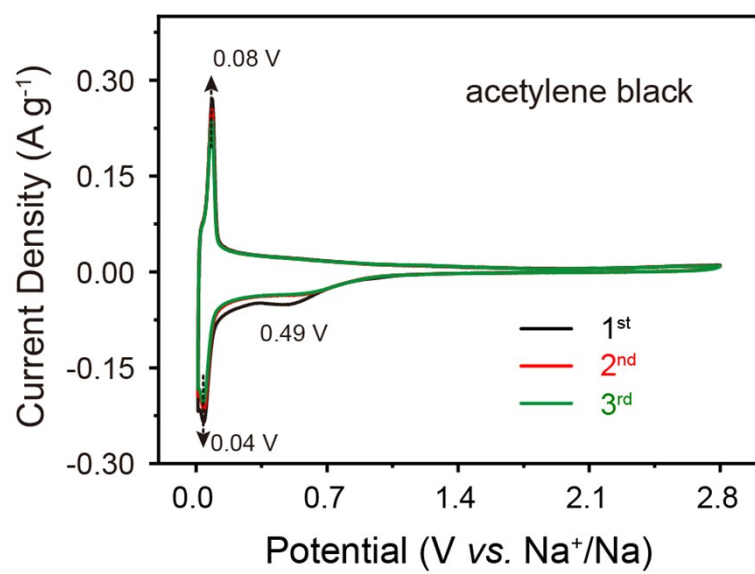


Fig. S10 CV curves of the first 3 cycles for the acetylene black.

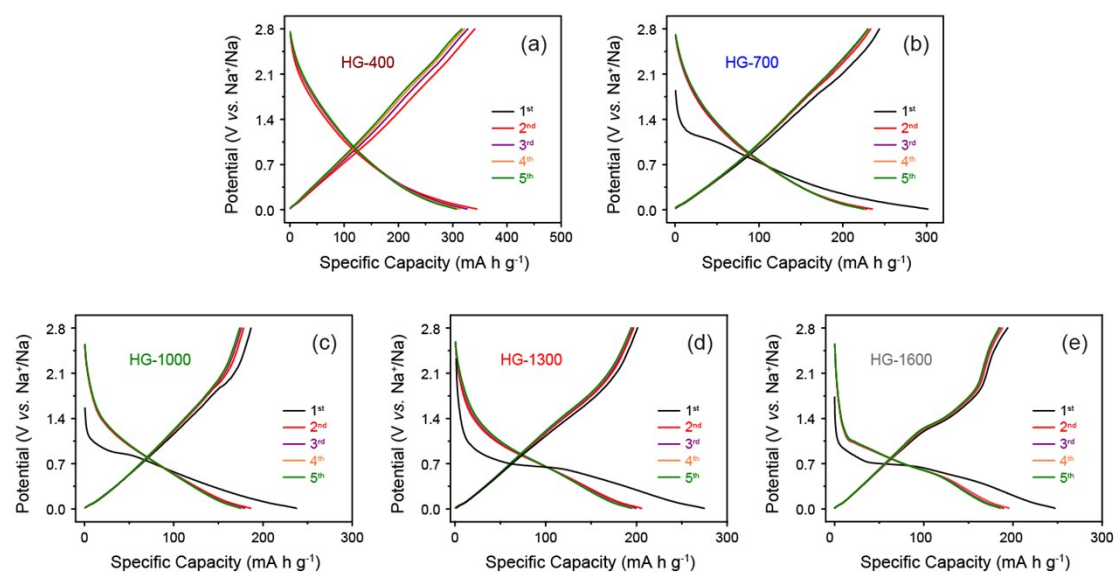


Fig. S11 Galvanostatic charge/discharge curves of the initial 5 cycles for the HG-400, HG-700, HG-1000, HG-1300, and HG-1600 electrodes in the potential range of 0.01-2.8 V at 0.05 A g⁻¹.

