

Electronic Supplementary Information

A Robust Water Oxidation Electrocatalyst From Amorphous Cobalt - Iron Bimetallic Phytate Nanostructures

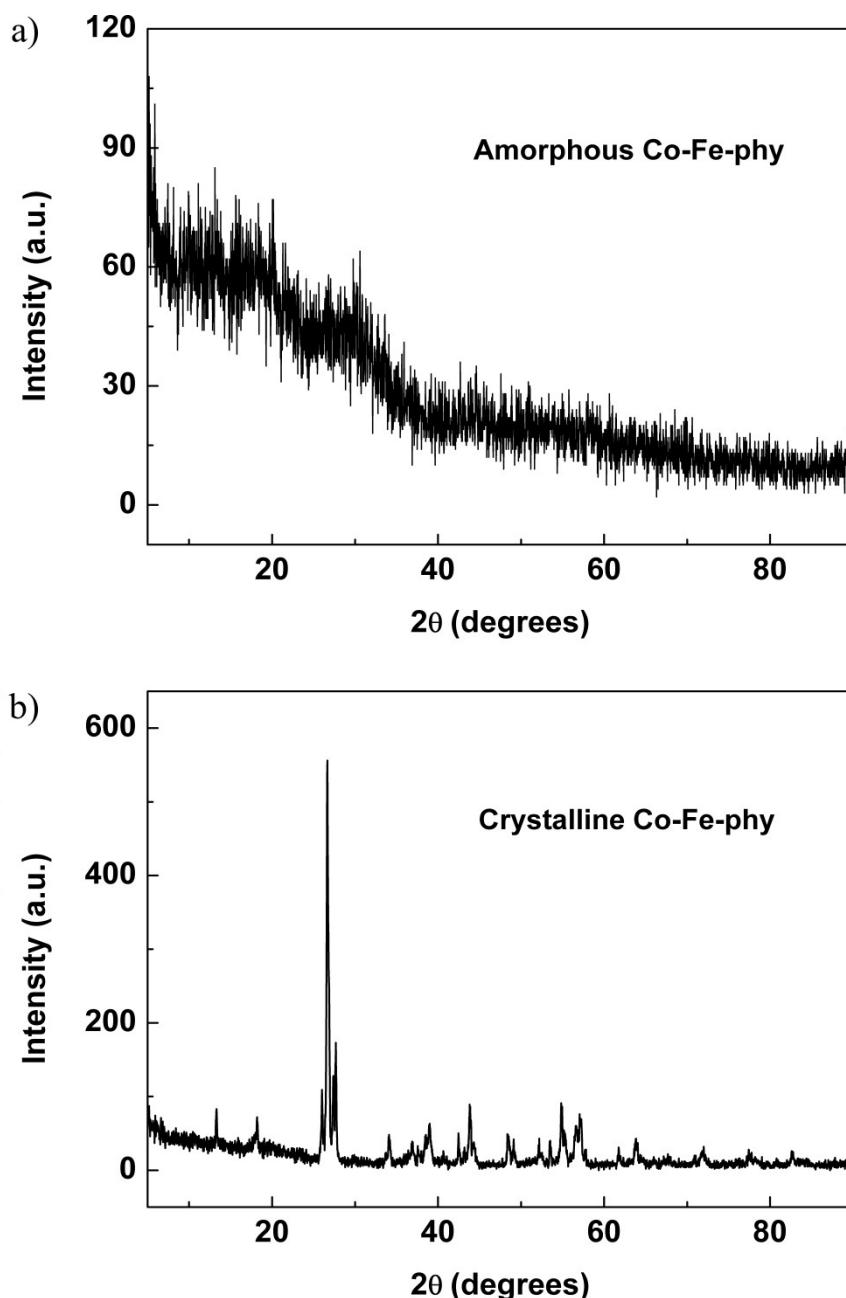


Fig. S1 XRD patterns of amorphous Co-Fe-phy (a) and crystalline Co-Fe-phy (b)

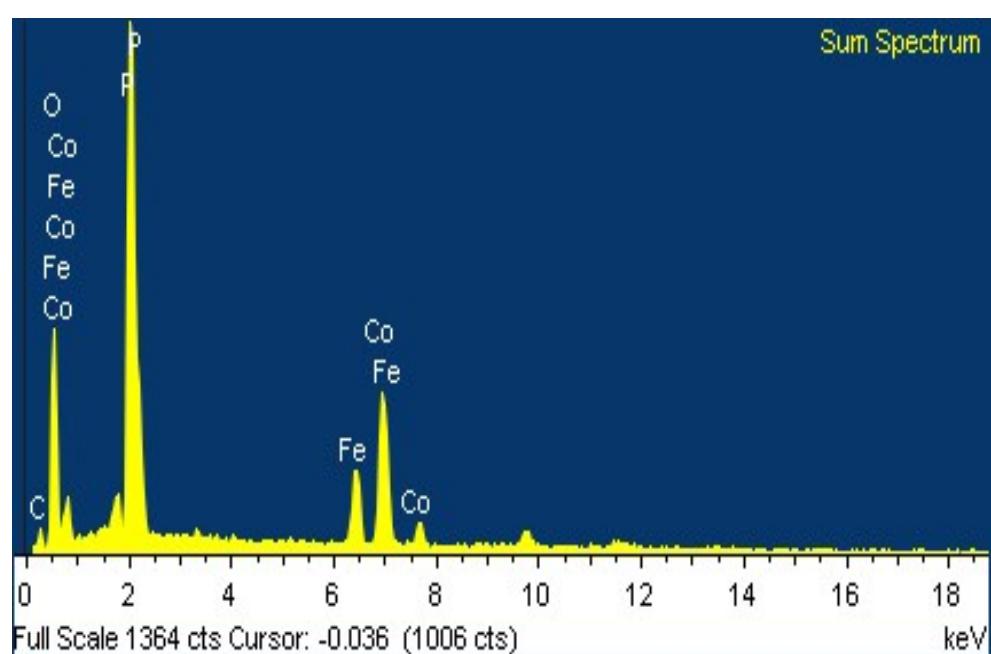


Fig. S2 EDS spectrum of the Co-Fe-phy catalyst.

