Supporting information

A new class electroactive Fe and P-functionalized graphene for oxygen reduction

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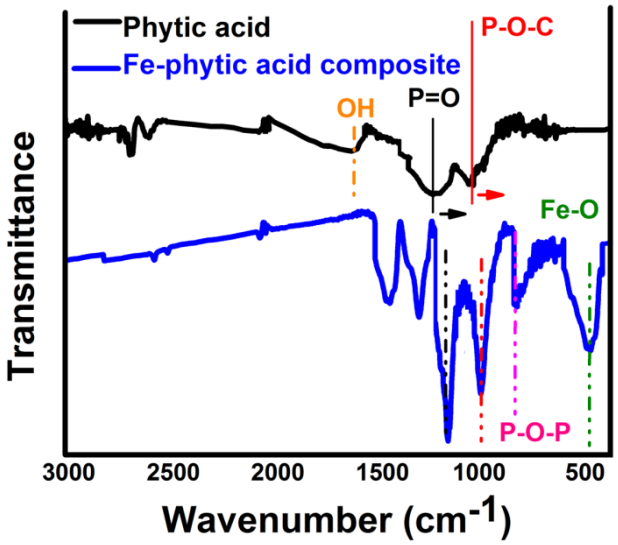

Fig. S1 FT-IR spectra of phytic acid and Fe-phytic acid composite.

Table S1 Structural characteristics by nitrogen sorption data of pristine, P-doped, and Fe and P-functionalized RGO samples

Physical characteristics					
Sample	BET total surface area (m^2g^{-1})	Mesopore surface area (m^2g^{-1})	Pore volume (cm^3g^{-1})	Mesopore volume (cm^3g^{-1})	BJH pore size (nm)
RGO	188.15	89.8	0.19	0.13	3.15
GP	514.16	332.9	0.45	0.26	3.16
GPFe	612.15	397.5	0.56	0.35	3.17

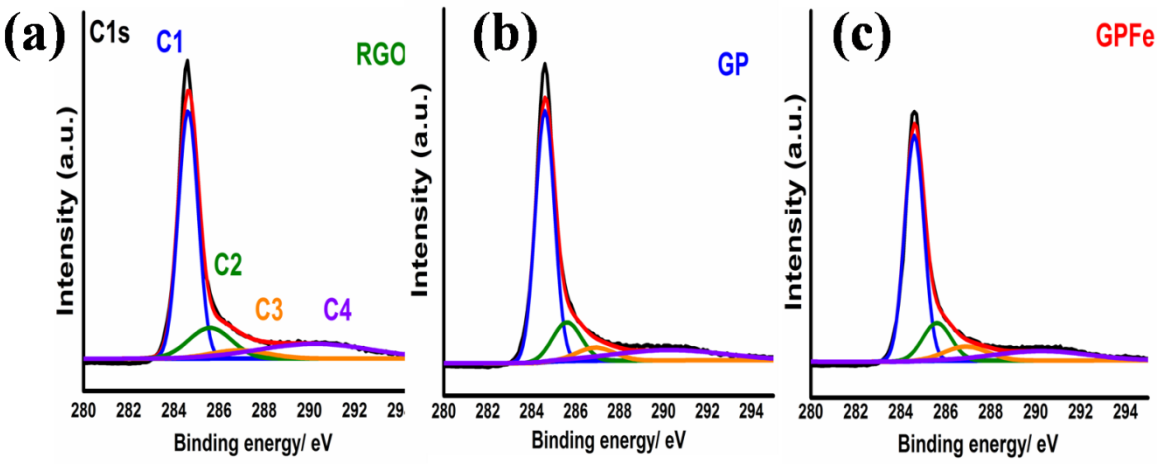

Fig. S2 Deconvoluted XPS spectra of C 1s for (a) pristine RGO, (b) GP, and (c) GPFe.

