Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Materials

Catalytic performance of pyrolyzed graphene supported Fe-N-C composite and its application for acid direct methanol fuel cells

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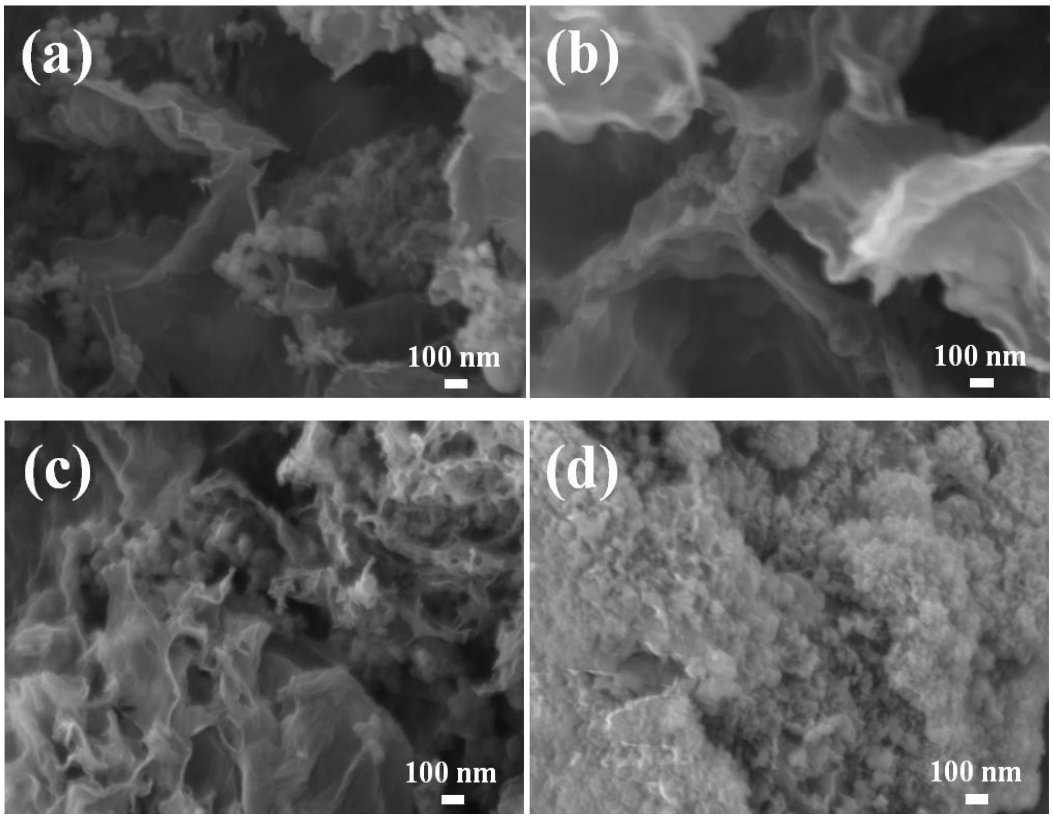

Fig. S1 FESEM images of Fe-N/C/rGO catalysts with different Fe contents of 5 wt % (a), 10 wt % (b) 15 wt % (c) and 20 wt % (d).