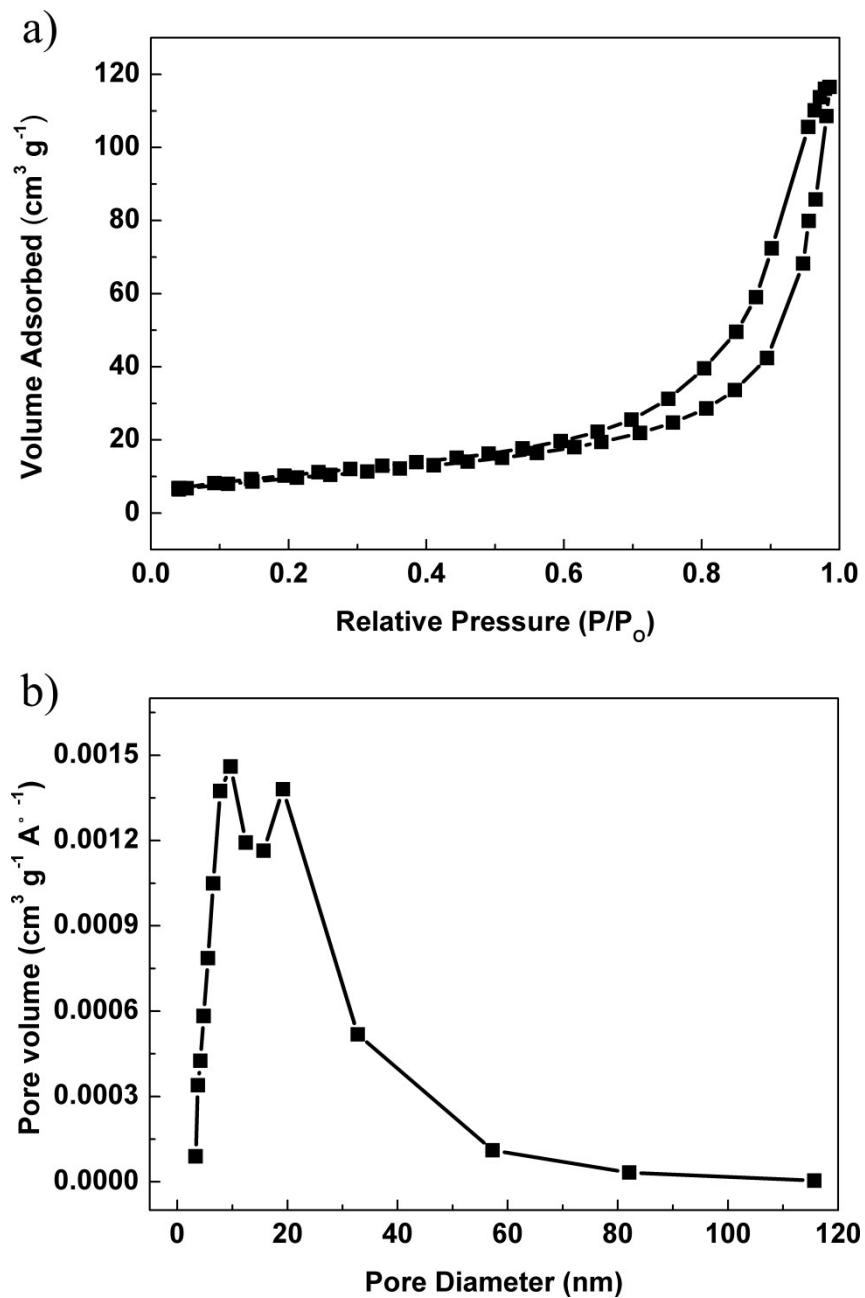


Fig. S3 Nitrogen adsorption-desorption isotherm (a) and corresponding pore size distribution (b) of the Co-Fe-phy catalyst.

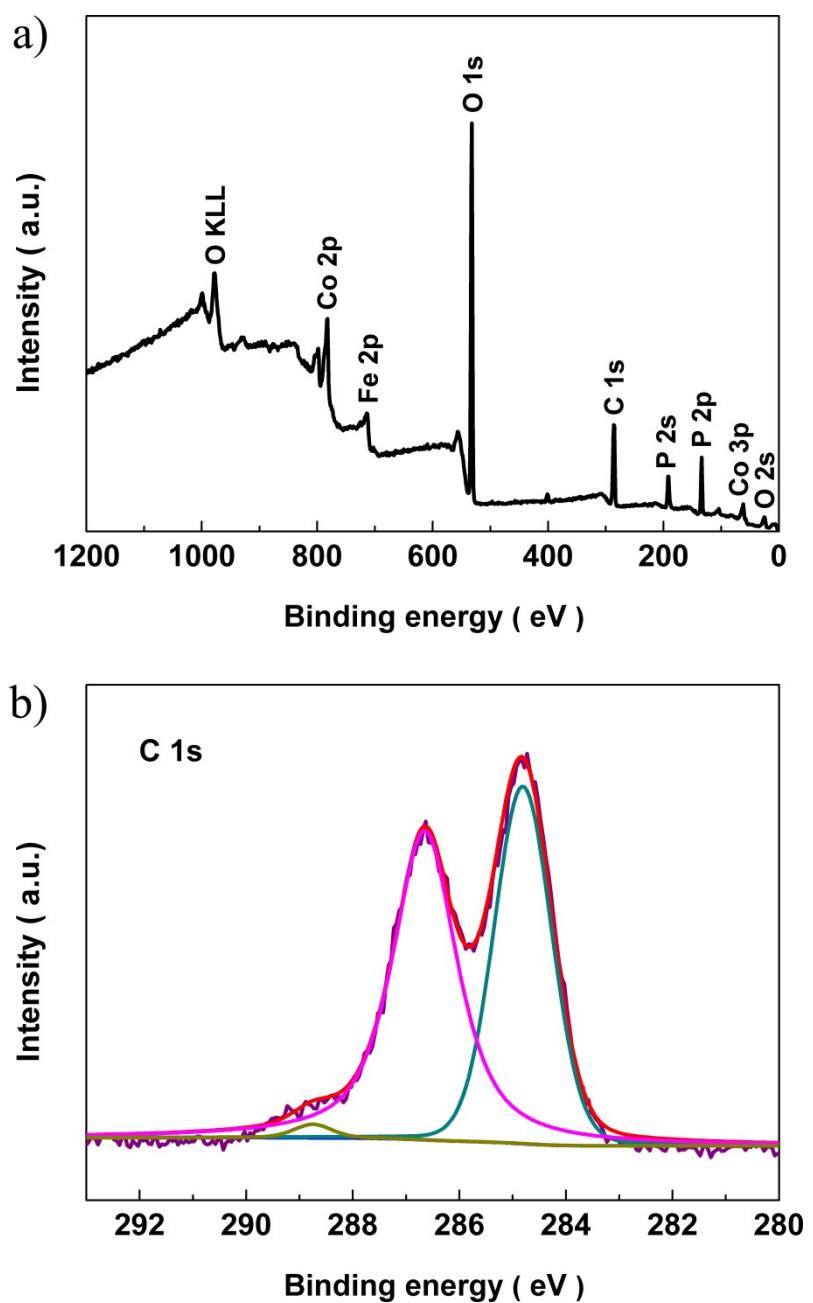


Fig. S4 The overall XPS spectrum (a) and high resolution C 1s XPS spectrum (b) of Co-Fe-phy.

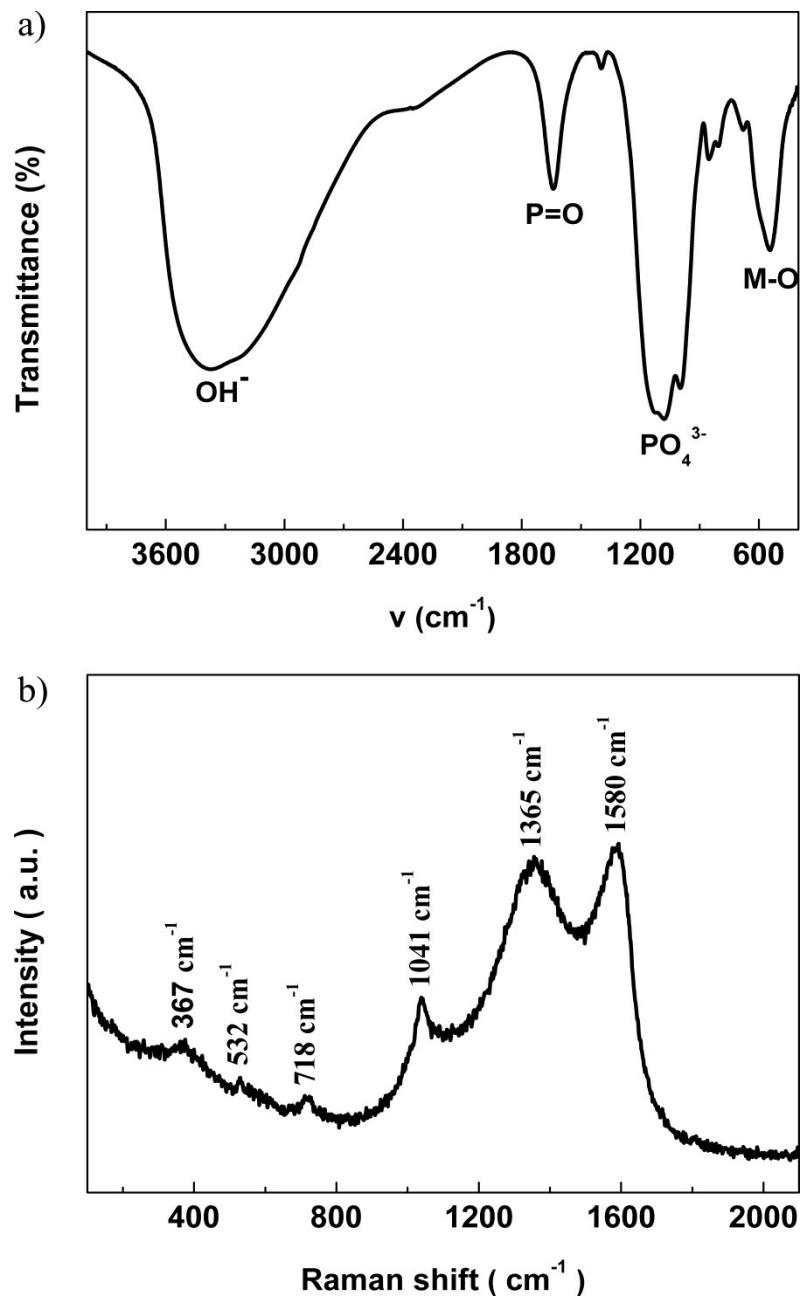


Fig. S5 IR spectrum (a) and Raman spectrum (b) of Co-Fe-phy.

