Supporting Information

Highly Active Fe-N-doped Porous Hollow Carbon Nanospheres as Oxygen Reduction Electrocatalysts in Both Acidic and Alkaline Media

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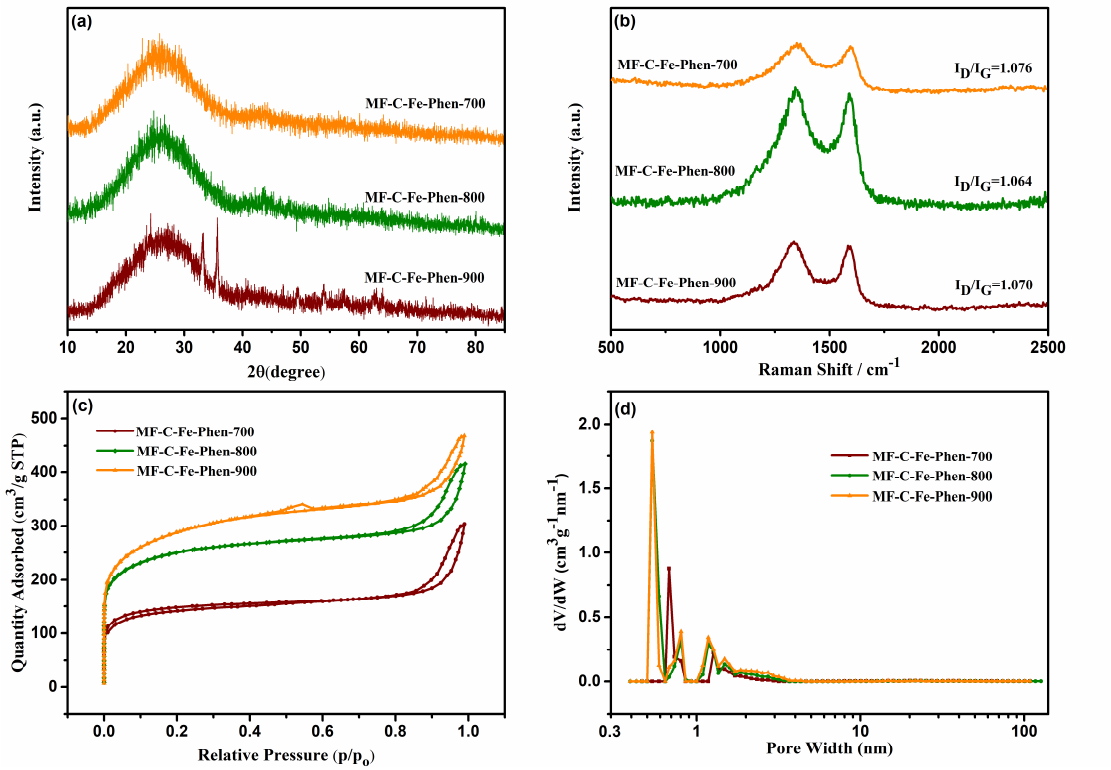

Figure S1 (a) XRD pattern of MF-C-Fe-Phen-700, MF-C-Fe-Phen-800, MF-C-Fe-Phen-900. (b) Raman spectra of MF-C-Fe-Phen-700, MF-C-Fe-Phen-800, MF-C-Fe-Phen-900. (c) Nitrogen adsorption-desorption isotherms of MF-C-Fe-Phen-700, MF-C-Fe-Phen-800 and MF-C-Fe-Phen-900. (d) The corresponding pore size distributions were calculated by Nonlocal Density Functional Theory (DFT) method.

