Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

ZIF-derived porous carbon: A conductive-agent-free supercapacitor electrode material

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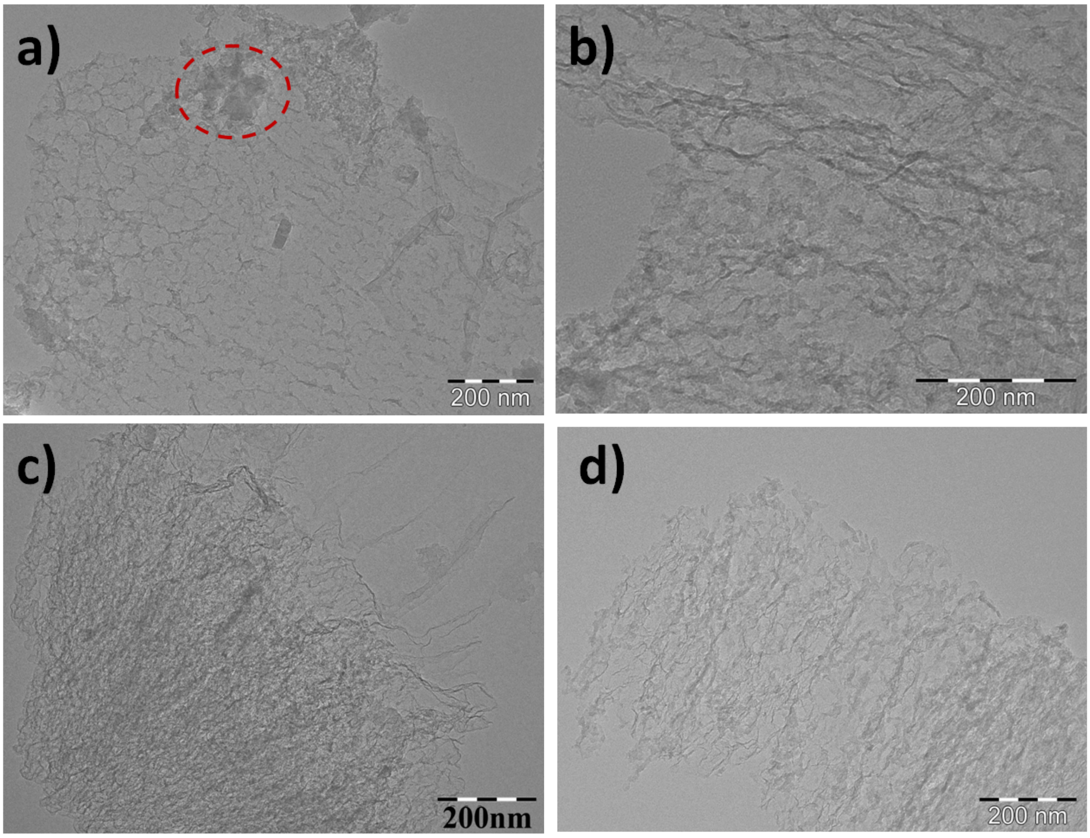

