

Electronic Supplementary Information

Electrocatalytic activity of Metalloporphyrins in situ grown on graphene sheets toward the oxygen reduction reaction in alkaline medium

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1. Supplementary data

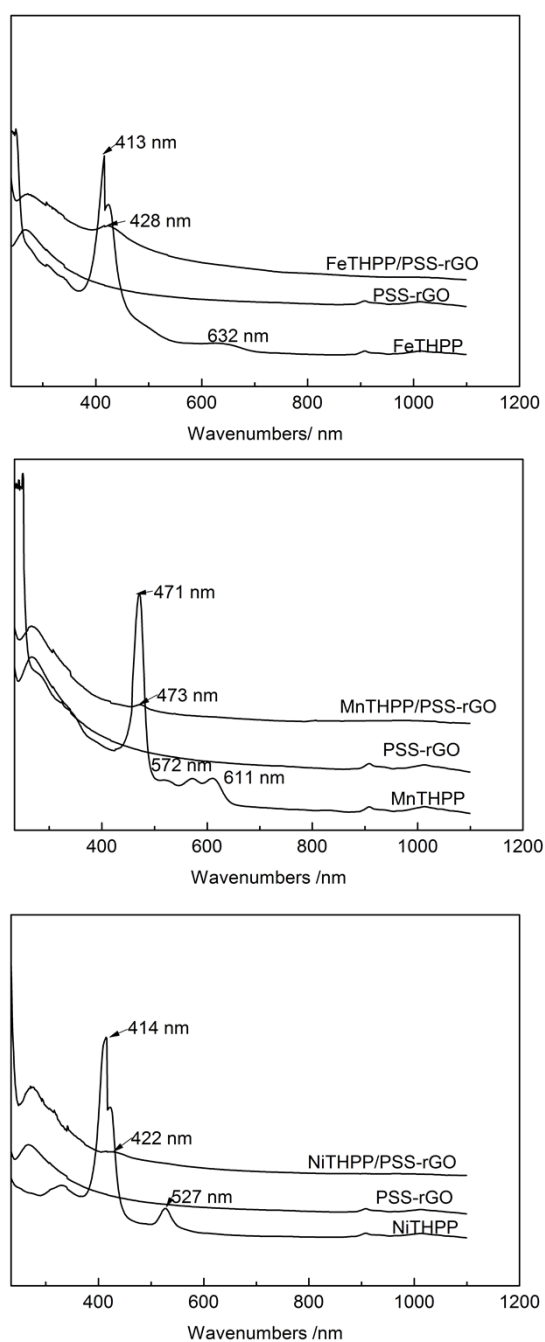


Fig. S1 UV-vis absorption spectra of PSS-rGO, metalloporphyrins and M-THPP/PSS-rGO composites, respectively.

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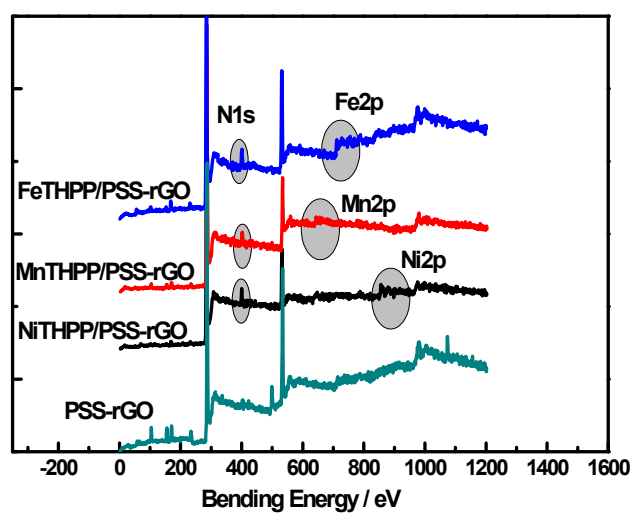


Fig. S2 XPS spectra of PSS-rGO, MnTHPP/PSS-rGO, NiTHPP/PSS-rGO and FeTHPP/PSS-rGO