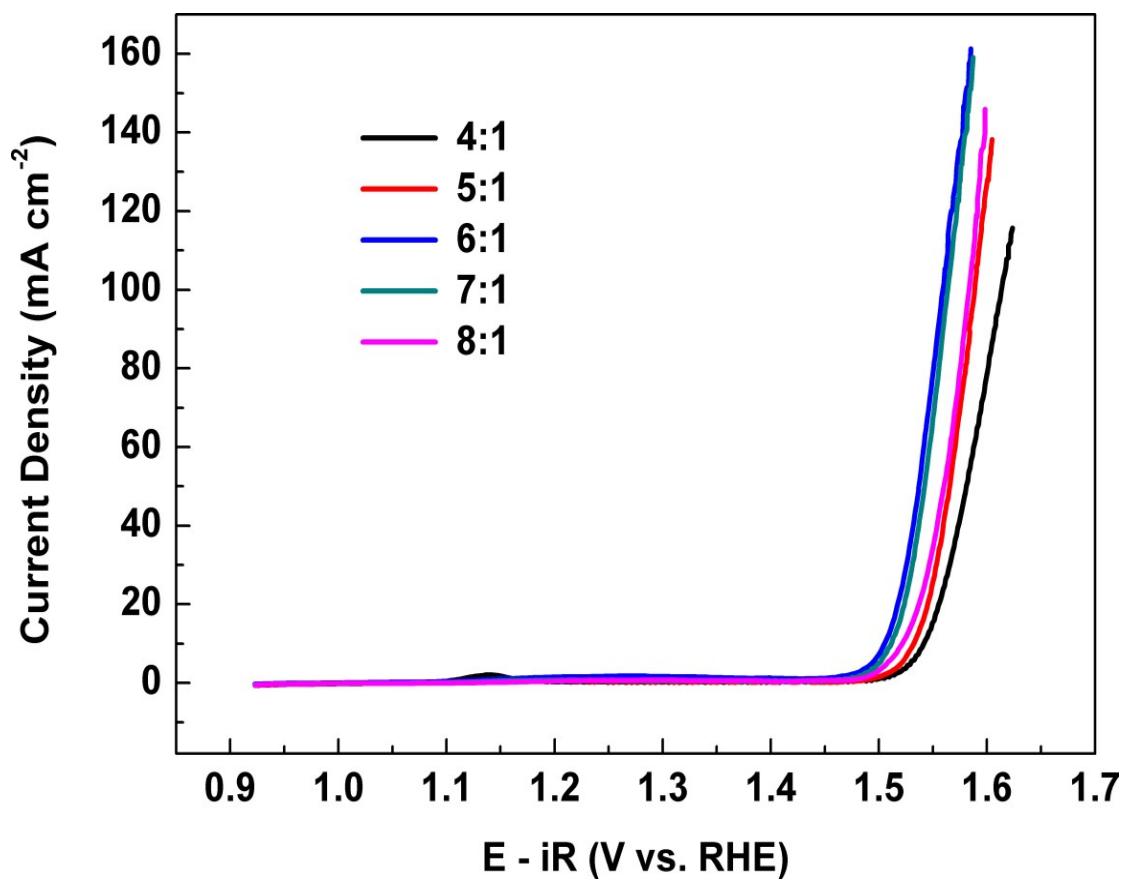


Fig. S6 LSVs of catalysts with different dosing mole ratios between metal and phytate.

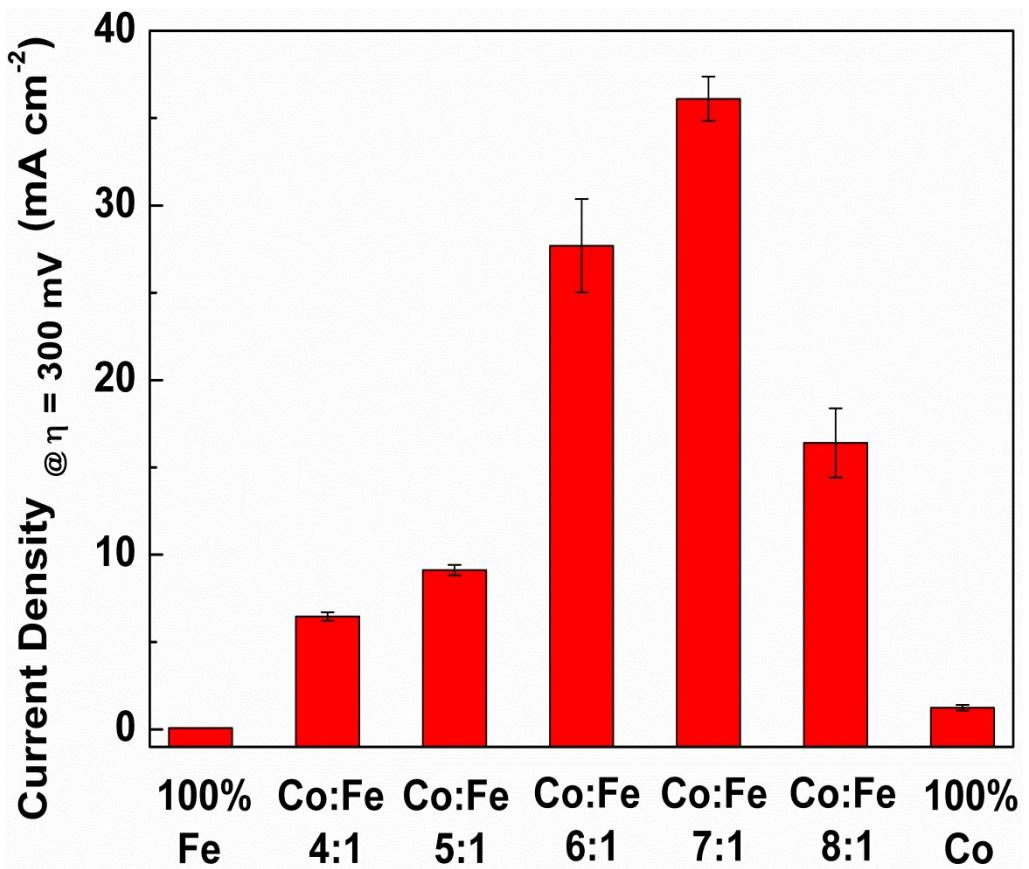


Fig. S7 The current density with different ratios of iron doping at overpotential of 300 mV.