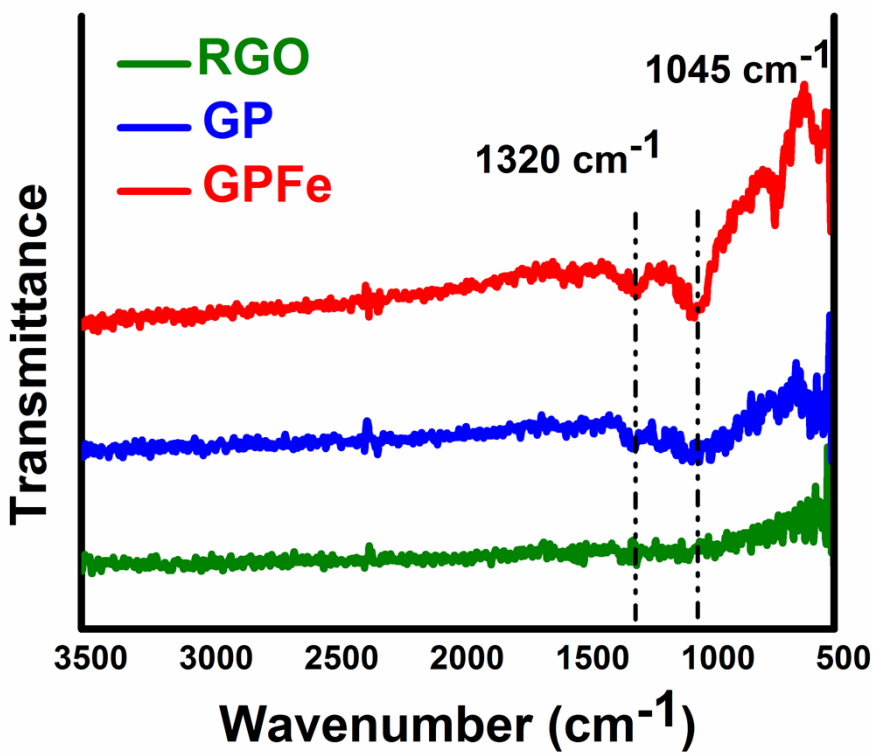

Fig. S3 FT-IR spectra of pristine RGO, GP, and GPFe.

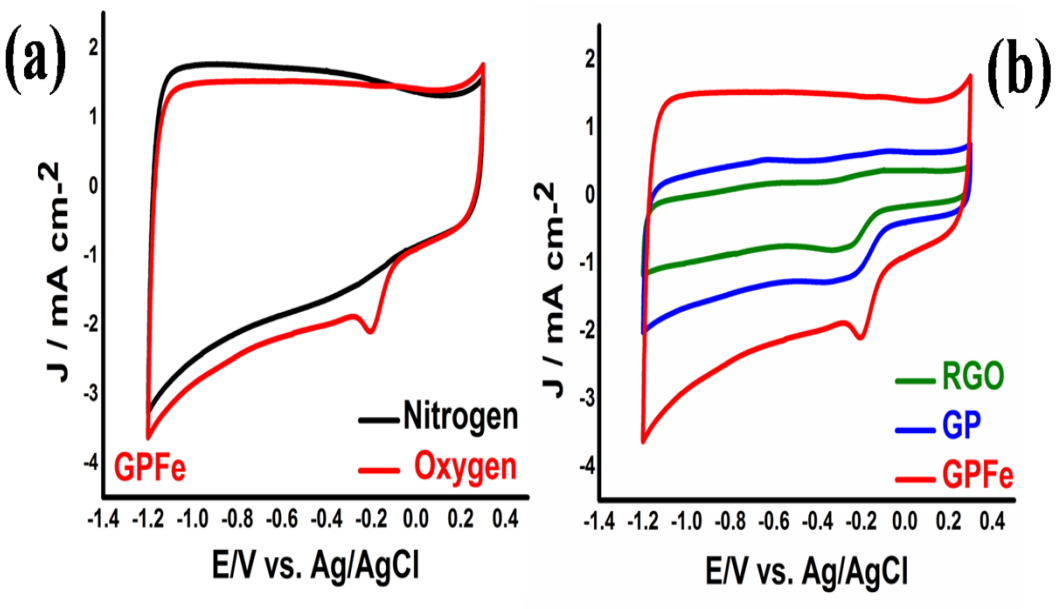

Fig. S4 (a) CV curves at scan rate of 50 mVs^{-1} for GPFe in N_2- and O_2-saturated 0.1 M KOH, and (b) CV profiles for pristine RGO, GP, and GPFe in O_2-saturated 0.1 M KOH.