Fig.S1 TEM image of Carbon-L-T, T= a)750, b)850, c)950, d)1000℃

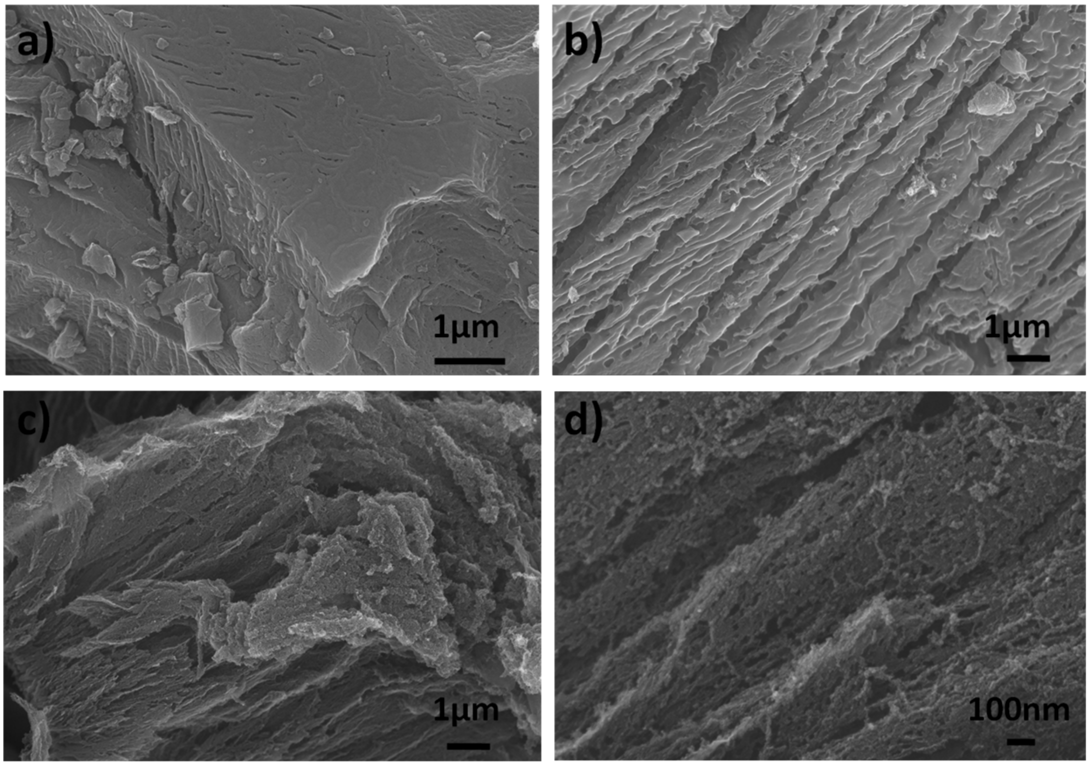

Fig.S2 SEM images of ZIF-derived porous carbons with different additional carbon sources： a) Carbon-F-950， b)Carbon-G-950, c) and d) Carbon-E-950