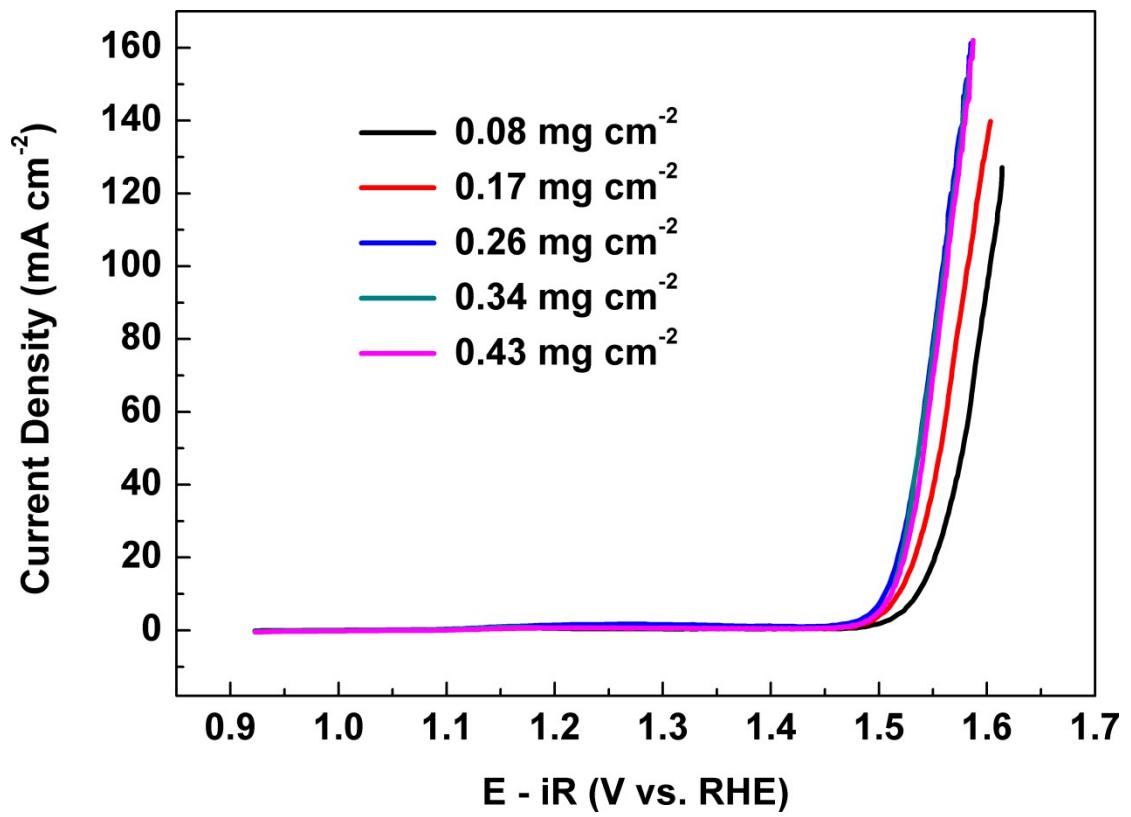


Fig. S8 Polarization curves of Co-Fe-phy on GCE with different mass loading.

The calculation of the turnover frequency (TOF):

TOF is defined as the number of O₂ molecules produced per second per active site. At first, we assumed that only Co-sites are available for catalysis. Then we calculated the TOF_{Co} according to the equation:

TOF=J*A/ (4*F*m), where J is the current density at overpotential of 300 mV (A cm⁻²), A is the area of glassy carbon electrode (0.07 cm⁻²), F is Faraday constant (96485 C mol⁻¹) and m is the number of moles of catalytic metal deposited on the GC electrode (mol). The factor 1/4 arrives by taking into account that four electrons are required to form one oxygen molecule.

Finally, five groups of TOF_{Co} at different Fe content were calculated and the TOF_{Co} is the minimum value of the number of O₂ molecules produced per second per active site. Additionally, the computing method of TOF_{Fe} was calculated in accordance with TOF_{Co}.

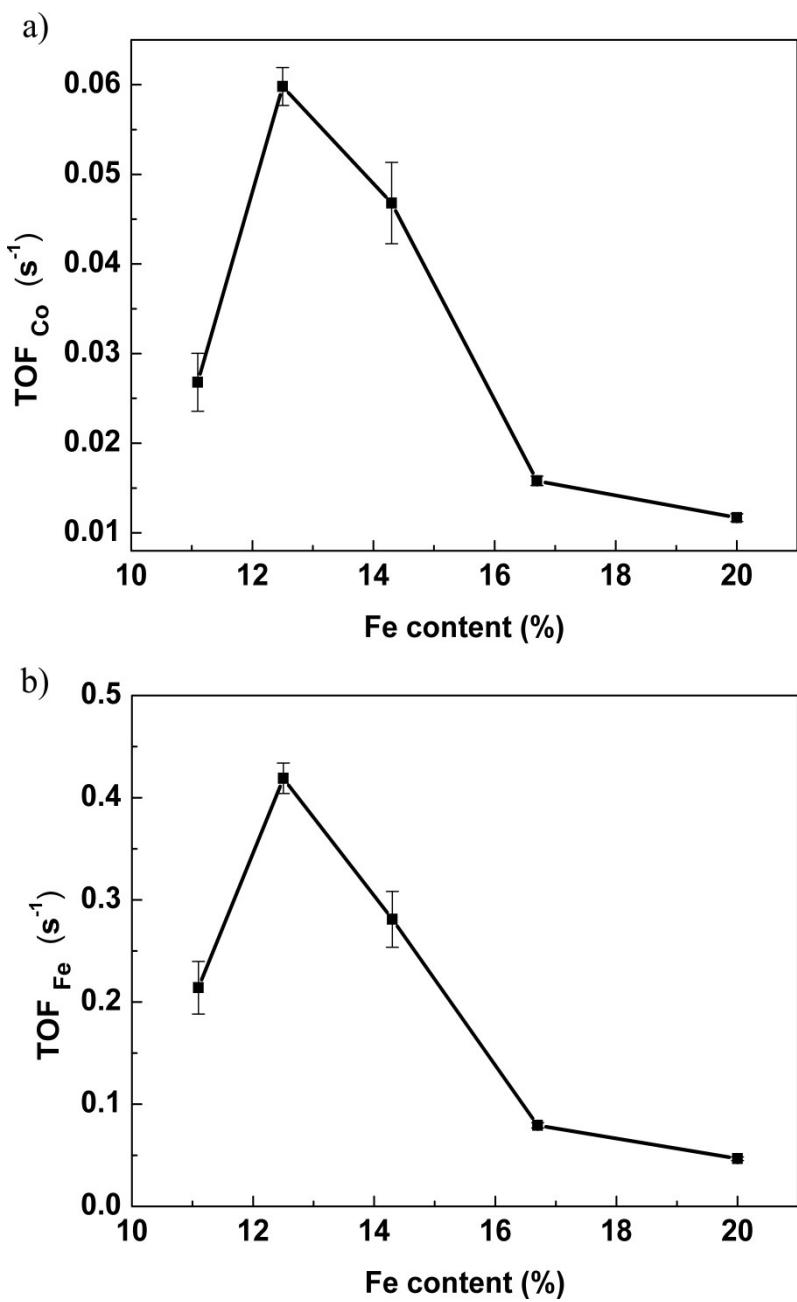


Fig. S9 TOF data depicted based on assuming (a) only all the Co-sites are available for catalysis (TOF_{Co}), and (b) only all the Fe-sites are available for catalysis (TOF_{Fe}) during polarization at $\eta = 300$ mV.