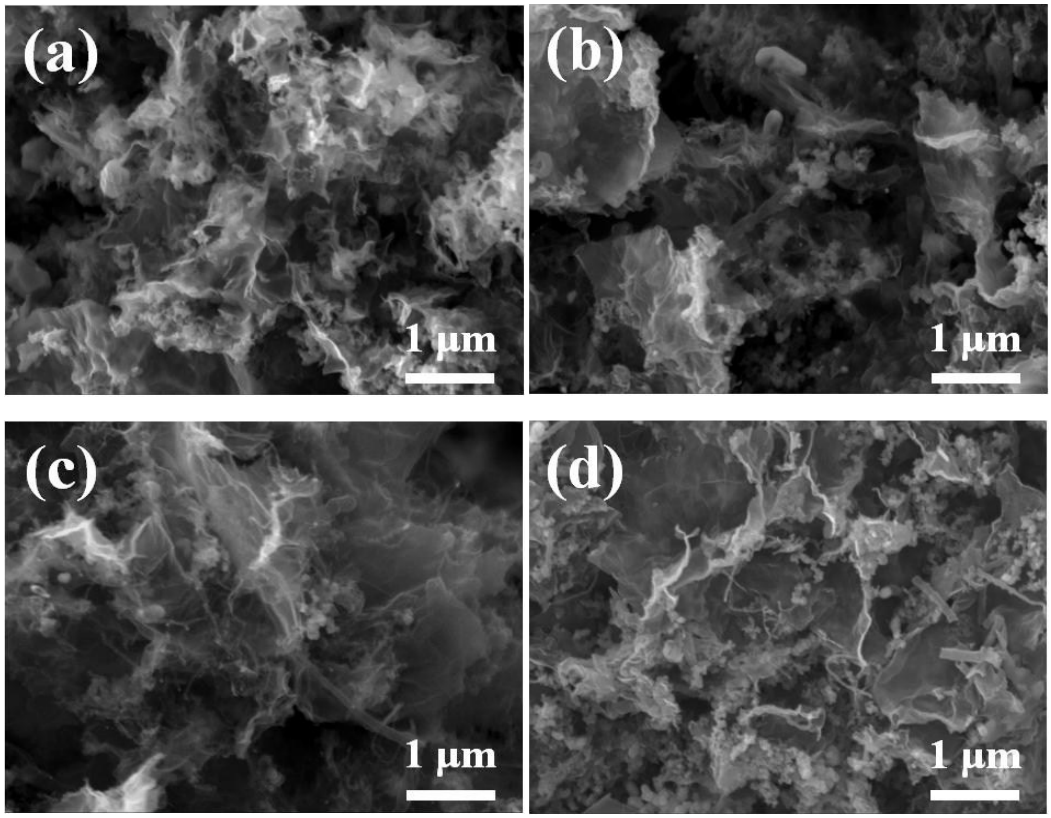

Fig. S2 FESEM images of Fe-N/C/rGO catalysts at different pyrolysis temperatures 650 ^{o}C (a), 750 ^{o}C (b), 850 ^{o}C (c) and 950 ^{o}C (d).

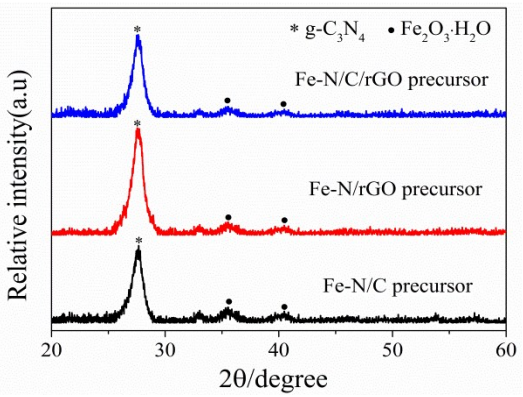

Fig. S3 XRD patterns of Fe-N/C, Fe-N/rGO, Fe-N/C/rGO precursors.

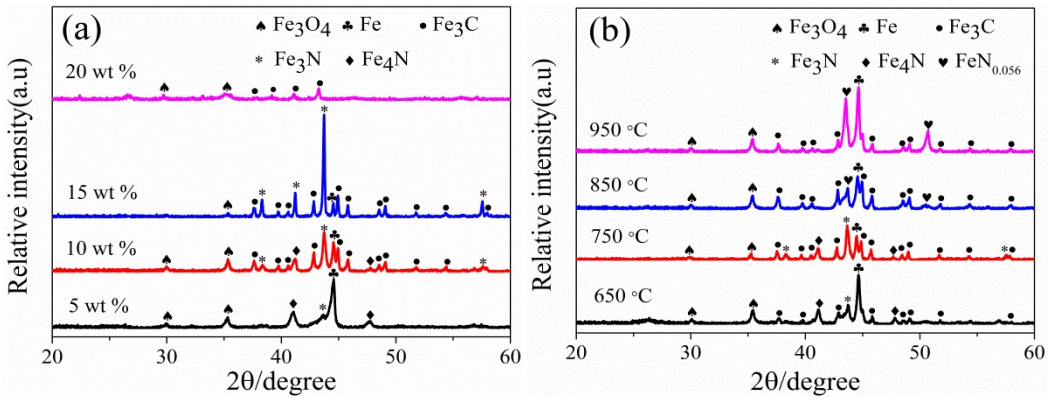

Fig. S4 XRD patterns of Fe-N/C/rGO catalysts with different Fe contents (a) and Fe-N/C/rGO catalysts at different pyrolysis temperatures (b).

