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Electronic Supplemental Information

Ordered Mesoporous FeN-Doped Carbon: A Class of Highly Active and Stable Catalysts in Acid, Base and Polymer Electrolyte Membrane Fuel Cells

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Supplementary Tables

Table S1. Comparison of electrochemical performances of OMFeNC and 40% Pt/C coated rotating disk electrodes in 0.5M H_2SO_4.

Electrochemical Parameters	OMFeNC-800	40% Pt/C
$E_{1/2}$ (V vs. RHE)	0.78	0.83
Activity at 0.6V, 1600 rpm (mA/cm^2)	5.5	5.4
ORR Electron Number	4	4
Kinetic Rate (K_f) at 0.6V ($cm.S^{-1}$)	0.10	-
Activity retention (I_{20}/I_0) at 900 rpm after 20 hours test	77.4%	69.5%

Table S2. Comparison of electrochemical performances of OMFeNC and 40% Pt/C coated rotating disk electrodes in 0.1M KOH.

Electrochemical Parameters	OMFeNC-800	40% Pt/C
$E_{1/2}$ (V vs. RHE)	0.85	0.87
Activity at 0.6V, 1600 rpm (mA/cm^2)	6.0	6.0
ORR Electron Number	4	4
Kinetic rate (K_f) at 0.6V ($cm.S^{-1}$)	0.17	-
Activity retention (I_{20}/I_0) at 900 rpm after 20 hours test	93.5%	87.8

