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Electrochemical fabrication of efficient cobalt-iron oxide/graphene heterostructure by a three-electrode system for electrocatalytic oxygen evolution reaction

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Author contributions

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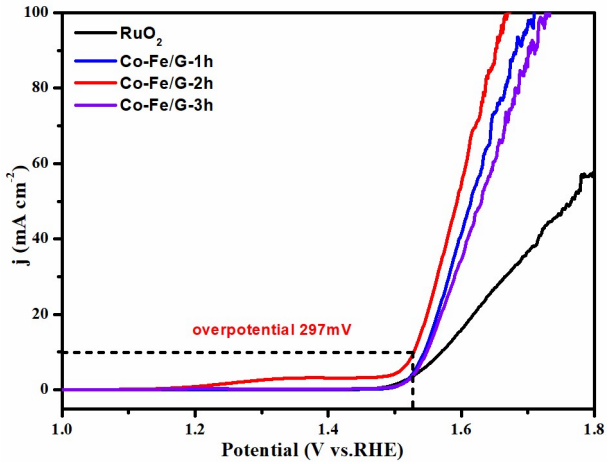

Fig. S1 LSV curves of Co-Fe/G prepared at different electrolysis time.

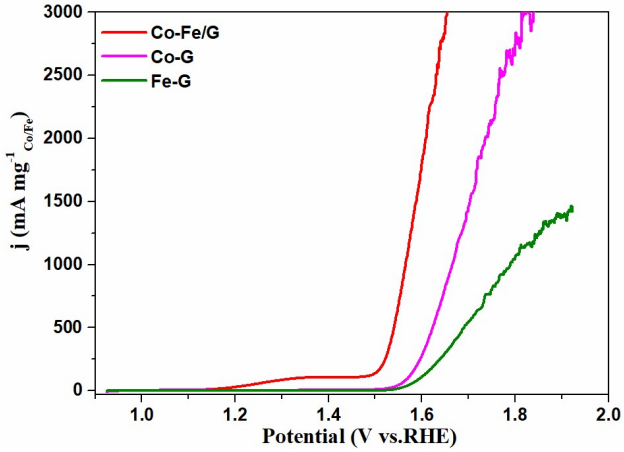

Fig. S2 LSV (mass activity) curves of Co-Fe/G, Co/G and Fe/G.

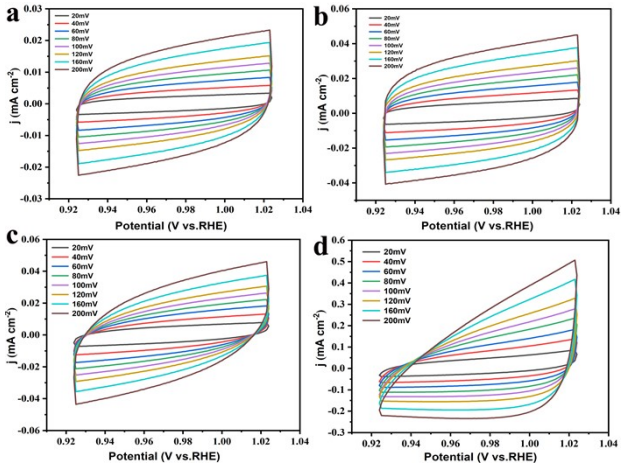

Fig. S3 Cyclic voltammograms of (a) graphene as well as the (b) Co/G, (c) Fe/G and (d) Co-Fe/G catalysts in 1 M KOH at different scan rates.

Just as is conceived, composition synergy could also support more electrochemical active surface area (ECSA) for OER. Here, ECSAs is determined by electrochemical double-layer capacitances (C_{dl}) measured in the non-faradaic potential. From the C_{DL}, one can easily find out the ECSA of an electrocatalyst using the following equation, in case when the specific capacitance (CS) of the same material is known or determined under similar experimental conditions. ECSA = C_{DL}/C_S Hence we have chosen an average of 0.040 mF to get the ECSA.

Table S1 ECSAs of different materials

	graphene	Fe/G	Co/G	Co-Fe/G
C_{dl} value	0.084	0.138	0.161	1.130
ECSA (cm^2)	2.1	3.45	4.025	32.5

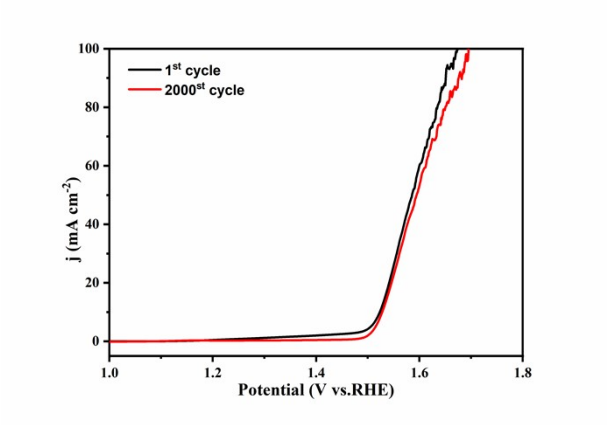

Fig. S4 Polarization curves of the Co-Fe/G catalyst before and after 2000 cycles.