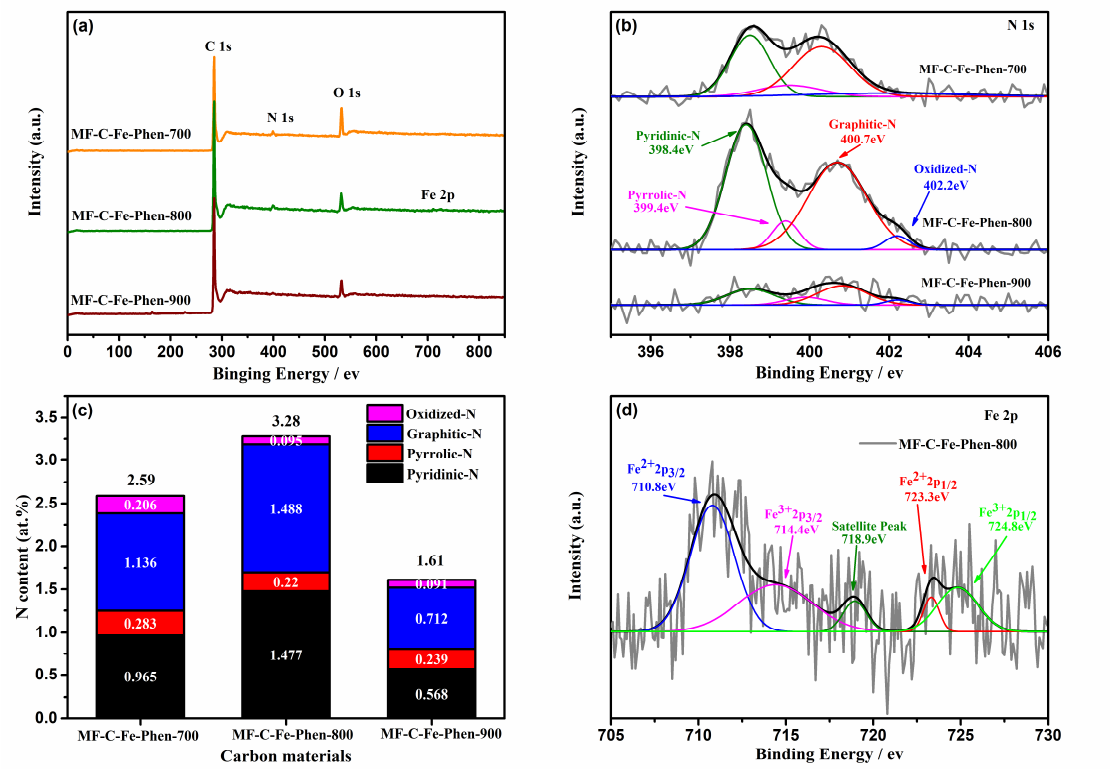

Figure S2 (a) XPS survey spectra of MF-C-Fe-Phen-700, MF-C-Fe-Phen-800, MF-C-Fe-Phen-900. (b) The corresponding high-resolution XPS spectra of N1s. (c) The atomic contents of different nitrogen types in the MF-C-Fe-Phen-700, MF-C-Fe-Phen-800 and MF-C-Fe-Phen-900 obtained from the deconvoluted N1s peaks. (d) High-resolution XPS spectra of Fe 2p for MF-C-Fe-Phen-800.