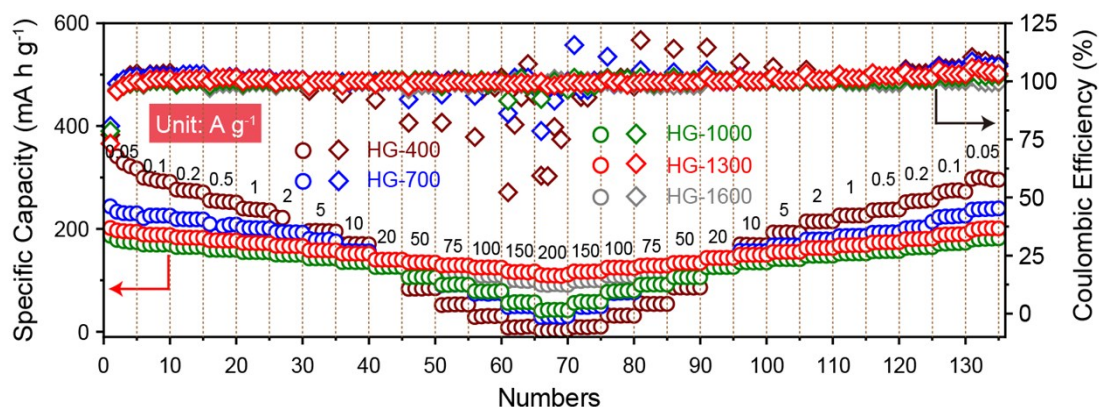


Fig. S12 Rate capability of the HG-400, HG-700, HG-1000, HG-1300, and HG-1600 electrodes at different current densities (Range: from 0.05 to 200 A g⁻¹, then return to 0.05 A g⁻¹ in turn).

As shown in Fig. S12, the initial specific capacities of HG-400, HG-700, HG-1000 and HG-1300 are 370.3 mA h g⁻¹, 243.6 mA h g⁻¹, 186.6 mA h g⁻¹ and 201.7 mA h g⁻¹, respectively. The reversible specific capacity of the HG-1300 is significantly lower than that of the HG-400 and HG-700. This is mainly due to the fact that the HG-1300 material prepared by high-temperature calcination contains a smaller amount of oxygen-containing functional groups. We know that, during charging/discharging, the oxygen-containing functional groups on graphene can store a part of sodium ions. The reaction contributes a portion of the specific capacity, but this portion of the capacity is not very stable; it will significantly diminish as the current density increases.