Table S2 . The calculated TOF values of these catalysts

Catalyst	Co (wt %)[a]	Fe (wt %)[a]	TOF(s^{-1})
Co/G	11.34	/	0.59
Fe/G	/	22.68	0.22
Co-Fe/G	5.71	2.90	3.82

[a] The values were determined from the ICP-OES analyses

The turnover frequency (TOF) values of all the catalysts for the OER were calculated according to the following equation.

$$\text{TOF } (s^{-1}) = j\, N_A / n\, F\, \Gamma \qquad \text{(S1)}$$

where j stands for the current density (A cm^{-2}), N_A is the Avogadro number, n is the number of electrons transferred to evolve a molecule of product (for O_2, it is 4), F is the Faraday constant (=96 485 C), and Γ is the surface concentration of active sites or number of participating atoms in the catalyst material. The calculated TOF values of all the catalysts are listed in the table.

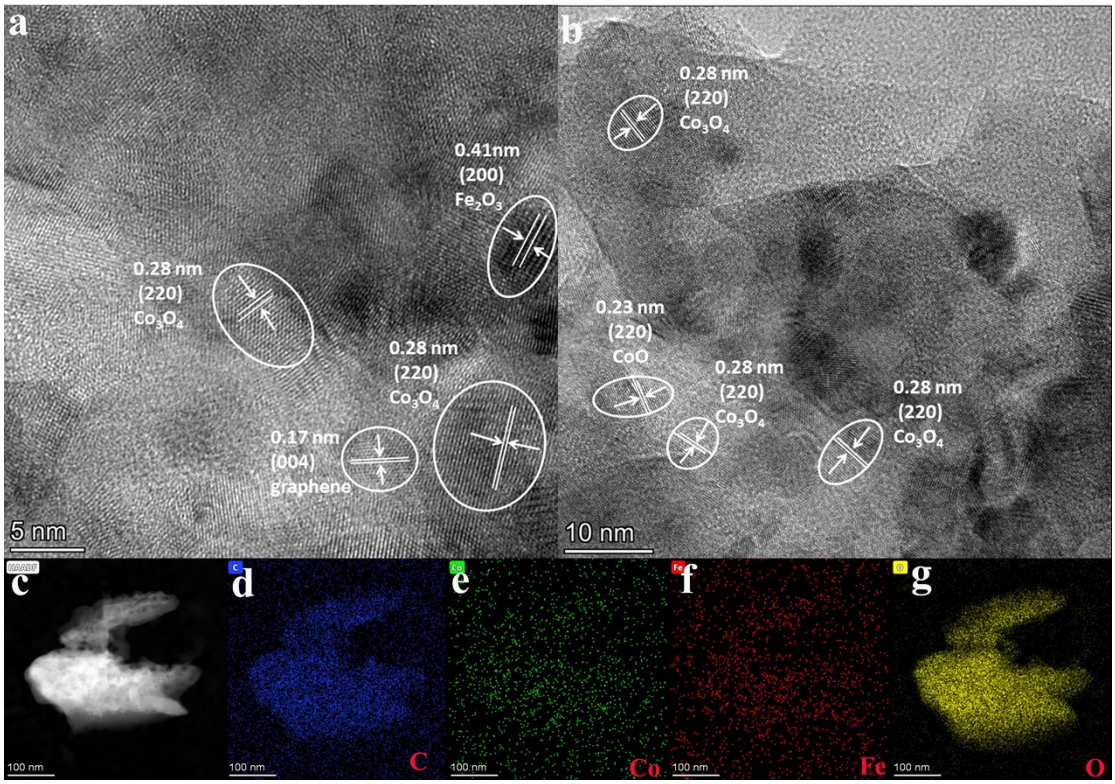

Fig. S5 HRTEM images (a,b), HAADF-STEM image (c) and corresponding EDS mapping images (d-g) of Co-Fe/G.

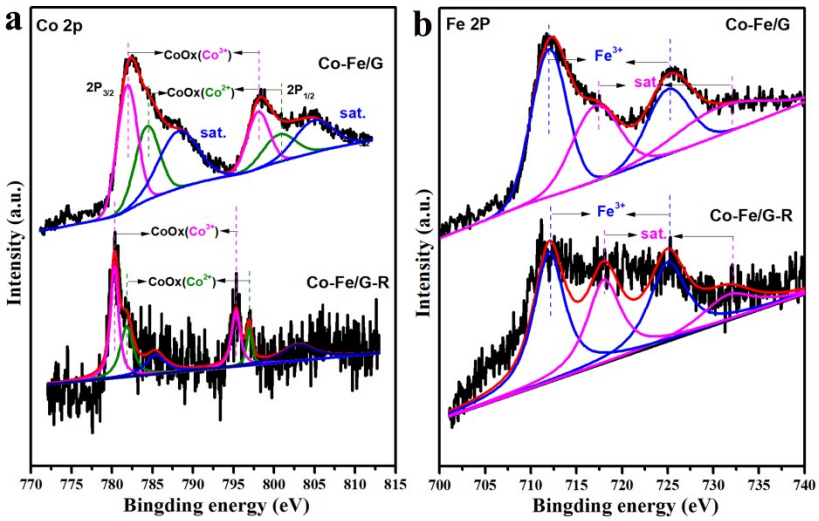

Fig. S6 (a) Co 2p XPS spectra and (b) Fe 2p XPS spectra of Co-Fe/G and Co-Fe/G-R.