Supplementary Figures

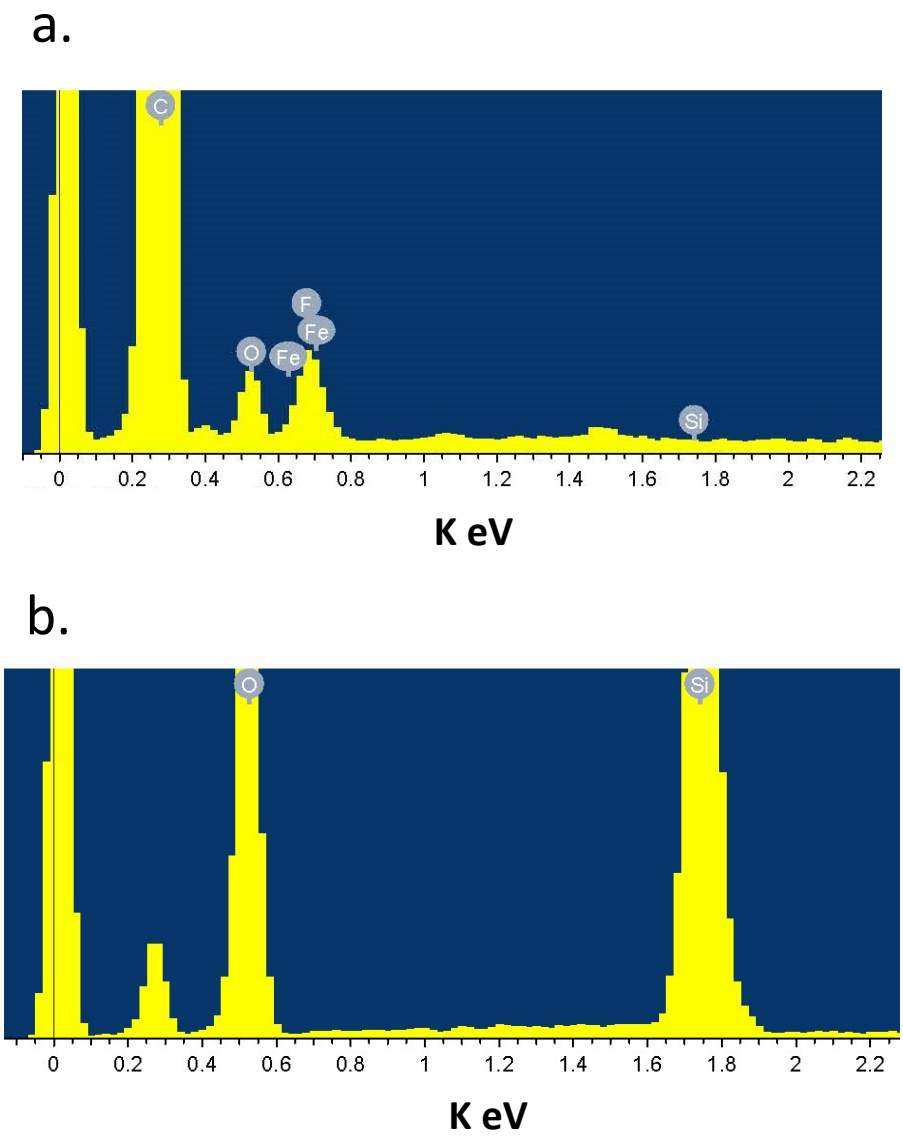

Figure S1. EDS spectra of OMFeNC-800 prepared with HF-free method (a) and SBA-15 (b). There is no Si detected for the OMFeNC 800 prepared with HF-free method.

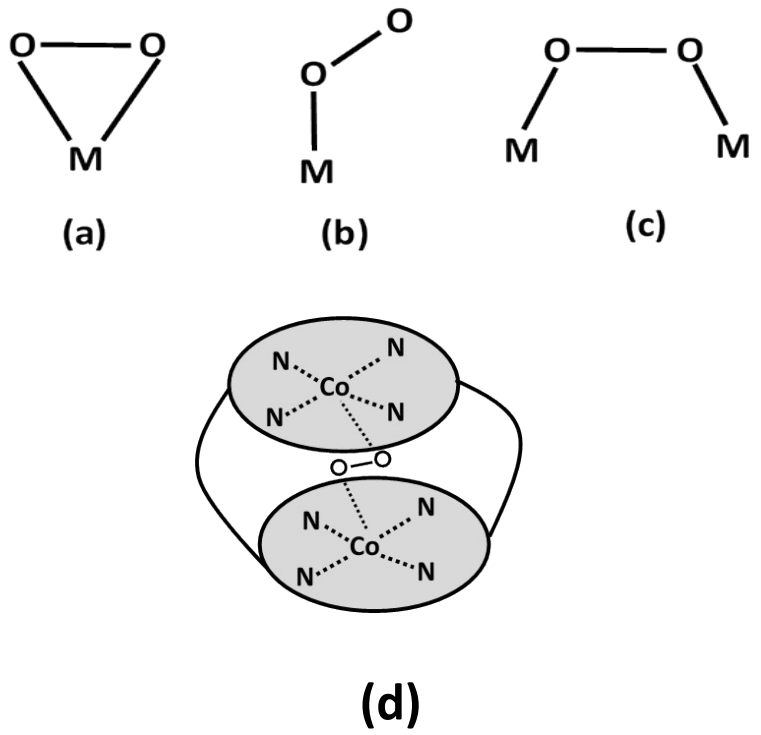

Figure S2. Schematic drawing of oxygen adsorption at transition metal surface with Griffiths model (a), Pauling model (b), and Bridge model (c) proposed by Yeager et al [1-4], and a face-to face cobalt porphyrin (d) for catalytic oxygen reduction synthesized by Collman and Anson et al [5-6].

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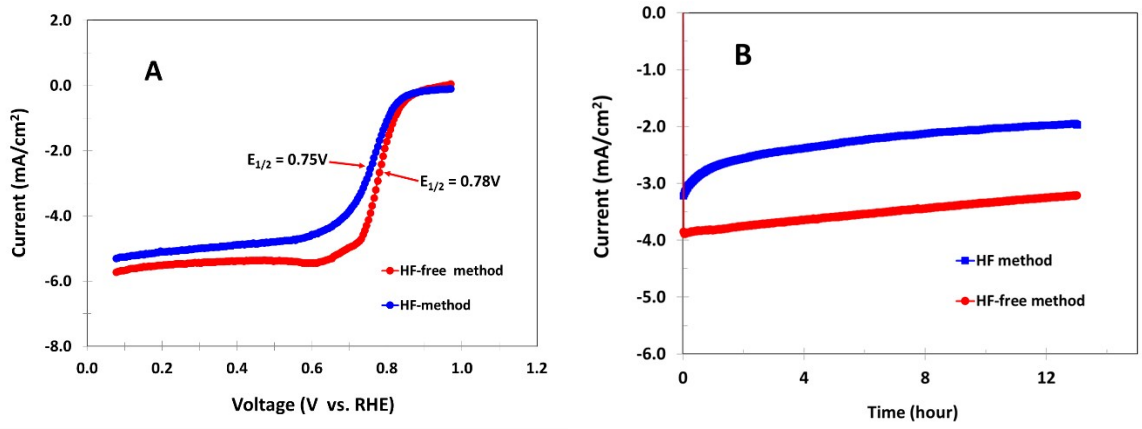