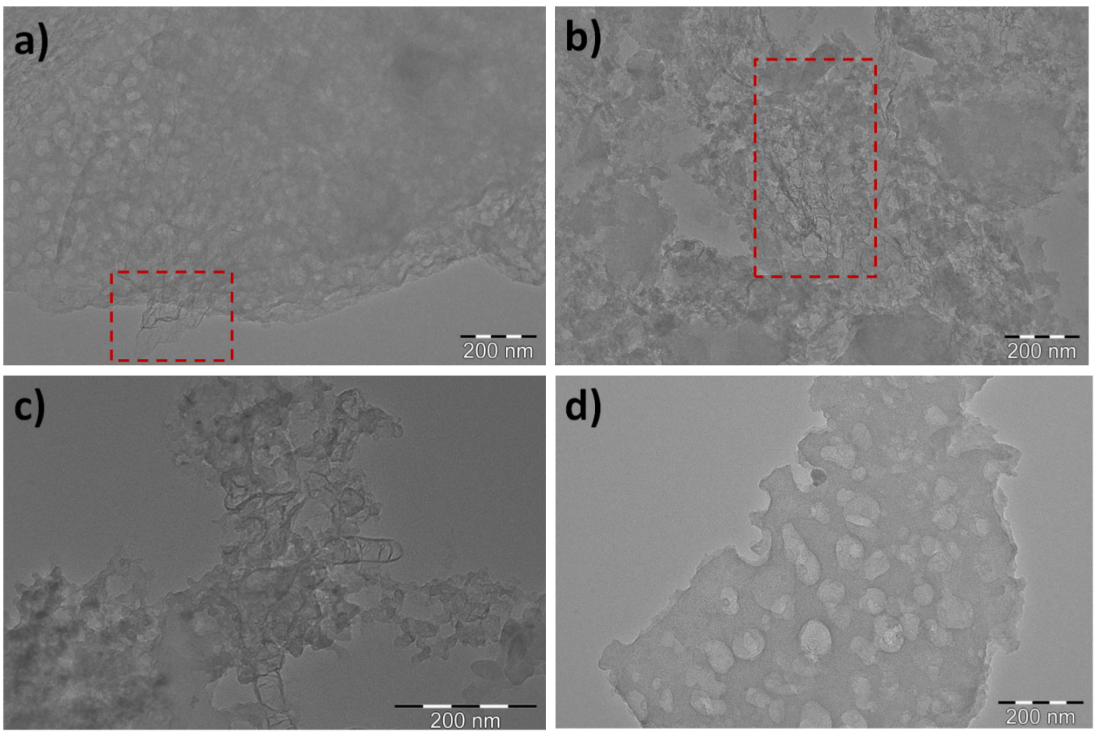

Fig.S3 TEM images of ZIF-derived porous carbons with different additional carbon sources a)