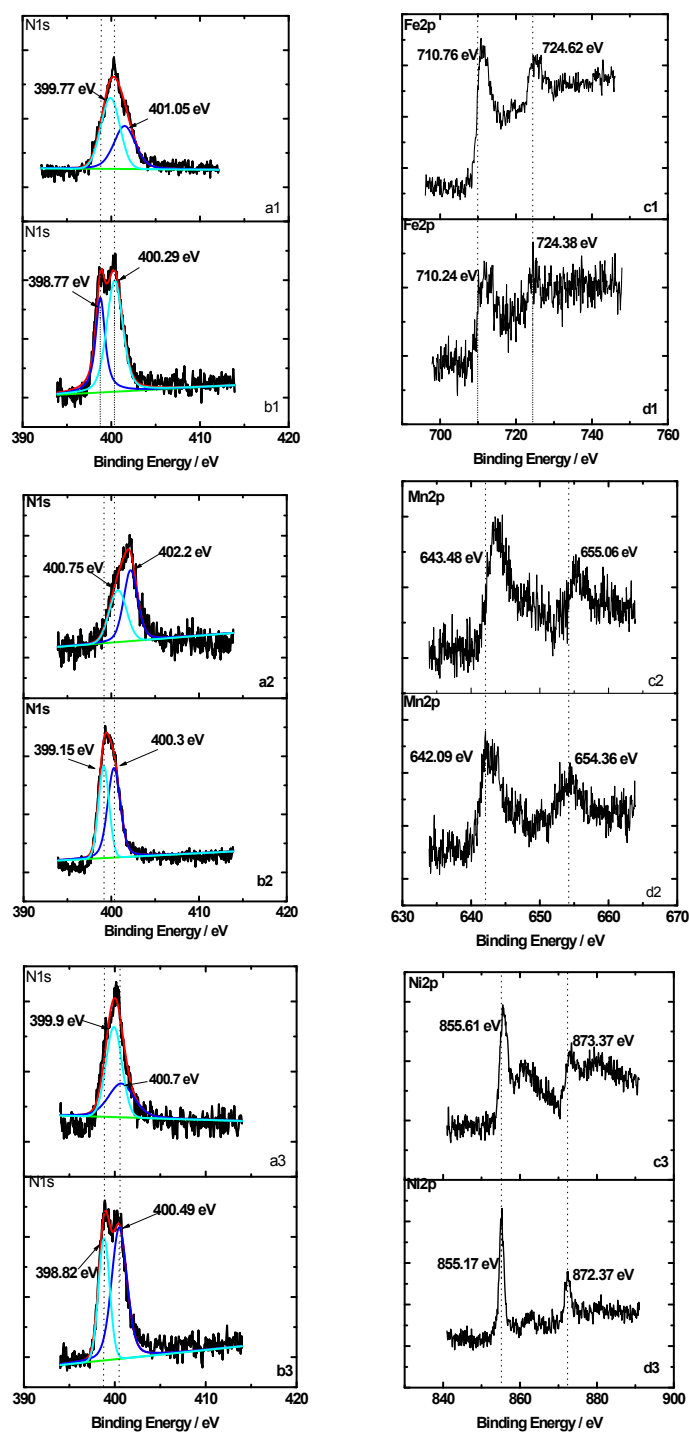


Fig. S3 High-resolution N1s XPS spectra of (a1) FeTHPP, (a2) MnTHPP, (a3) NiTHPP, (b1) FeTHPP/PSS-rGO, (b2) MnTHPP/PSS-rGO, (b3) NiTHPP/PSS-rGO; Metal 2p XPS spectra of (c1) FeTHPP, (c2) MnTHPP, (c3) NiTHPP, (d1) FeTHPP/PSS-rGO, (d2) MnTHPP/PSS-rGO, (d3) NiTHPP/PSS-rGO.

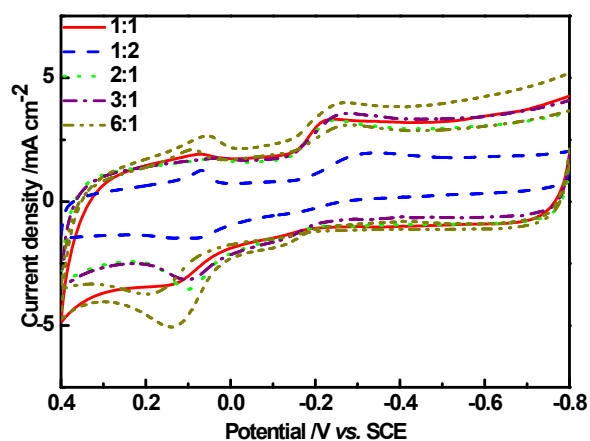


Fig. S4 CV curves of the CoTHPP/PSS-rGO composite with different mass ratio of CoTHPP to PSS-rGO in O₂-saturated 0.1 M NaOH solution at the scan rate of 100 mV s⁻¹.