Figure S3. Catalytic activity and stability of OMFeNC-800. (A) Polarization curves of OMFeNC-800 coated rotating disk electrodes, 10 mv/s, 1600 rpm. (B) Chronoamperometric curves of OMFeNC-800 coated rotating disk electrode at 0.6V, 900 rpm. The OMFeNCs were made with HF-method and HF-free method, respectively. Catalyst loading: 0.4 mg/cm^2. Electrolyte: O_2 saturated 0.5M H_2SO_4 solution.

The polarization curves shown in Figure S3-A indicates that the half wave potential of the OMFeNC made with HF-free method is 30 mV higher than that with HF-method for catalytic ORR in O_2 saturated 0.5M H_2SO_4. The average limiting current of OMFeNC is also increased by ~15% from HF-method to HF-free method. The durability test results are shown in Figure S3-B. The chronoamperometric curve of the OMFeNC made with HF-free method is much more stable, having ~25% higher current density than that with HF method for entire range of the experiment.

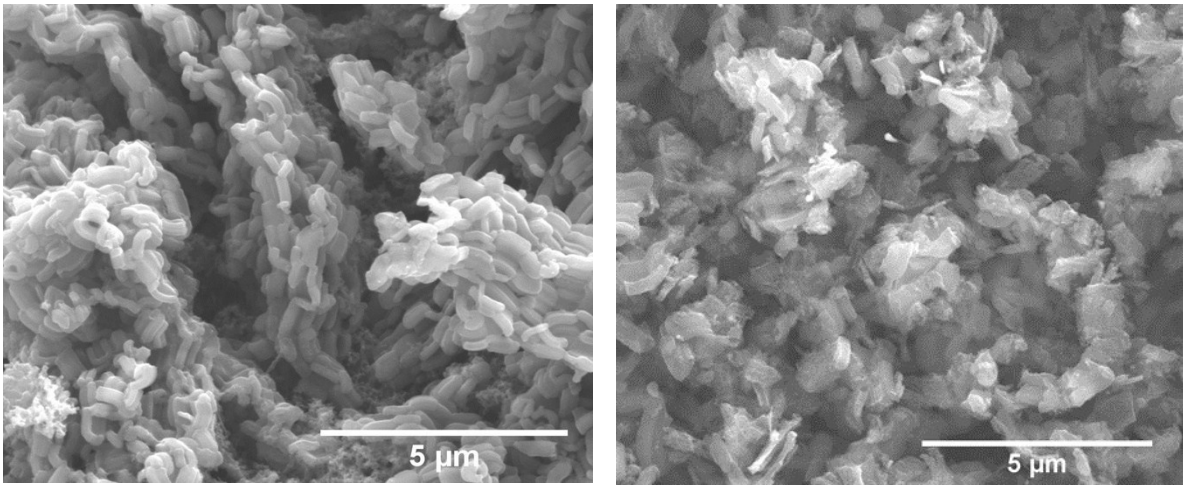

Figure S4. SEM images of OMFeNC-800 made with HF-free method (A) and HF-method, respectively.