Carbon-F-950，b)Carbon-G-950, c) Carbon-E-950 and d) Carbon-Z-950

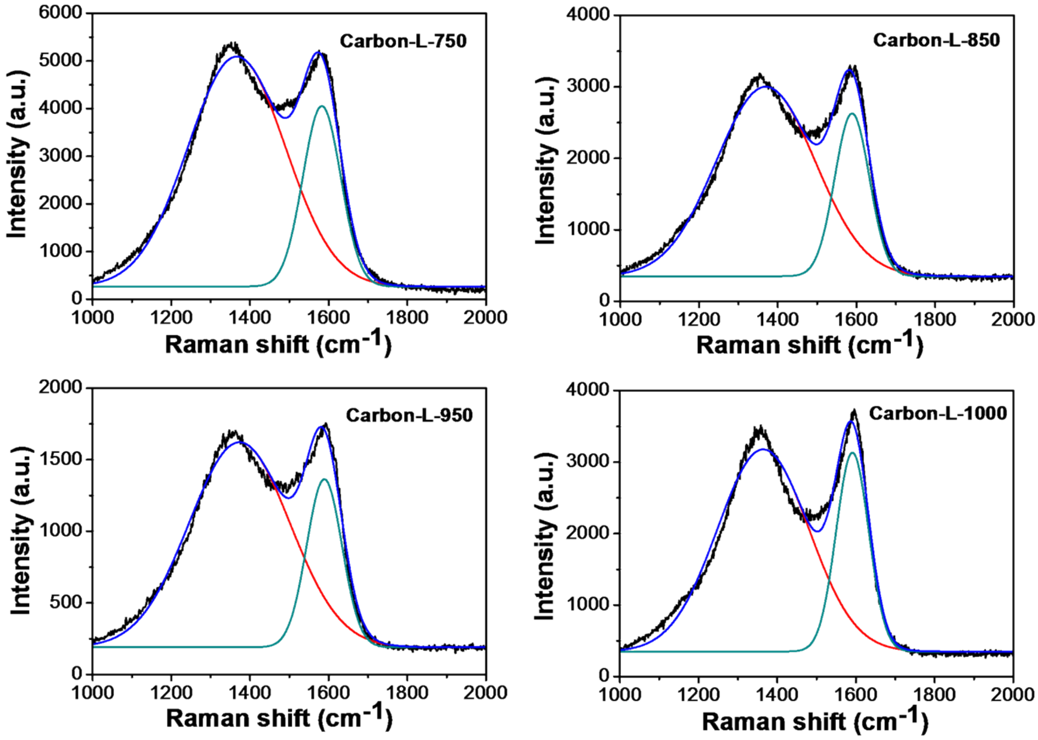

Fig S4 Deconvolution of the Raman spectrum of Carbon-L-T

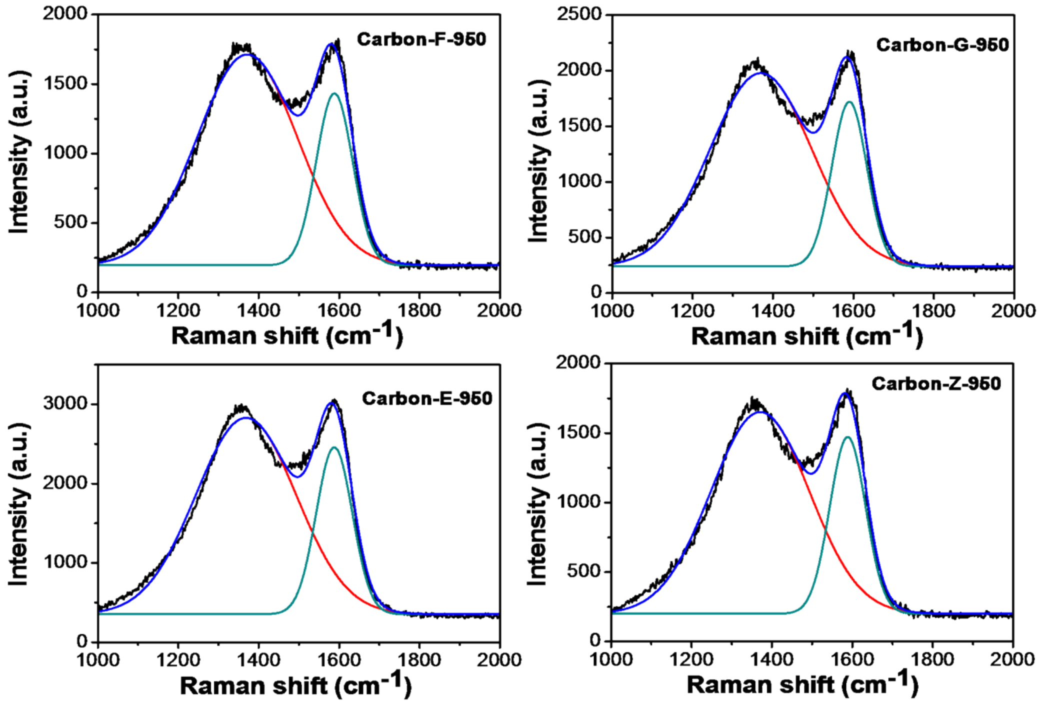

Fig S5 Deconvolution of the Raman spectrum of ZIF-derived porous carbons with different additional carbon sources

Tab.S1 The I_G/I_D of ZIF-derived porous carbons

Samples	Carbon-L-750	Carbon-L-850	Carbon-L-950	Carbon-L-1000
I_G/I_D	1.02	1.07	1.08	1.14
Samples	Carbon-F-950	Carbon-E-950	Carbon-G-950	Carbon-Z-950
I_G/I_D	1.05	1.08	1.08	1.08