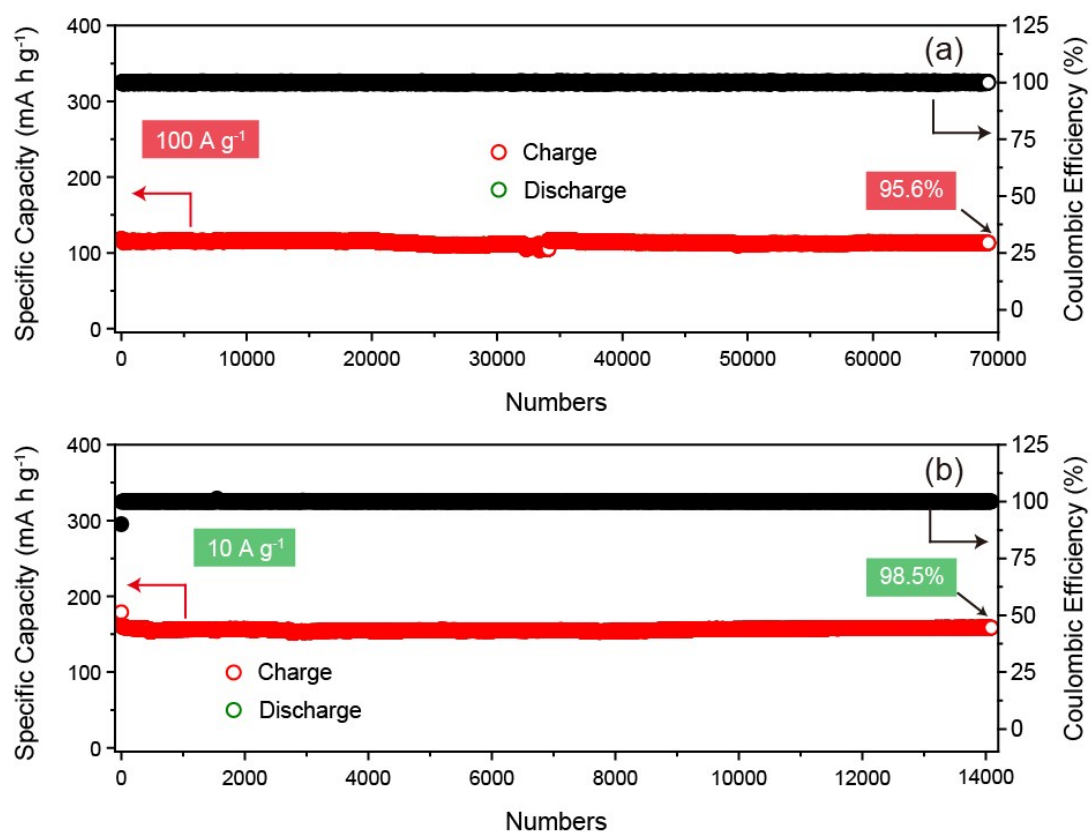


Fig. S13 Cycle performance of the HG-1300 electrode at 100 A g⁻¹ and 10 A g⁻¹.

Table S1. Comparisons of cycling performances in this study with the previously reported carbon-based materials for Na storage. As shown, the present HG-1300 exhibits excellent cycle stability.

Materials	j (A g ⁻¹)	Cycles (r)	Reversible capacity (mA h g ⁻¹)	Retention (%)	Decay rate per cycle (%)
	20	100 000	121.1	90.7	0.000093
HG-1300	10	14 000	158.8	98.5	0.000107
	100	70 000	113.2	95.6	0.000063
S-MCN-700 ¹	0.1	100	304.2	35.2	0.35
HC ²	1.0	2 000	196	90	0.005
HC ³	0.2	1 500	72.3	84	0.0107
C-600 ⁴	10	15 000	115	~100	--
CPP ⁵	0.2	200	203.3	98	0.01
3D PCFs ⁶	5	10 000	99.8	95.9	0.00041
3D N-GF ⁷	0.5	150	594	69.7	0.202
S-N/C ⁸	1	1 000	211	86	0.014
FP-MP 5:2 1000 ⁹	0.15	100	191	74	0.26
N-FLG-800 ¹⁰	0.5	2 000	210	98.6	0.0007
LPHC ¹¹	1	1 000	150	85	0.015
COAT-10-1400 ¹²	0.1	100	286	97	0.03
HCSs-CNTs ¹³	1.0	500	95.1	60	0.08
RHHC-1300 ¹⁴	0.025	100	346	93	0.07
NCL@GF ¹⁵	0.5	2 500	279	70	0.012
NC-550 ¹⁶	0.1	200	212	76.1	0.1195
NNCS ¹⁷	0.03	200	243.1	85	0.075
CF ¹⁸	0.2	200	169	97.7	0.0115
CNS ¹⁹	1	500	190	71.9	0.0562

HPNSC ²⁰	0.2	3 350	160.5	76	0.0072
without H ₃ PO ₄ treatment ²¹	0.2	220	181	84.6	0.07
AC111400 ²²	0.03	150	226	89	0.073
NMC600 ²³	0.05	300	268.9	71.46	0.095
SN-HCS ²⁴	0.5	2 000	169	81.25	0.0094
CPs ²⁵	0.02	100	298.1	99.3	0.007
LS1400 ²⁶	0.1	450	330	94	0.013
CC700 ²⁷	1	8 000	105	85	0.001875
N-HC ²⁸	5	10 000	101.4	97.3 ^{1000th}	0.0003
carbonized CNC ²⁹	0.1	400	300	88.2	0.0295
SGCN ³⁰	5	5 000	161.8	73.6	0.00528
HCP ³¹	2	1 000	176.8	75	0.025