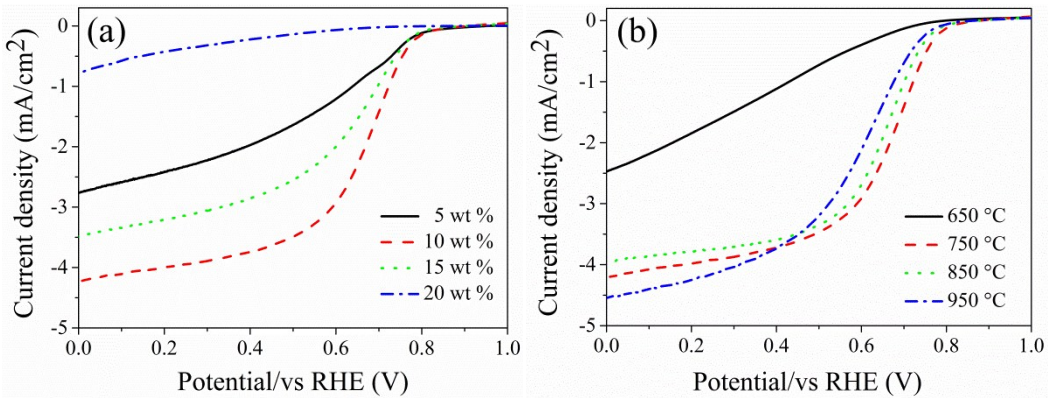

Fig. S5 LSV curves of Fe-N/C/rGO catalysts with different Fe contents (a) and Fe-N/C/rGO catalysts at different pyrolysis temperatures (b) in O_2-saturated 0.5 M H_2SO_4 solution at the rotating speed of 1600 rpm and the scan rate of 5 mV s^{-1}.

Table S1 Surface areas and pore volumes of Fe-N/C/rGO catalysts with different Fe contents of at different pyrolysis temperatures.

Samples	Pyrolysis temperature (^oC)	Fe content (wt %)	S_{BET} ($m^2\ g^{-1}$)	V_{pore} ($cm^3\ g^{-1}$)
Fe-N/C/rGO	750	5	260	0.83
	750	10	256	0.87
	750	15	176	0.25
	750	20	11.6	0.04
	650	10	60.7	0.37
	850	10	214	0.51
	950	10	184	0.46

Table S2 N contents of Fe-N/C/rGO catalysts with different Fe contents of at different pyrolysis temperatures.

Samples	Pyrolysis temperature (°C)	Fe content (wt %)	N (wt %)
Fe-N/C/rGO	750	5	6.3
	750	10	5.8
	750	15	4.7
	750	20	3.5
	650	10	20.6
	850	10	3.6
	950	10	2.5

Table S3. Comparison of ORR performance with various Fe-based catalysts in acidic electrolyte.

Sample	$\Delta E_{1/2}$ **(mV)***	**Scan rate** $(mV\ s^{-1})$	**Rotation rate (rpm)**	**Current density at 0.4V vs.RHE** $(mA\ cm^{-2})$	**Electrolyte**	**References**
Fe-N/C/rGO-LH	69	5	1600	3.8	0.5 M H_2SO_4	This work
Fe/N/C	~200	5	1600	3.3	0.5 M H_2SO_4	*J. Phys. Chem. C*, 2016, 120, 1586−1596
Fe/N/G	~150	10	1600	4.5	0.1 M $HClO_4$	*Appl. Catal. B-Environ.*, 2016, 183, 185–196
Fe-N/MC@0.6	~170	10	1600	4.7	0.1 M $HClO_4$	*ChemCatChem* 2015,7, 2937-2944
Fe-N/C NNs	108	10	1600	4.05	0.5 M H_2SO_4	*Sci. Rep.*, 2015, 11, 17396
Fe-N/CNN3	~150	10	1600	2.8	0.5 M H_2SO_4	*Appl. Catal. B-Environ.*, 2015, 166–167, 75–83
N–Fe/G(60)-900-S	89	10	1600	5.81	0.1 M $HClO_4$	*Nanoscale*, 2015, 7, 14707-14714
Fe-N-HCMS	150	10	2025	6.5	0.5 M H_2SO_4	*Adv. Energy Mater.*, 2014, 4
Fe−N/C-800	59	10	1600	5.6	0.1 M $HClO_4$	*J. Am. Chem. Soc.*, 2014, 136, 11027−11033

* $\Delta E_{1/2}$ represents the difference in the half-wave potentials between Pt/C catalyst and the sample catalyst, i.e., $\Delta E_{1/2} = E_{1/2}\,(Pt/C) - E_{1/2}(sample)$.