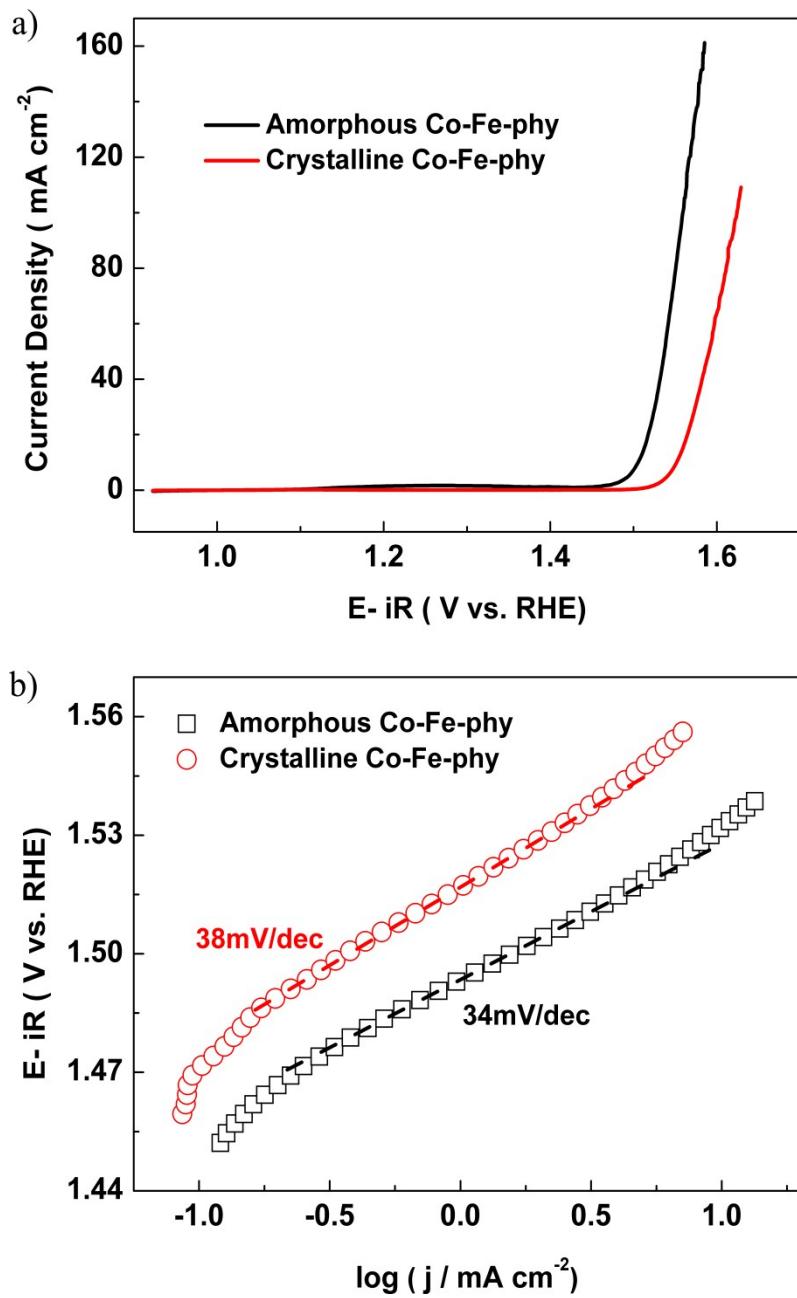


Fig. S10 Polarization curves (a) and corresponding Tafel plots (b) of amorphous and crystalline Co-Fe-phy in 1 M KOH.

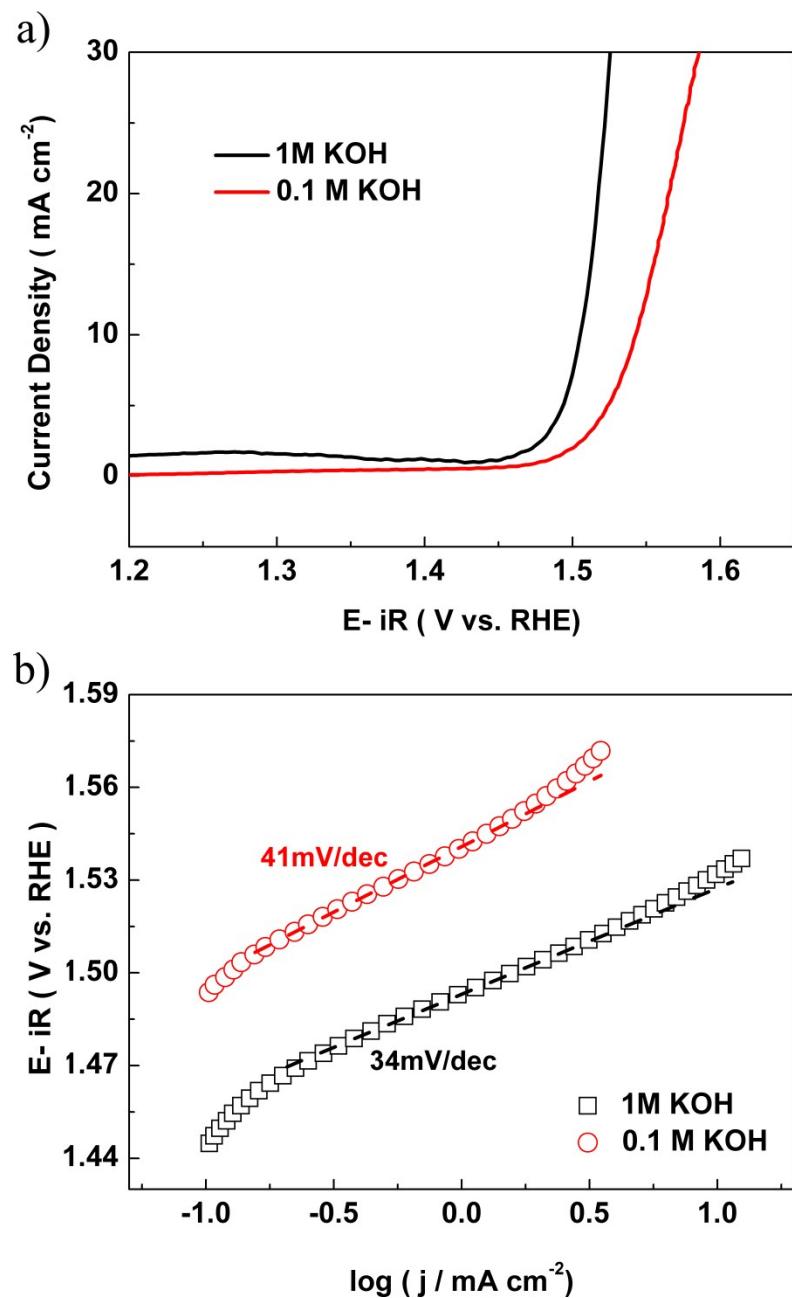


Fig. S11 (a) Polarization curves of Co-Fe-phy in 0.1 and 1 M KOH at a scan rate of 10 mV s^{-1} ; (b) Tafel plots.

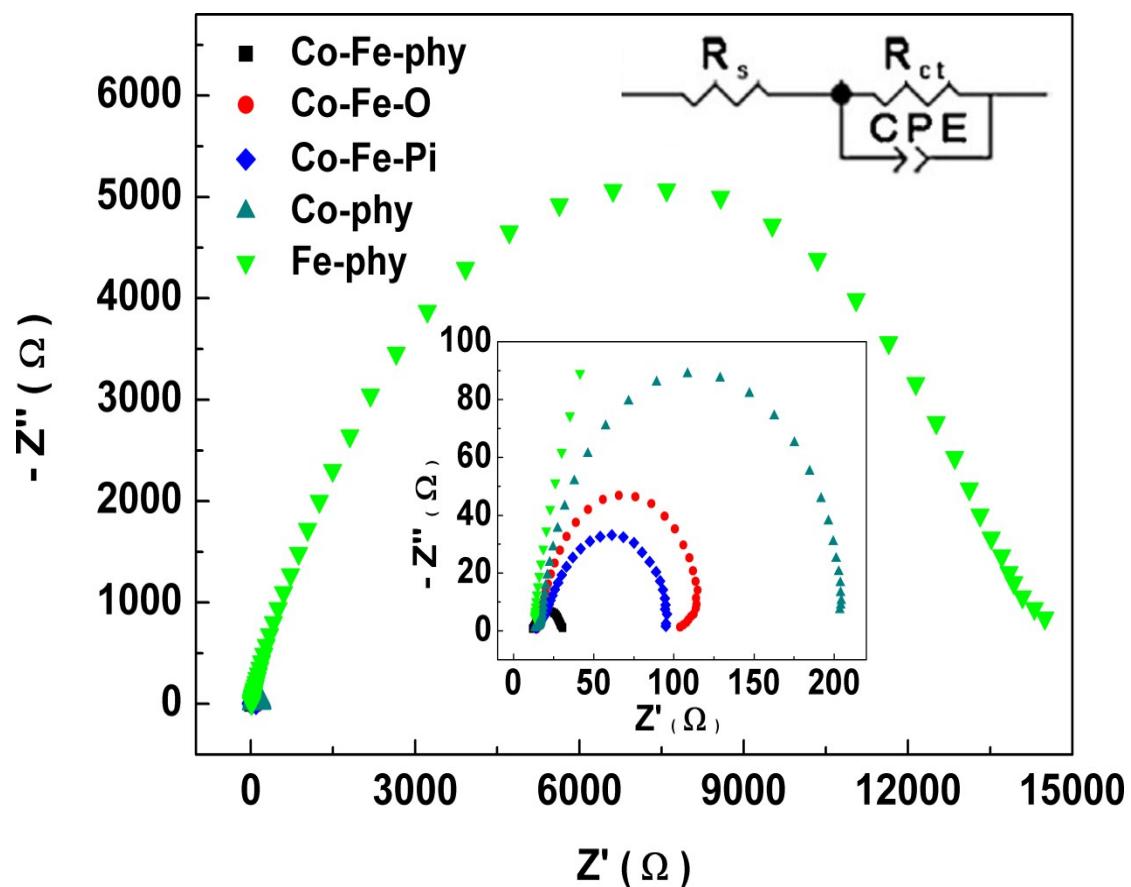


Fig. S12 The EIS of the five catalysts on GCE; the top-right corner displays the simplified Randles equivalent circuit.