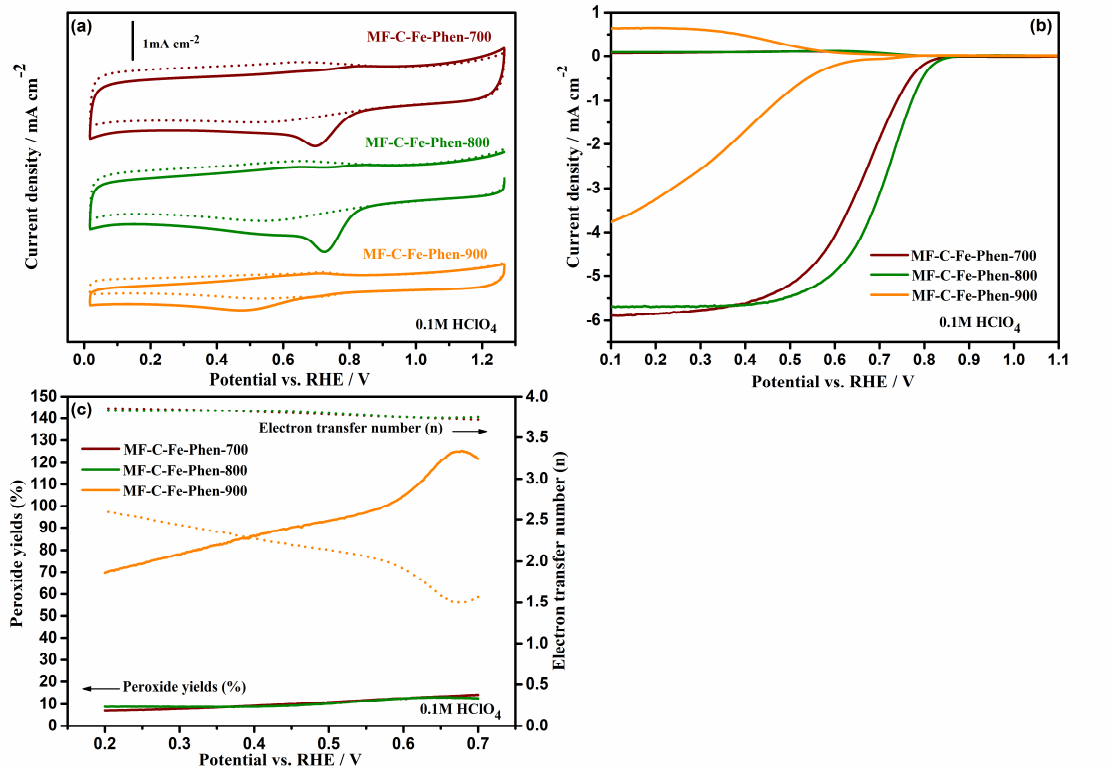

Figure S3 (a) CV curves of MF-C-Fe-Phen-x (x=700, 800, 900) in O_2 or N_2-saturated 0.1 M $HClO_4$ solution at a scan rate of 10 mV s^{-1}. (b) Rotating ring disk electrode (RRDE) curves for MF-C-Fe-Phen-x (x=700, 800, 900) in O_2-saturated 0.1 M $HClO_4$ solution at a scan rate of 10 mV $s^{-1}$and a rotation rate of 1600 rpm. (c) The corresponding peroxide yield and electron transfer number in O_2-saturated 0.1 M $HClO_4$ solution at various potentials based on the RRED dates.

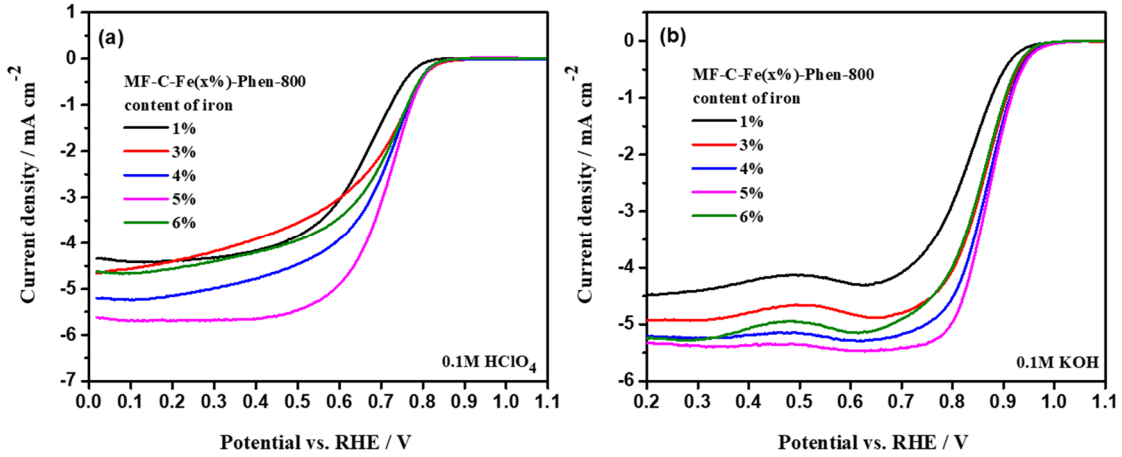

Figure S4 LSV curves of MF-C-Fe(x%)-Phen-800 (x%=1%, 3%, 4%, 5%, 6%) in O_2-saturated at a scan rate of 10 mV s^{-1} and a rotation rate of 1600 rpm in 0.1 M $HClO_4$ (a) and 0.1 M KOH solution (b).