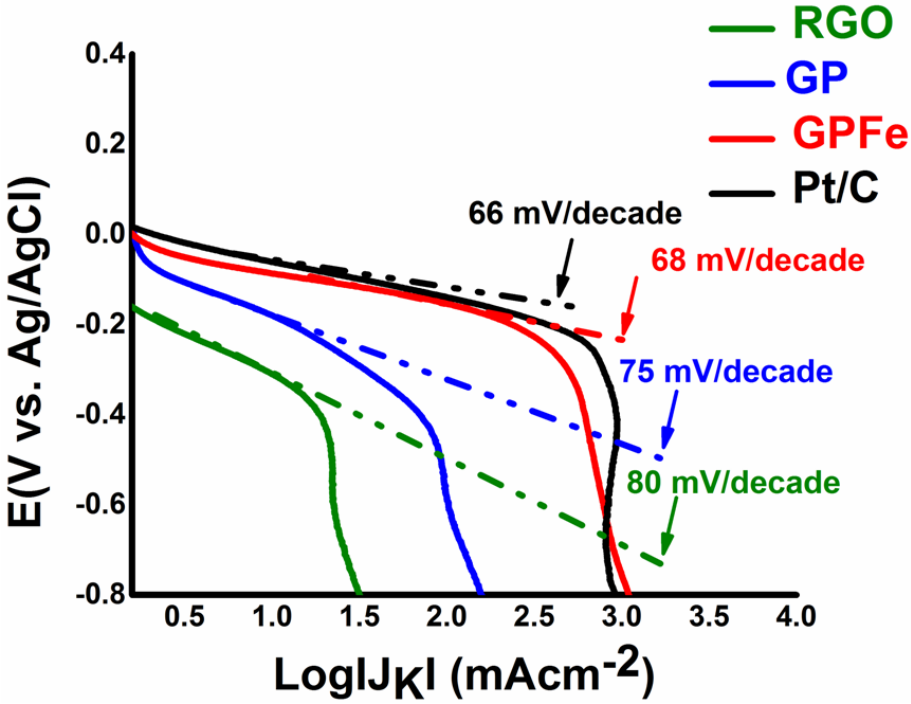

Fig. S5 Tafel plots for pristine RGO, GP, GPFe and Pt/C derived by the mass-transport correction of corresponding LSV data at a rotation rate of 1,600 rpm in O_2-saturated 0.1 M KOH solution.