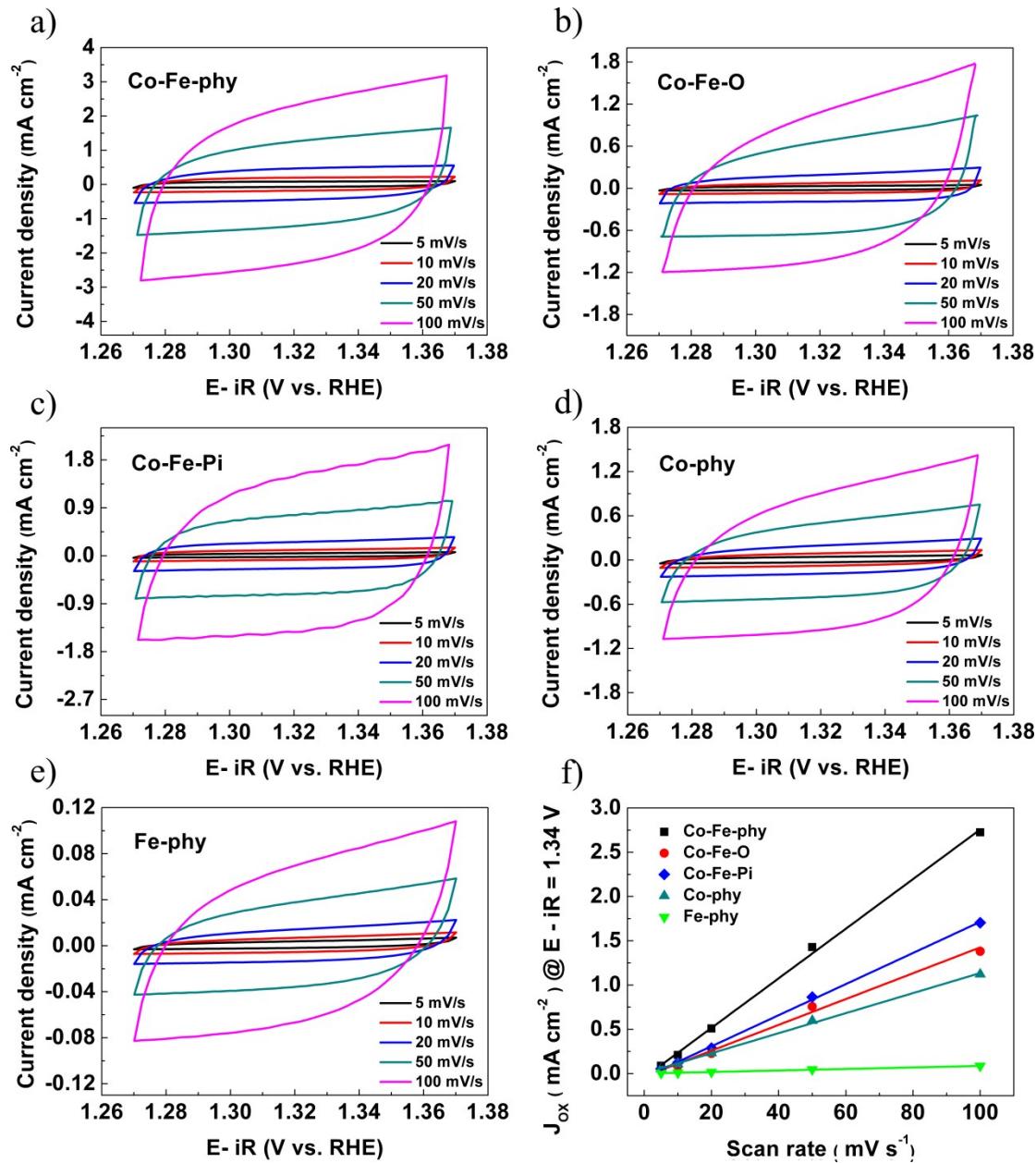


Fig. S13 The CV curves of Co-Fe-phy (a), Co-Fe-O (b), Co-Fe-Pi (c), Co-phy (d) and Fe-phy (e) at a sweep rate of 5, 10, 20, 50 and 100 mV s^{-1} in 1 M KOH; the linear fitting curves of the oxidation current at 1.34 V vs. RHE versus scan rates (f).

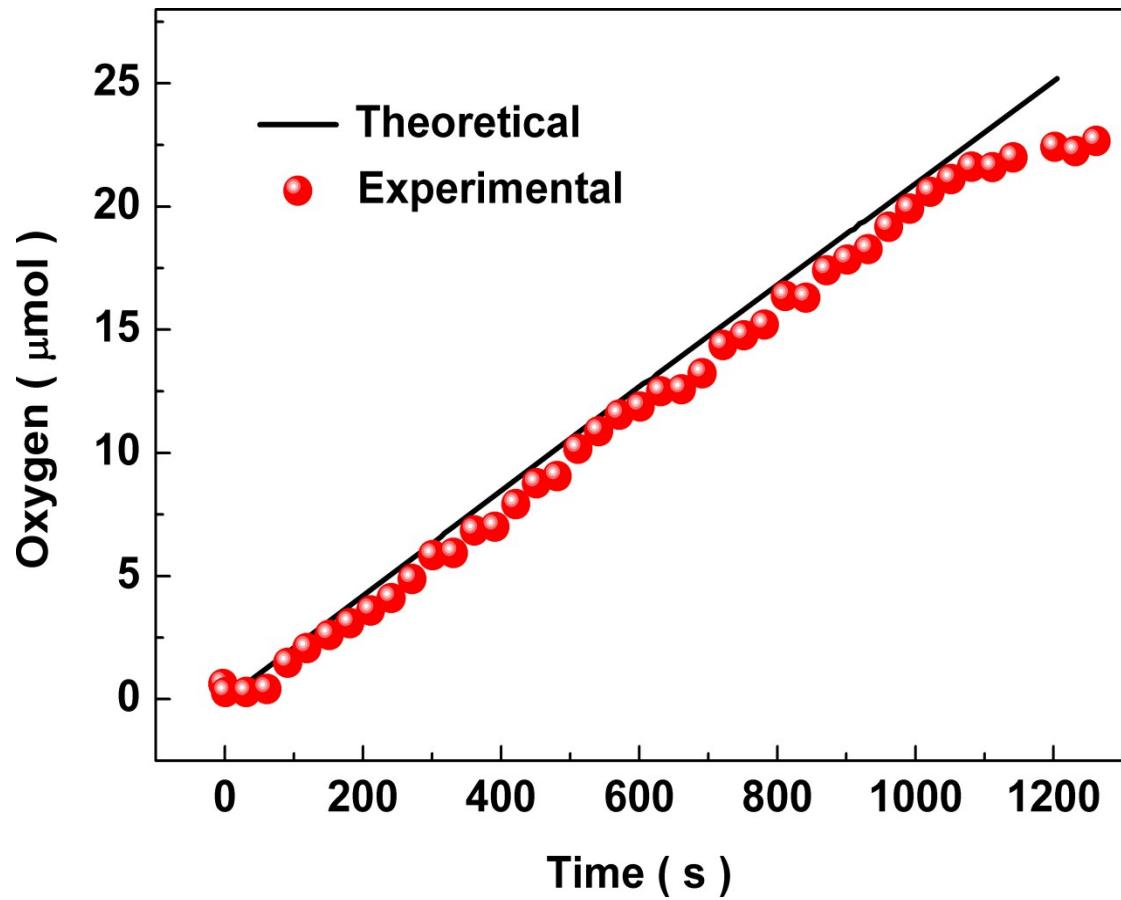


Fig. S14 Faradaic efficiency of the Co-Fe-phy catalyst loaded on CFP at 1.52 V vs. RHE in 1M KOH.