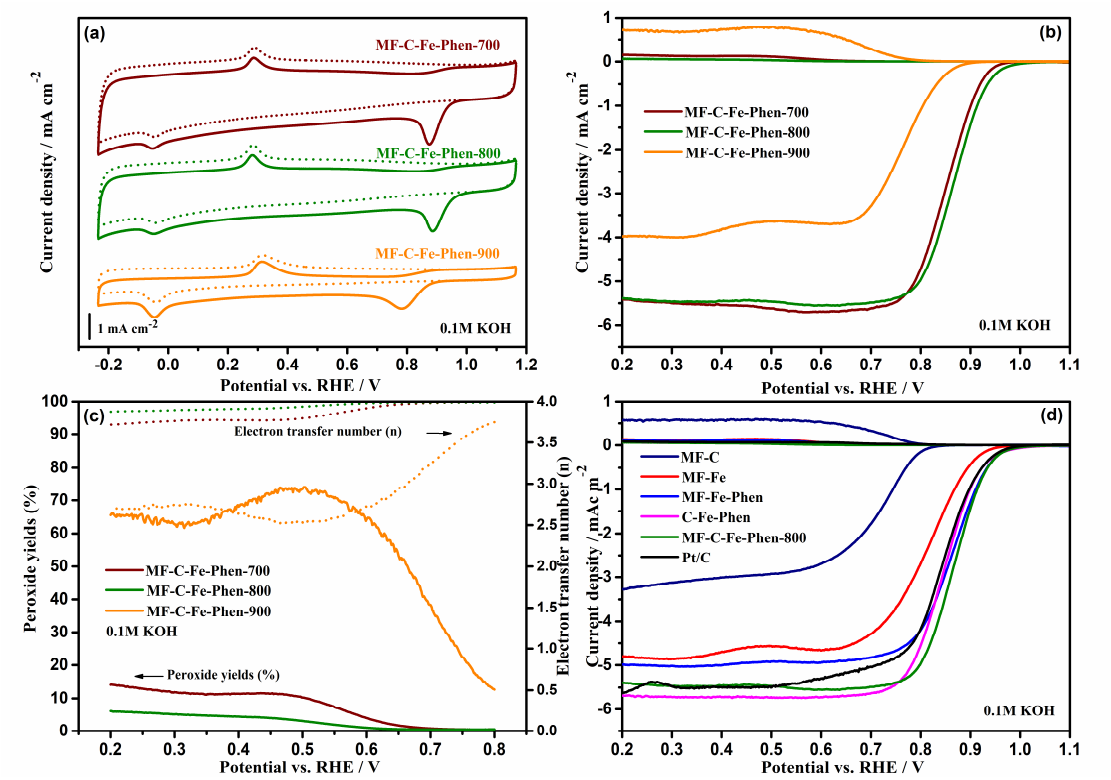

Figure S5 (a) CV curves of MF-C-Fe-Phen-x (x=700, 800, 900) in O_2 or N_2-saturated 0.1 M KOH solution at a scan rate of 10 mV s^{-1}. (b) Rotating ring disk electrode (RRDE) curves for MF-C-Fe-Phen-x (x=700, 800, 900) in O_2-saturated 0.1 M KOH solution at a scan rate of 10 mV $s^{-1}$and a rotation rate of 1600 rpm. (c) The corresponding peroxide yield and electron transfer number in O_2-saturated 0.1 M KOH solution at various potentials based on the RRED dates. (d) RRDE curves for MF-C, MF-Fe, MF-Fe-Phen, C-Fe-Phen, MF-C-Fe-Phen-800 and Pt/C in O_2-saturated 0.1 M KOH solution at a scan rate of 10 mV $s^{-1}$and a rotation rate of 1600 rpm.