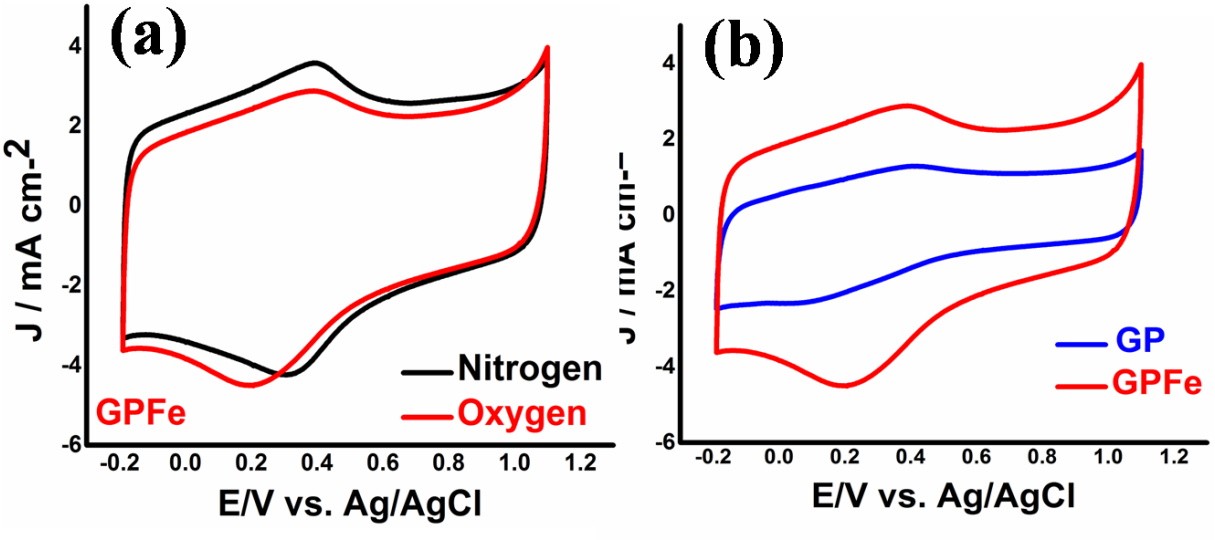

Fig. S6 (a) CV curves at scan rate of 50 mVs^{-1} for GPFe in N_2- or O_2-saturated 0.5 M H_2SO_4, and (b) CV profiles for GP and GPFe in O_2-saturated 0.5 M H_2SO_4.

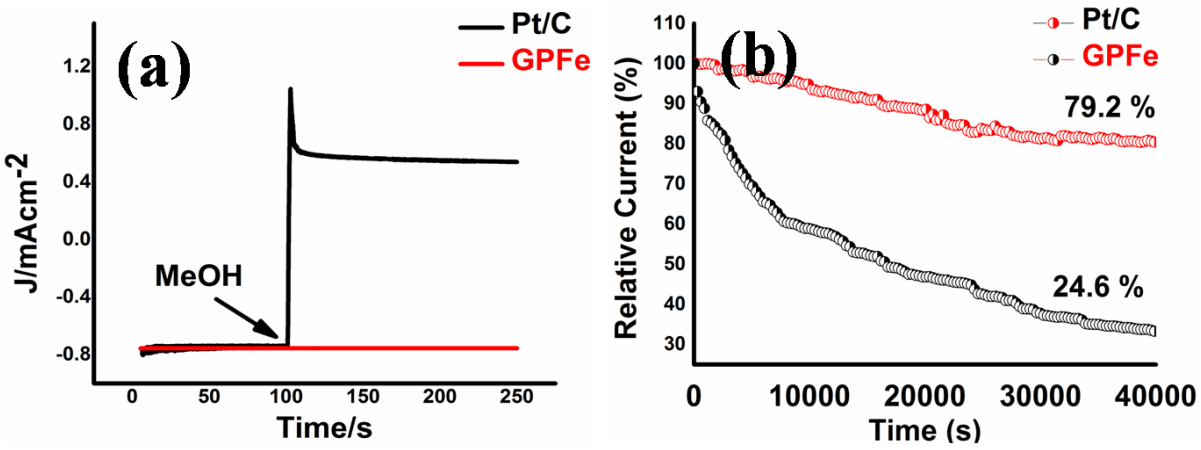

Fig. S7 (a) CA curves at -0.3 V in O_2-saturated 0.1 M KOH solution before and after addition of 3.0 M methanol, and (b) relative J–t responses vs. time at -0.3 V in O_2-saturated 0.1 M KOH solution for GPFe and 20 wt% Pt/C (E-TEK) electrodes.