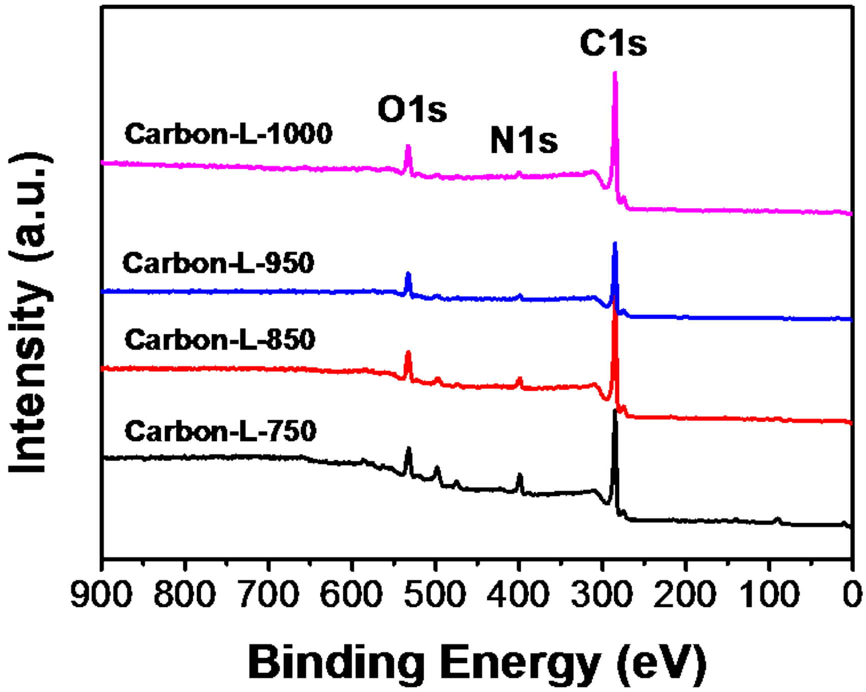

Fig.S6 XPS spectra of as-prepared Carbon-L-T

XPS analysis (Fig.S6) approves the existence of nitrogen and oxygen atoms in the ZIF-derived porous carbons. The N-containing benzimidazole ligands in ZIF-7 framework are sources of nitrogen atoms. With the carbonization temperature increasing, the nitrogen content of Carbon-L-T was gradually decreased. The presence of oxygen can be attributed to moisture, atmospheric O_2, or CO_2 adsorbed on ZIF-derived carbon as well as the residual oxygen-containing groups from ZIF-7 (nitroxyl group) and glucose (hydroxyl group, carbonyl group). As N and O functional groups are all electrochemically active to provide pseudocapacitance, it appears that both of them may participate in the pseudocapacitance reaction.[1]

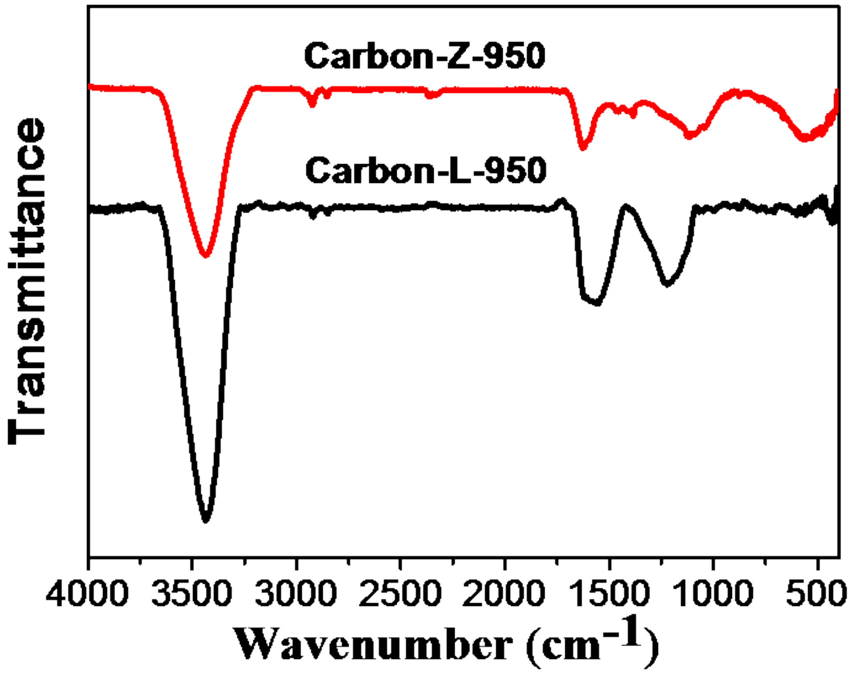

Fig.S7 FT-IR spectra of as-prepared Carbon-L-950 (black line) and Carbon-Z (red line) from 400 to 4000 cm^{-1}

Fig S7 shows the FT-IR spectra of Carbon-L-950 and Carbon-Z-950, which may provide more information about local structures. All samples share a stretching band at 3437cm^{-1}, which indicates the existence of the hydroxyl group and adsorbed water molecules. The C=O of carboxyl group in Carbon-L-950 with glucose and C=C of aromatic ring in ZIF-7 derived porous carbon are revealed by the band at 1640 cm^{-1} and 1580 cm^{-1}, respectively. They are overlapped to become a broad absorption peak.[2] In the region 1300～1000cm^{-1}, the more complex bands may be assigned to C-O groups. [3] The result of FT-IR reveals that there are abundant of -OH and C=O groups on the surface of Carbon-L-950. Actually, O-containing functional groups improve the wettability of the carbon electrode with the electrolyte.[4, 5] The same result can be proved well by their contact angle measurement (Fig S8).