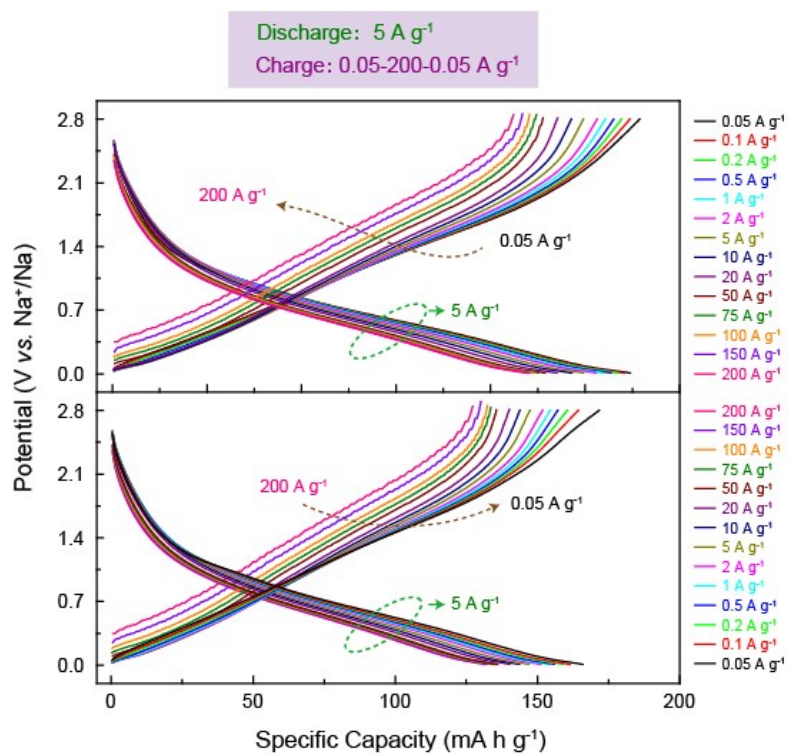


Fig. S14 Galvanostatic charge/discharge curves at different current densities.

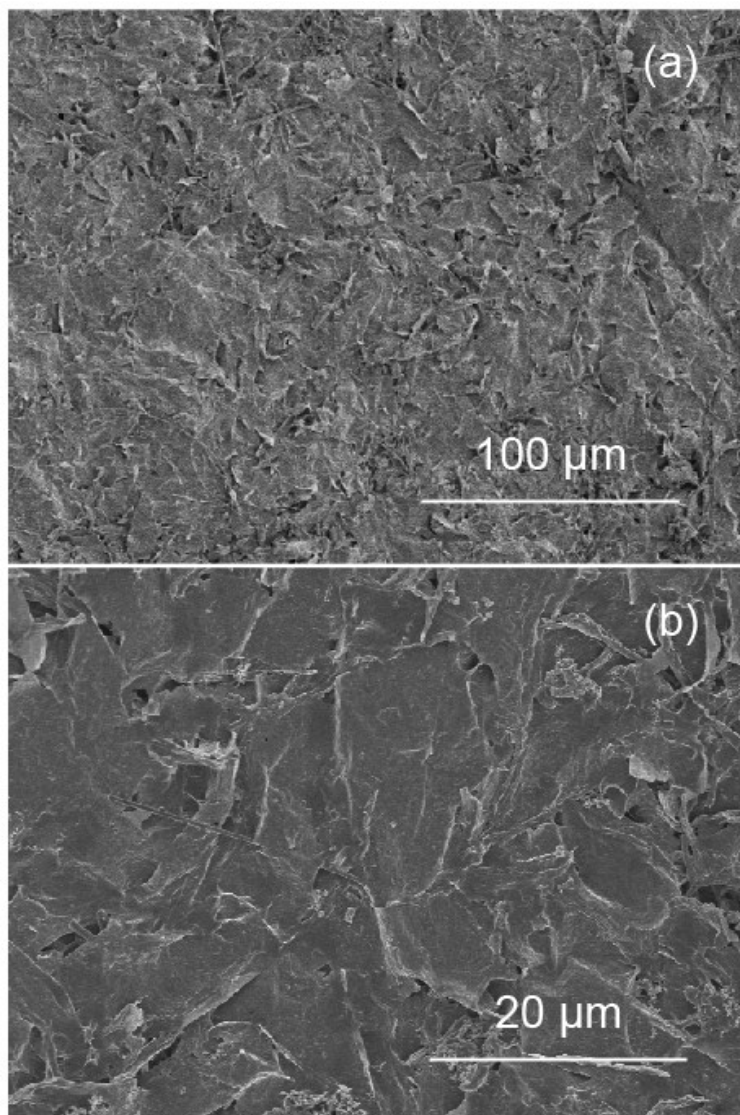


Fig. S15 (a and b) the SEM images of the HG-1300 electrode after 6000 cycles at the state of 5 A g⁻¹ discharge and 1 A g⁻¹ charge.