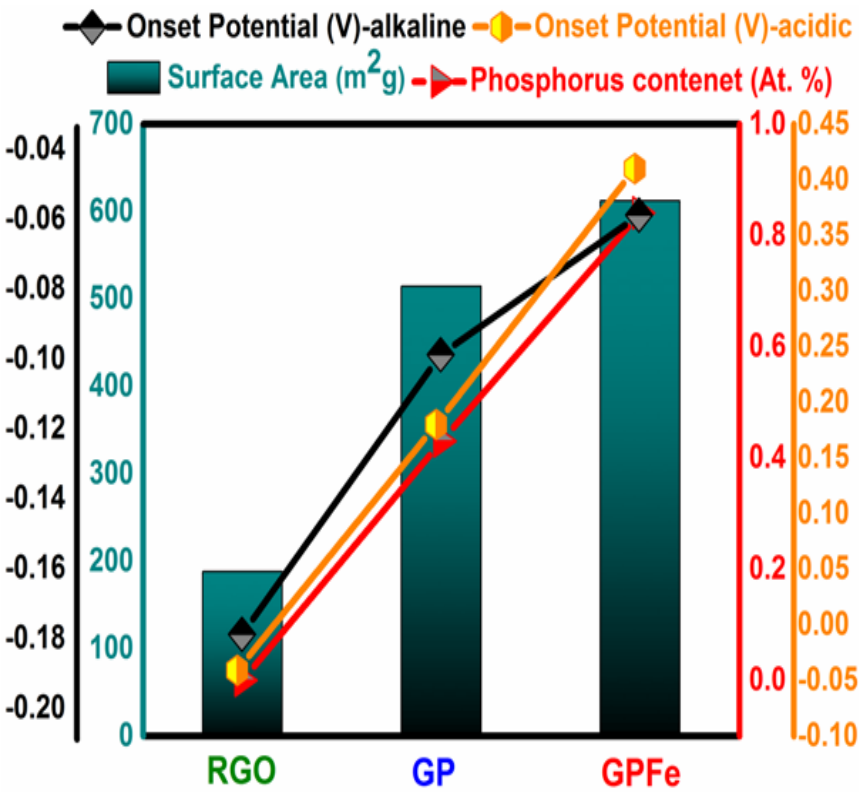

Fig. S8 Comparison of P content, surface area and onset potential in alkaline and acidic media for pristine RGO, GP and GPFe.