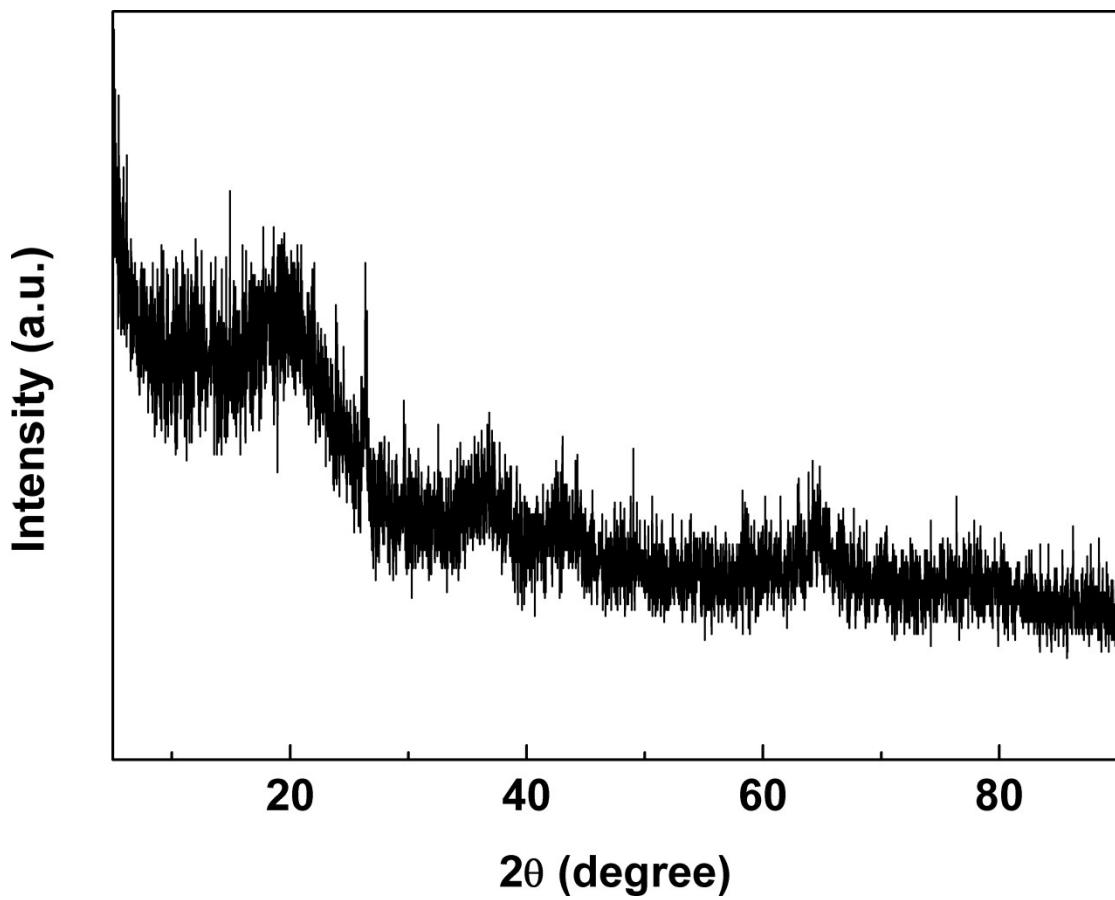


Fig. S15 The XRD pattern of the catalyst after 300 cycles.

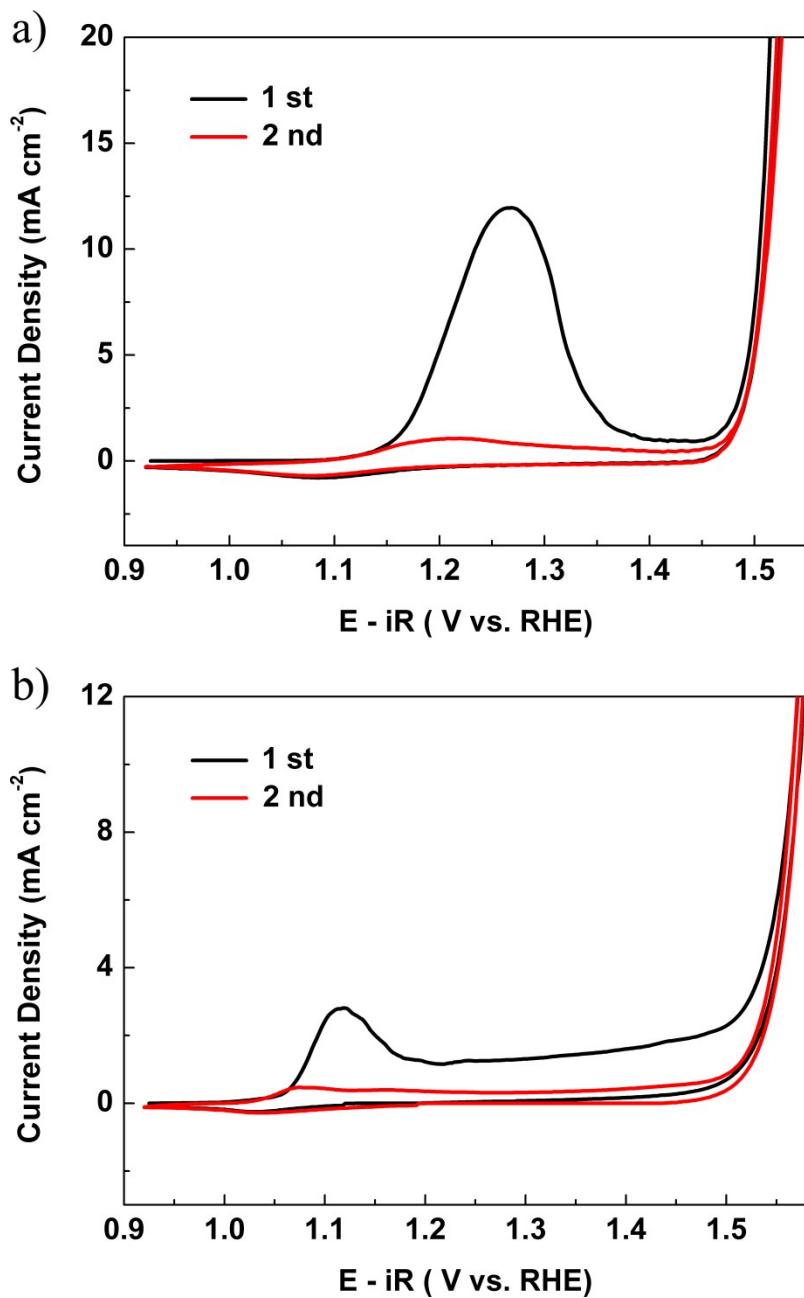


Fig. S16 The CV cycles of Co-Fe-phy (a) and Co-phy (b) at a scan rate of 10 mV s^{-1} in 1 M KOH .