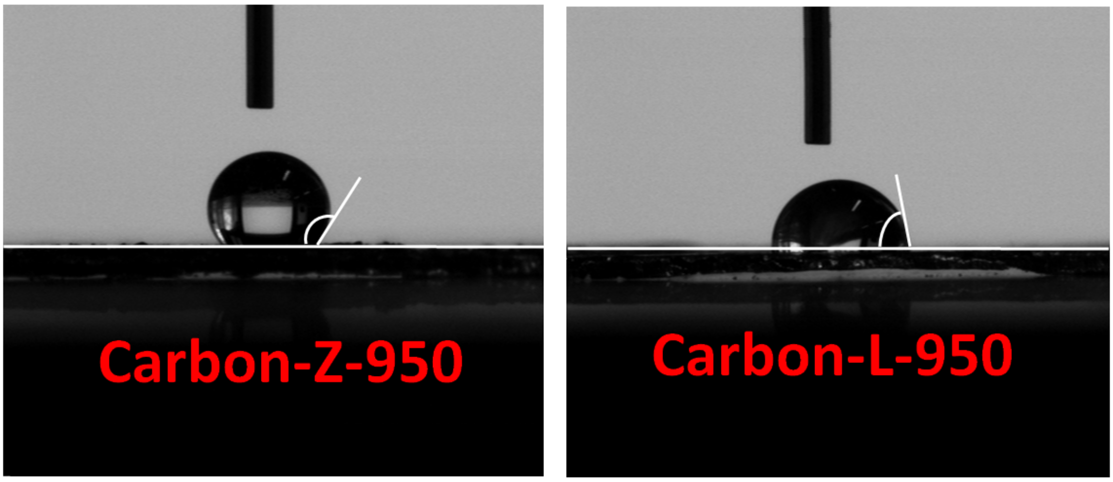

Fig.S8 6M KOH solution droplet (2.5μL) on the surface of Carbon-Z-950 and Carbon-L-950