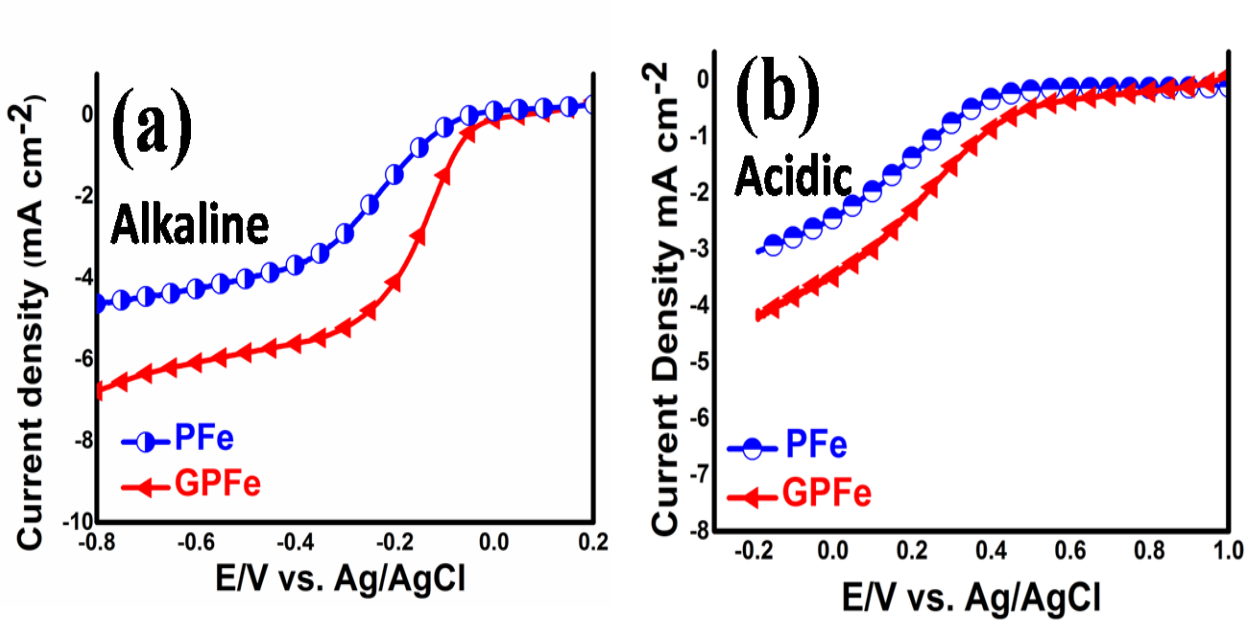

Fig. S9 linear sweep voltammograms (scan rate: 10 mV/s and rotation speed: 1,600 rpm) for PFe and GPFe catalysts in O_2-saturated (a) 0.1 M KOH, and (b) 0.5 M H_2SO_4 solution, respectively.

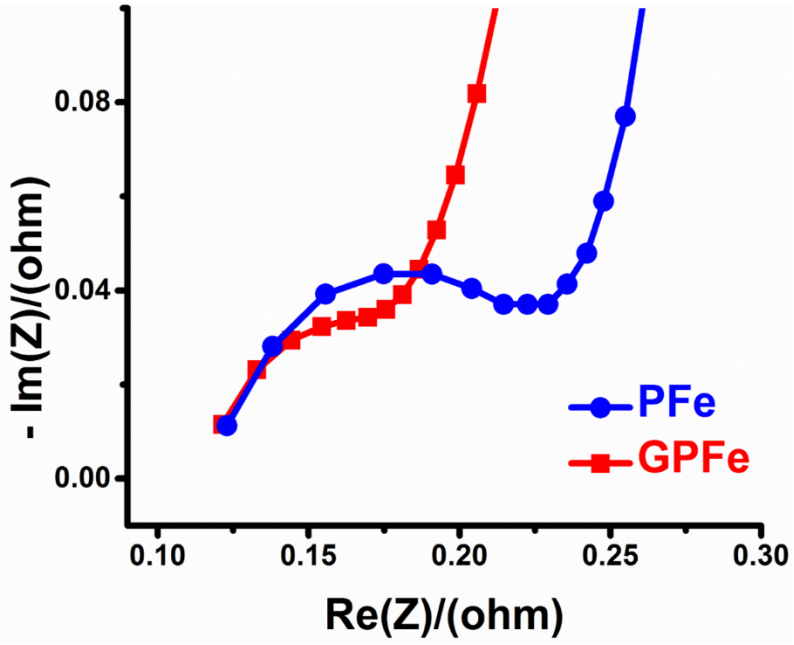

Fig. S10 EIS Nyquist plots measured for the PFe and GPFe samples in O_2-saturated 0.5 M H_2SO_4 solution.