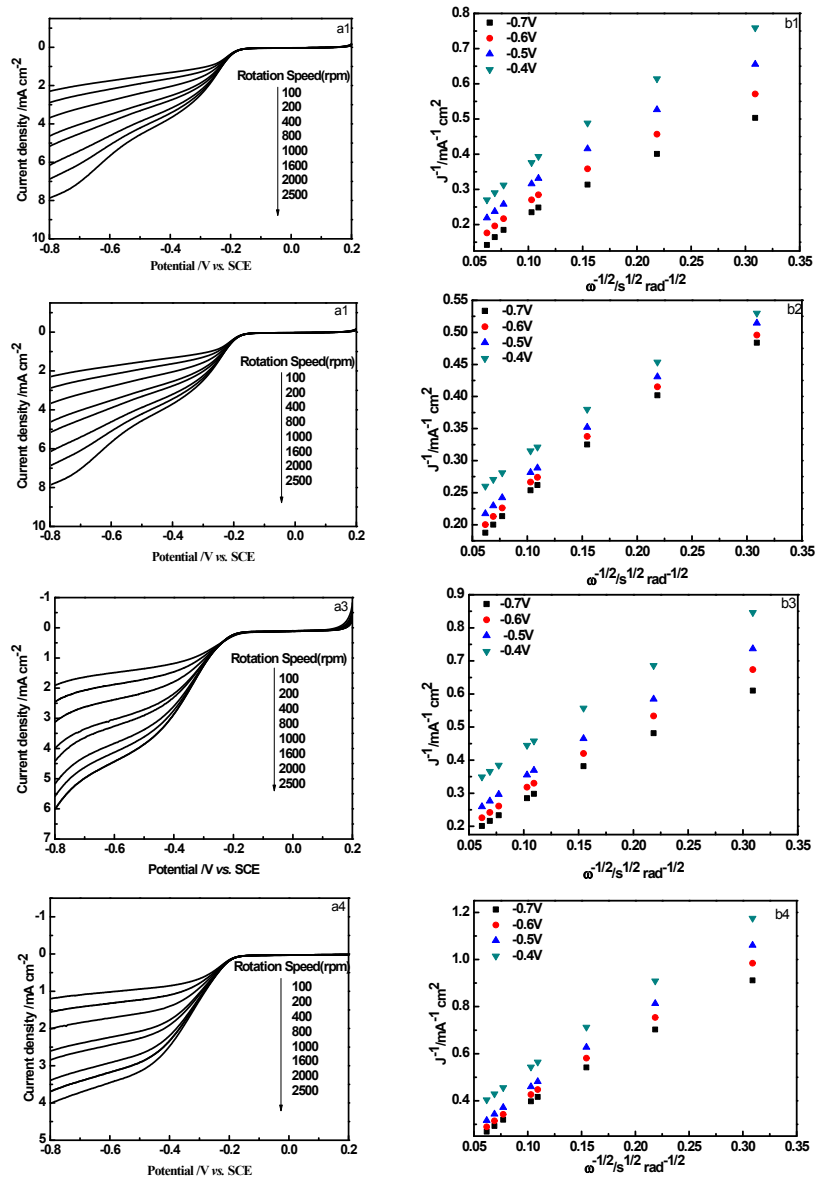


Fig. S5 LSVs for the ORR on (a1) FeTHPP/PSS-rGO, (a2) MnTHPP/PSS-rGO, (a3) NiTHPP/PSS-rGO and (a4) PSS-rGO at different rotation speeds from -0.8 V to +0.2 V vs. SCE in O_2 -saturated 0.1 M NaOH at the scan rate of 10 mV s^{-1} . The corresponding K-L plots for (b1) FeTHPP/PSS-rGO, (b2) MnTHPP/PSS-rGO, (b3) NiTHPP/PSS-rGO and (b4) PSS-rGO at different potentials.