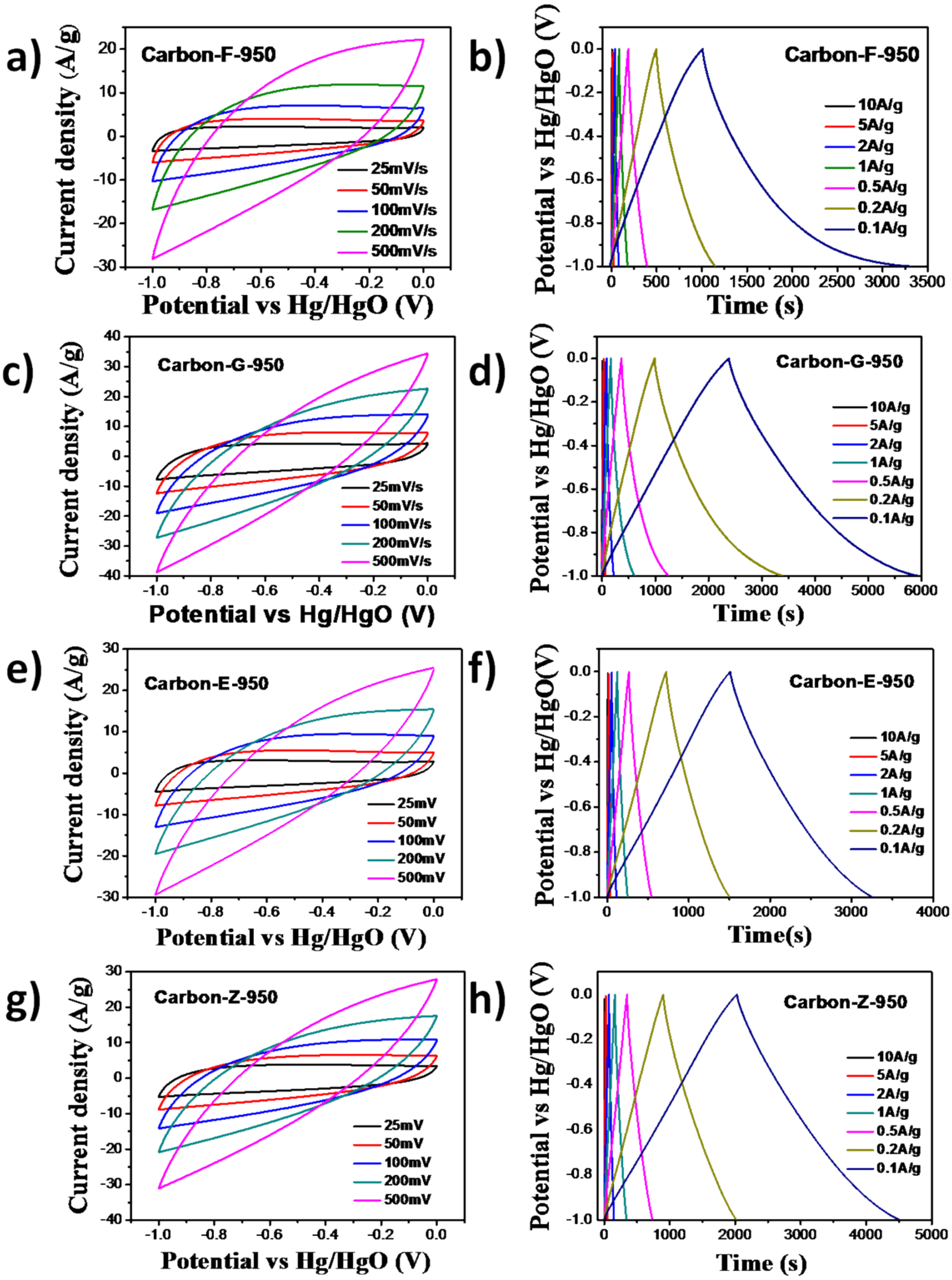

Fig.S9 CV curves at various scan rates and charge-discharge curves at different current densities of ZIF-derived porous carbons obtained by different additional carbon sources

Except for Eq.1, the specific capacitance (C, F g^{-1}) was also calculated from CV curves by using the following equation:

$$C = \frac{\int IdV}{2 \times s \times \Delta V \times m}$$

(Eq.S1)

where I (A) is the current, ΔV (V) refers to the potential change, s (mV s^{-1}) is scan rate, and m (g) is the mass of ZIF-derived porous carbons in the working electrode.

The specific capacitances of ZIF-derived porous carbons from CV and charge-discharge curves in this work are summarized in Tab S2.

Tab.S2 Specific capacitance of ZIF-derived porous carbons at different current density and scan rate (F/g)

Conditions / Samples	Current density（A/g）							Scan rate（mV/s）				
	0.1	**0.2**	**0.5**	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**
Carbon-L-750	—	127.6	76	53.4	34.8	14	6	85	31.8	21.25	15.28	8.54
Carbon-L-850	—	200.72	150.5	128.8	106	75	52	92.2	76.4	59.55	43.7	26.21
Carbon-L-950	**228.1**	**226.2**	**222.9**	**218.6**	**212.8**	**195**	**178**	**185.2**	**167.3**	**142.5**	**109.43**	**63.37**
Carbon-L-1000	—	135.4	115.8	110.2	102.4	88	74	101	90.2	76.4	59.4	36.08
Carbon-Z-950	202	182	174.5	163	146.4	113	80	126.8	103.8	78.7	55.53	31.34
Carbon-F-950	100.9	99.2	92.1	85.2	76.8	62	50	78.2	68.6	57.45	44.9	28.41
Carbon-E-950	152	144.8	133.5	123	116.4	89	68	106.4	91.6	73.45	52.05	29.19
Carbon-G-950	238	198	185	167	164	146	116	162.2	134.5	102.25	70.48	38.22

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2. S. Mo, Z. Sun, X. Huang, W. Zou, J. Chen and D. Yuan, *Synth. Met.*, 2012, **162**, 85-88.
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