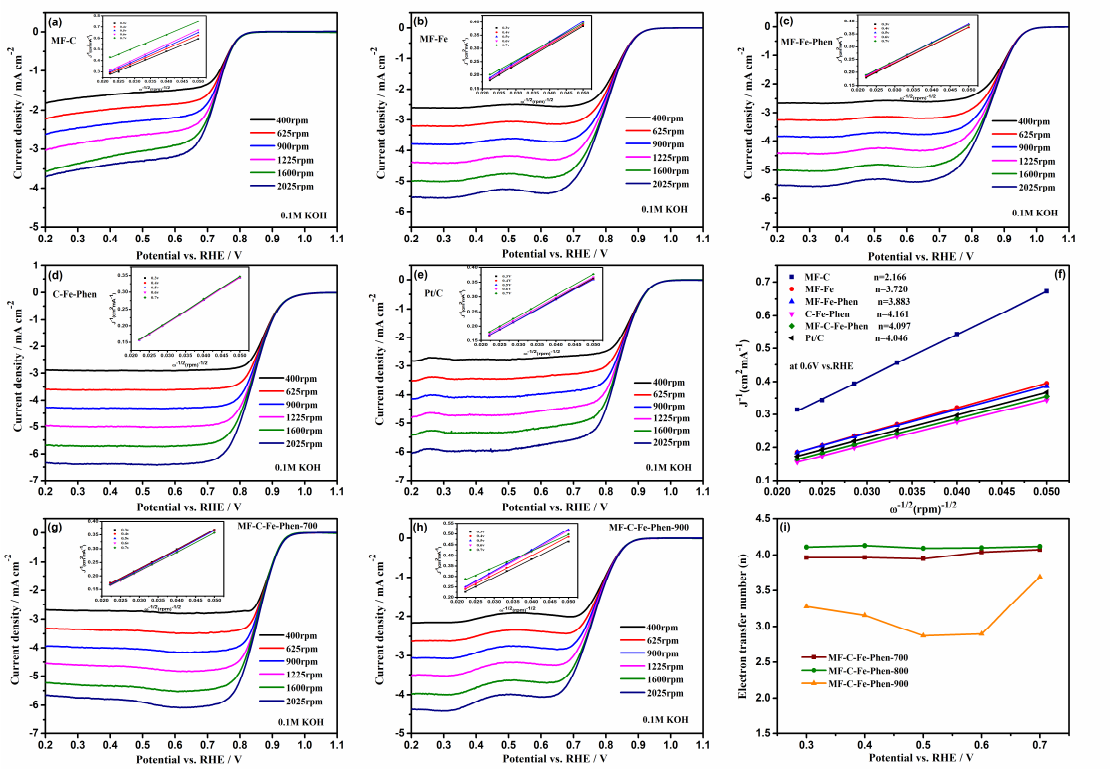

Figure S6 LSV curves in O_2-saturated 0.1 M KOH solution at a different rotation rate from 400 to 2025 rpm, the inset shows the K-L plots at the potential range of 0.3 to 0.7 V for (a) MF-C. (b) MF-Fe. (c) MF-Fe-Phen. (d) C-Fe-Phen. (e) Pt/C. (g) MF-C-Fe-Phen-700. (h) MF-C-Fe-Phen-900. (f) The K-L plots at the potential of 0.6 V (vs. RHE) for MF-C, MF-Fe, MF-Fe-Phen, C-Fe-Phen, MF-C-Fe-Phen-800 and Pt/C. and the corresponding electron transfer number calculated by the K-L equation. (i) Transferred electron number of MF-C-Fe-Phen-700, MF-C-Fe-Phen-800, MF-C-Fe-Phen-900 at the potential range of 0.3 to 0.7 V calculated by the K-L equation.

Table S1 Textural properties of MF-C, MF-Fe, MF-Fe-Phen, C-Fe-Phen, MF-C-Fe-Phen-700, MF-C-Fe-Phen-800 and MF-C-Fe-Phen-900

Sample	S^{a}_{BET} (m^2/g)	S^{b}_{micro} (m^2/g)	S_{meso} (m^2/g)	V^{c}_{total} (cm^3/g)	V^{d}_{micro} (cm^3/g)	V_{meso} (cm^3/g)	Pore size [e] (nm)	
							Micro[f] (nm)	D_{av}[g] (nm)
MF-C	1455.31	501.83	953.48	2.2006	0.2533	1.9473	0.631	6.05
MF-Fe	231.09	29.61	201.48	0.4959	0.0135	0.4824	0.632	8.58
MF-Fe-Phen	517.84	96.94	420.9	0.6955	0.0446	0.6509	0.612	5.37
C-Fe-Phen	818.87	452.27	366.6	1.3769	0.2328	1.1441	0.582	6.73
MF-C-Fe-Phen-700	480.87	321.41	159.46	0.4699	0.1582	0.3117	0.562	3.91
MF-C-Fe-Phen-800	807.24	434.34	372.9	0.6424	0.2210	0.4214	0.580	3.18
MF-C-Fe-Phen-900	952.28	387.38	564.9	0.7239	0.1959	0.528	0.615	3.04

[a] Surface area determined by the BET method.

[b] Micropore surface area determined by t-Plot micropore area.
[c] Total pore volume calculated by the DFT method.
[d] Micropore volume determined by t-Plot micropore volume.
[e] the pore distribution curves determined by the DFT method.
[f] Micropore width determined by the HK method.
[g] Average pore width determined by Adsorption average pore width (4V/A by BET)

Table S2 Elemental compositions of MF-C, MF-Fe, MF-Fe-Phen, C-Fe-Phen, MF-C-Fe-Phen-700, MF-C-Fe-Phen-800 and MF-C-Fe-Phen-900 determined by the XPS analysis.

Samples	C (at. %)	N (at. %)	O (at. %)	Fe (at. %)
MF-C	78.18	1.03	20.79	-
MF-Fe	92.00	1.95	5.48	0.58
MF-Fe-Phen	92.46	2.53	4.50	0.51
C-Fe-Phen	92.61	2.21	4.79	0.39
MF-C-Fe-Phen-700	82.83	2.59	14.19	0.39
MF-C-Fe-Phen-800	89.32	3.28	6.90	0.50
MF-C-Fe-Phen-900	91.13	1.61	6.84	0.42