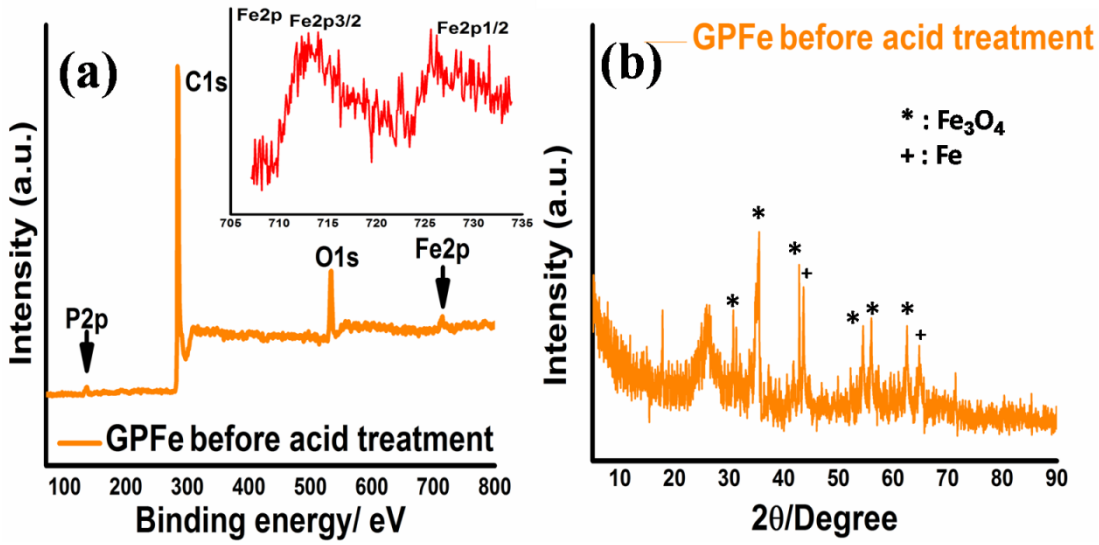

Fig. S11 (a) XPS survey spectrum and Fe 2p narrow scan spectrum and (b) XRD pattern of GPFe before acid treatment.

Table S2 Surface element contents obtained from the XPS analysis for GPFe before and after acid treatment

	Atomic composition (%)			
Sample	C 1s	O 1s	P 2p	Fe 2p
GPFe before acid treatment	88.81	9.31	0.85	1.03
GPFe after acid treatment	94.24	4.32	0.84	0.6

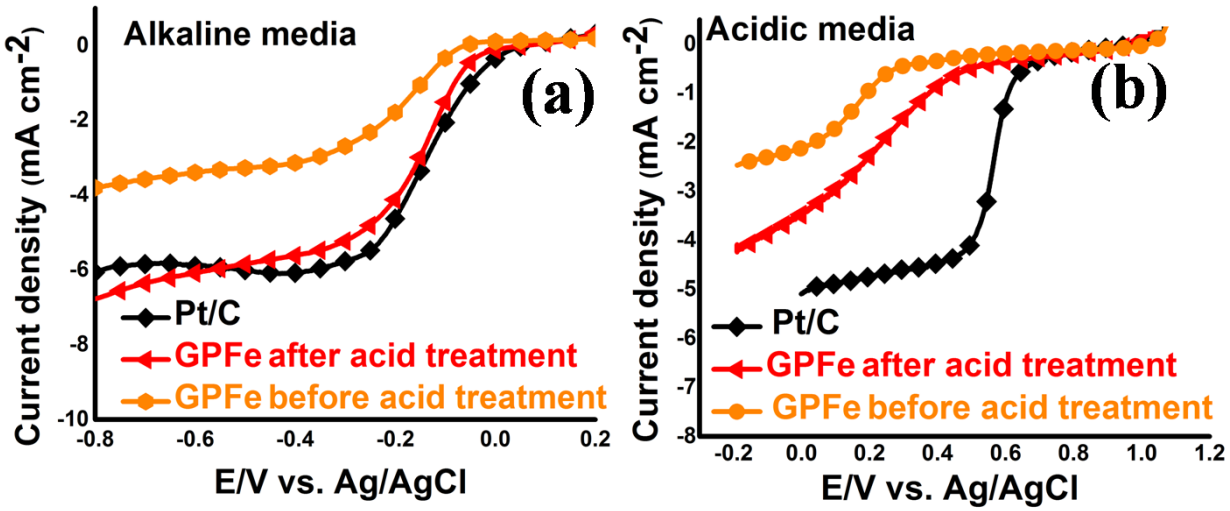

Fig. S12 linear sweep voltammograms (scan rate: 10 mV/s and rotation speed: 1,600 rpm) for GPFe catalyst before and after acid treatment, and 20 wt% Pt/C (E-TEK) electrodes in O_2-saturated in (a) 0.1 M KOH, and (b) 0.5 M H_2SO_4 solution, respectively.