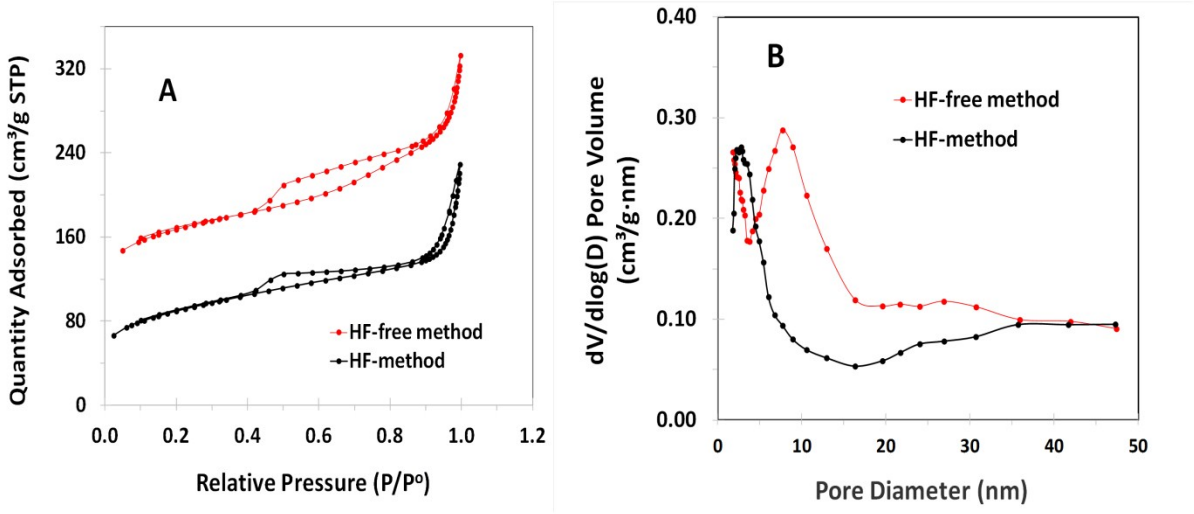

Figure S5. (A) N_2 adsorption-desorption isotherm of OMFeNC obtained by HF-free method and HF-method. (B) pore size distribution of OMFeNC obtained by HF-free method and HF-method.

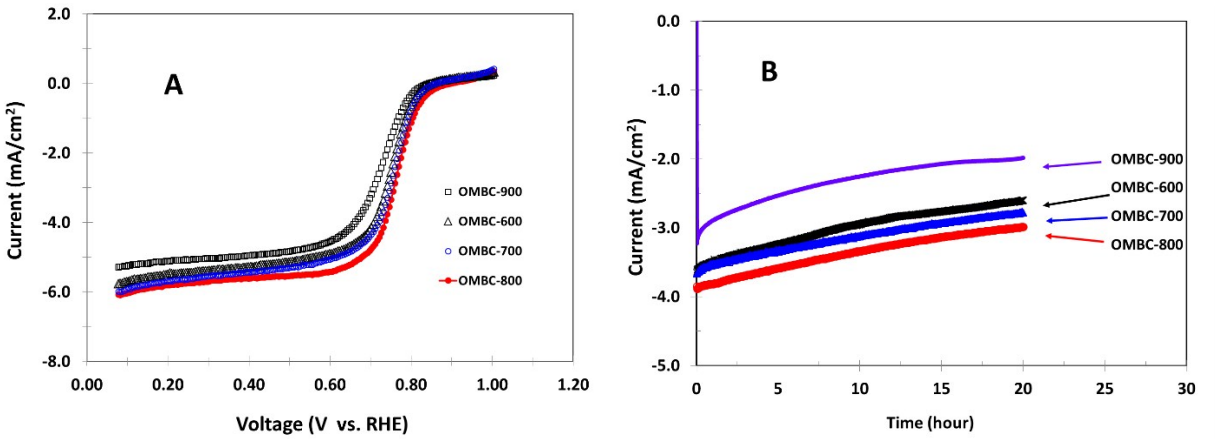

Figure S6. . Electrocatalytic activity and stability of OMFeNC made by HF-free method at different temperatures (A) Polarization curves of OMFeNC coated rotating disk electrodes, 10 mv/s, 1600 rpm. (B) Chronoamperometric curves of OMFeNC coated rotating disk electrode at 0.6V, 900 rpm, respectively. Catalyst loading: 0.4 mg/cm^2. Electrolyte: O_2 saturated 0.5M H_2SO_4.

A minimum temperature is required to completely carbonize hemin and decompose Teflon for make OMFeNC. Therefore, we started from 600°C to pyrolyze the mixture of hemin and Teflon. The activity and stability of OMFeNC for catalytic ORR is varying with heat-treating temperature. As shown in Figure S5-A, the OMFeNC's activity for catalytic ORR increases from 600 to 800°C heat-treatment. The corresponding half wave potential and limiting current increase are seen. When we increased temperature to 900°C for pyrolysis, the OMFeNC's activity is decreased. The durability test results of OMFeNC for catalytic ORR at 900 rpm in O_2 saturated 0.5M H_2SO_4 are shown in Figure S5-B. The OMFeNC-800 has the highest current density for the entire test range by 20 hours test.