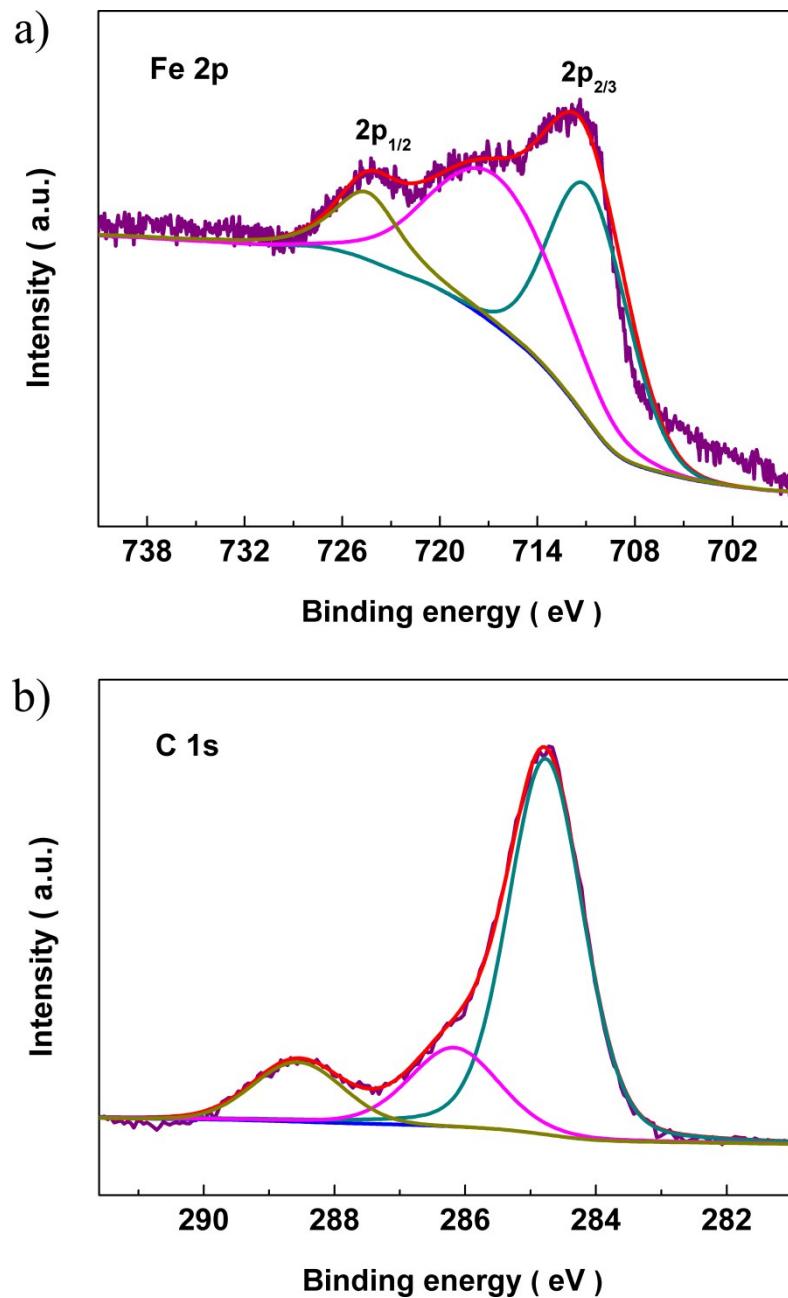


Fig. S17 Fe 2p (a) and C 1s (b) XPS spectra after 300 cycles.

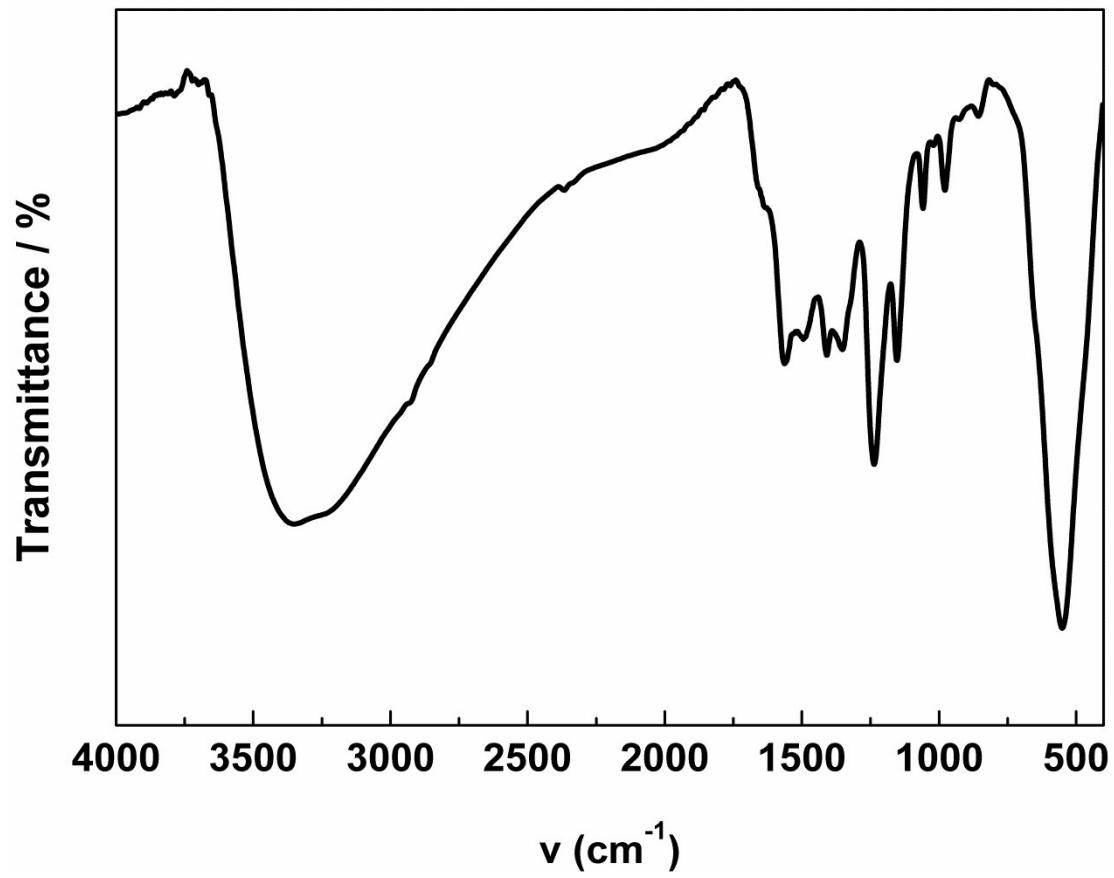


Fig. S18 IR spectrum of Co-Fe-phy after cycles.

Table S1 Comparison of the catalytic activity for OER with several reported catalysts.

Catalyst	j/mA cm ⁻² @ η/mV	Tafel slope (mV dec ⁻¹)	Electrolyte	Mass loading /mg cm ⁻²	Reference
Co-Fe-phy	10@278	34	1M KOH	0.26	This work
Co-Fe-phy	10@313	41	0.1M KOH	0.26	This work
Amorphous CoFe ₂ O _n	10@510	48	0.1M KOH	0.051	1
Crystalline CoFe ₂ O ₄	10@570	61	0.1M KOH	0.051	1
CoFe ₂ O ₄ NFs	5@410	82	0.1M KOH	0.428	2
Amorphous Ni-Co binary oxide	10@325	39	1M KOH	-	3
Zn _x Co _{3-x} O ₄ -3:1 RP arrays	10@320	51	1M KOH	1	4
CoMn LDH	10@324	43	1M KOH	-	5
LiFe _x Ni _{1-x} PO ₄ /rGO/GC	10@295	47	1M KOH	-	6
Co ₃ (PO ₄) ₂ @N-C	10@317	62	1M KOH	0.3	7
CoP/C	10@360	66	0.1M KOH	0.05	8
(Co _{0.54} Fe _{0.46}) ₂ P/C	10@370	-	0.1M KOH	0.2	9
3D-NA/Co/CoNPAs	10@265	69	1M KOH	-	10
Fe ₂ Ni ₂ N NPAs	-	34	1M KOH	-	11
Ultrathin NiFe LDH nanosheets with MoO ₄ ²⁻ intercalation	10@280	40	1M KOH	0.28	12
Plasma-engraved Co ₃ O ₄ nanosheets	10@300	68	0.1M KOH	-	13
Ni-Fe oxide films	5@384	~ 48	0.1M KOH	0.1	14
Co ₃ O ₄ /NiCo ₂ O ₄	10@340	88	1 M KOH	-	15
Ni-Fe alloy	10@375	42	1 M KOH	-	16
Ultrathin NiCo ₂ O ₄ nanosheets/GC	10@320	30	1 M KOH	0.285	17
np-(Co _{0.52} Fe _{0.48}) ₂ P	10@270	30	1 M KOH	-	18
Co ₃ V ₂ O ₈	10@359	65	1 M KOH	0.21	19
Fe-mCo ₃ O ₄ /GC	10@380	60	1 M KOH	-	20

Reference:

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