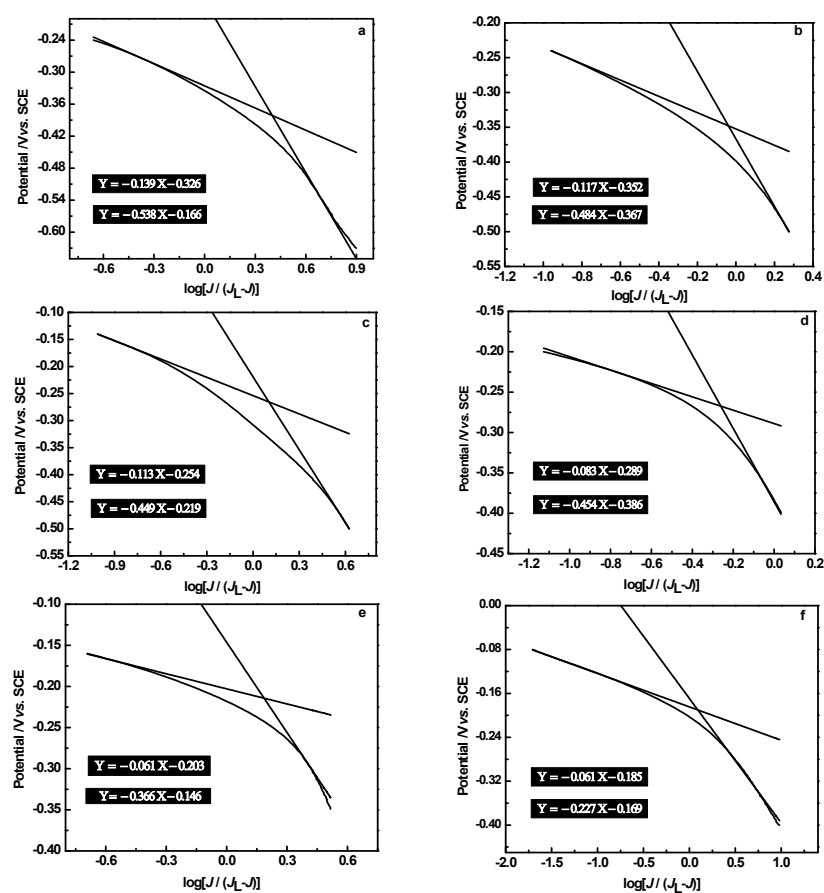


Fig. S6 Tafel curves of samples obtained from the LSVs at the rotation speed of 1600 rpm. (a) PSS-rGO, (b) NiTHPP/PSS-rGO, (c) MnTHPP/PSS-rGO, (d) FeTHPP/PSS-rGO, (e) CoTHPP/PSS-rGO, (f) Pt/C.

Table S1 Electrocatalytic performance of recently reported graphene-supported transition metal N₄-macrocycles as catalysts for ORR in alkaline medium.

Catalysts	$\Delta E_{\text{onset}}^{\text{a, c}}$ (mV)	$\Delta E_{1/2}^{\text{a, c}}$ (mV)	$J_L^{\text{b, c}}$ (mA cm ⁻²)	Electrolyte solution	Reference electrode	References
CoTNPc/PGr composite	-50	0	4.65	0.1 M NaOH	Hg/Hg ₂ Cl ₂	[1]
rGO/(Co ²⁺ -THPP) ₇ catalyst	-80	-50	3.70	0.1 M KOH	Ag/AgCl	[2]
FePc(CP) ₄ /Gr composite	-4	-10	5.02	0.1 M NaOH	Hg/Hg ₂ Cl ₂	[3]
GO-CoAPFP catalyst	-50	-30	4.45	0.1 M KOH	Ag/AgCl	[4]
Graphene-FePc composite	20	50	5.45	0.1 M KOH	Ag/AgCl	[5]
FePc-Gr composite	50	70	5.35	0.1 M NaOH	Hg/Hg ₂ Cl ₂	[6]
CoTHPP/PSS-rGO composite	-50	-20	5.18	0.1 M NaOH	Hg/Hg ₂ Cl ₂	This study

a represents the difference onset potentials and half-wave potentials between various catalysts and Pt/C.

b represents diffusion-limited current densities of various catalysts for ORR at rotation speed of 1600 rpm.

c The onset (E_{onset}) and half-wave ($E_{1/2}$) potential are reported from the corresponding literatures and the corresponding figures in the present study.

Reference

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