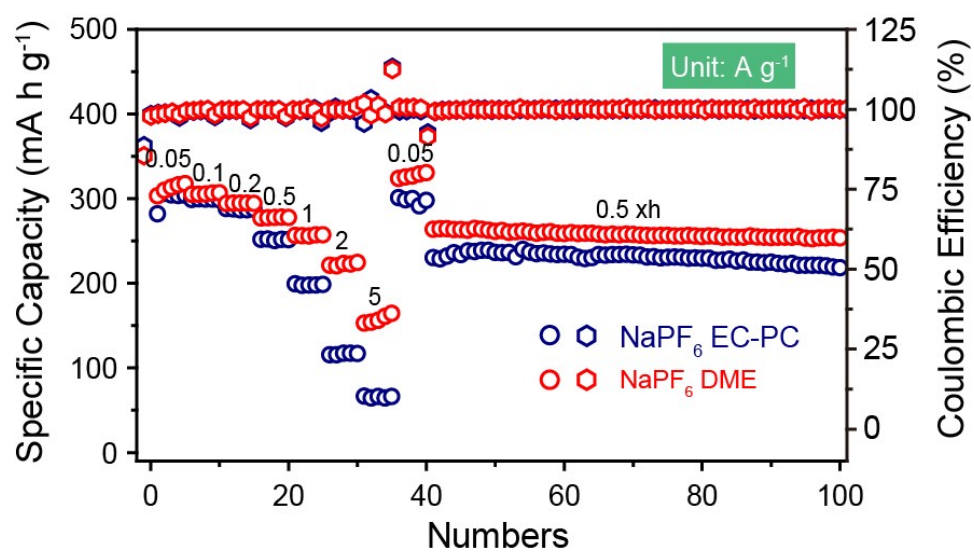


Fig. S16 Rate capability comparison for CSC electrode in 1 M NaPF₆/DME and 1 M NaPF₆/EC-PC electrolytes.

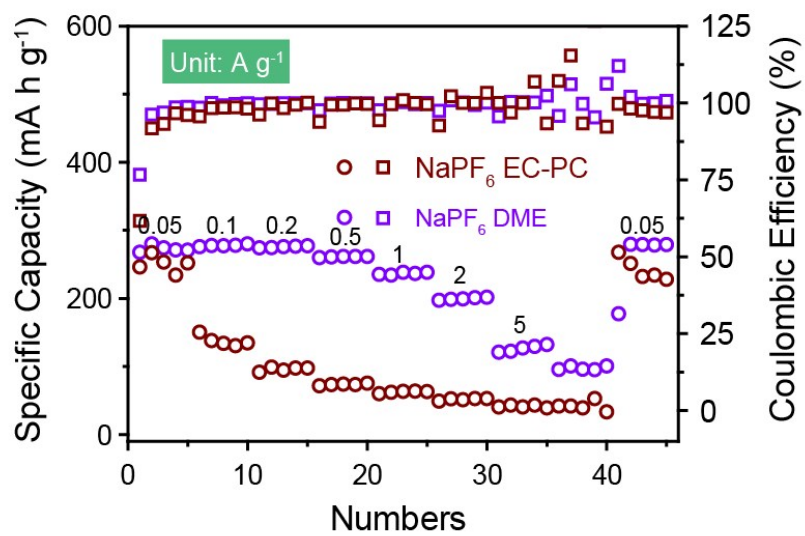


Fig. S17 Rate capability comparison for LSC electrode in 1 M NaPF₆/DME and 1 M NaPF₆/EC-PC electrolytes.

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