Electronic Supplementary Material

IrCo Alloy nanoparticles supported N-Doped carbon for hydrogen evolution electrocatalysis in acidic and alkaline electrolytes

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Figure S1

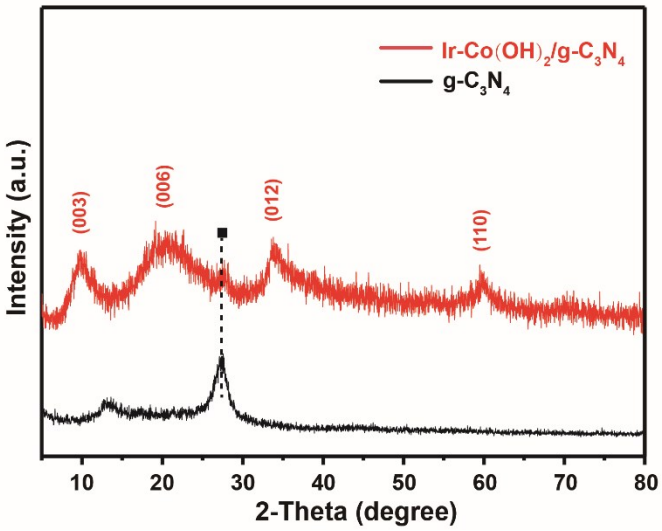

Figure S1 XRD patterns of Ir doped-$Co(OH)_2$/g-C_3N_4 and g-C_3N_4.

Figure S2

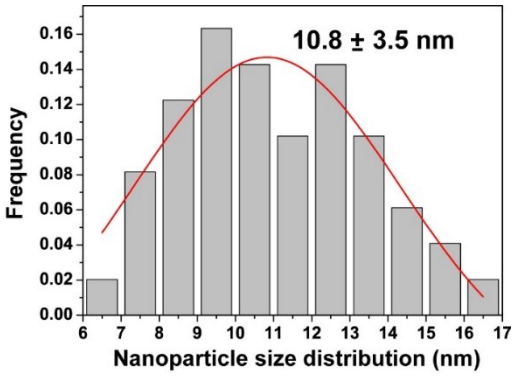

Fig. S2 A histogram of size distribution of IrCo nanoparticles.

Figure S3

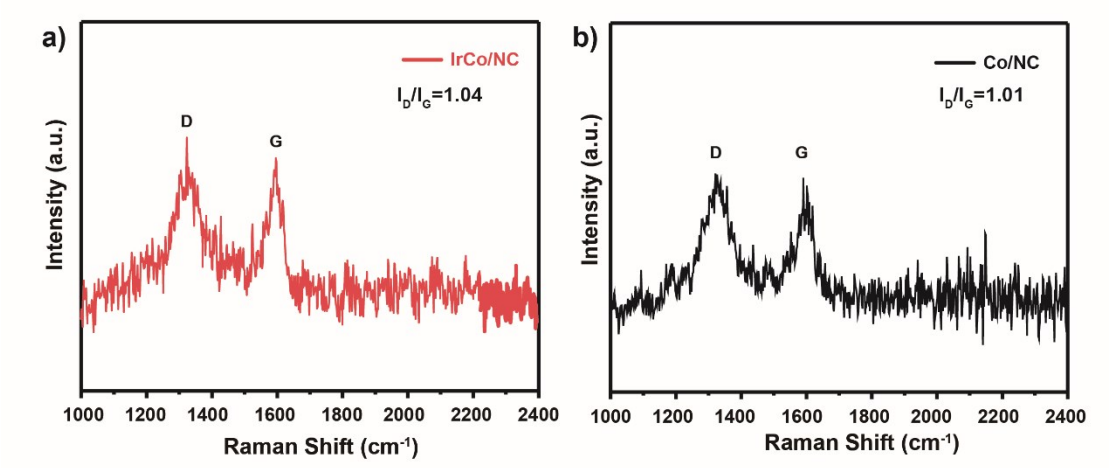

Figure S3 Raman spectra of IrCo/NC and Co/NC.

Figure S4

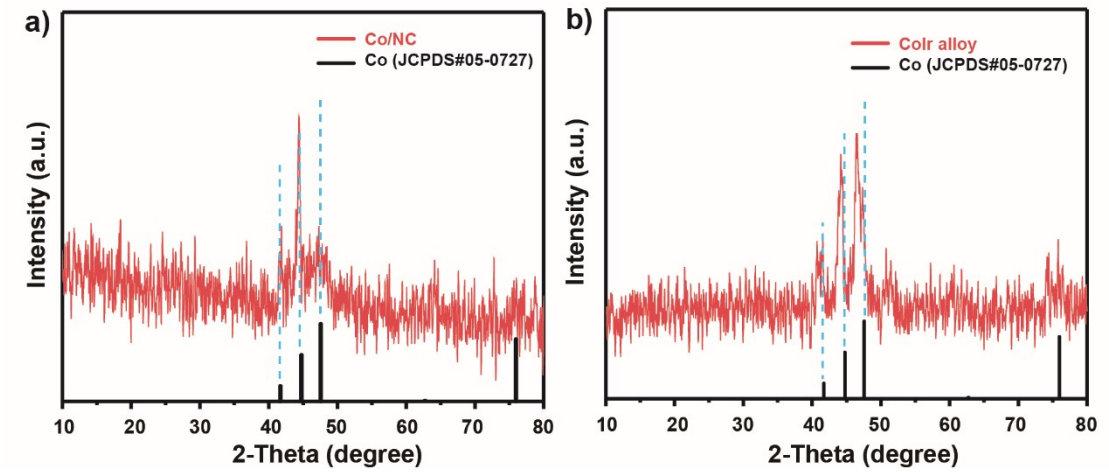

Figure S4 XRD patterns of (a) Co/NC and (b) IrCo alloy for comparison.

Figure S5

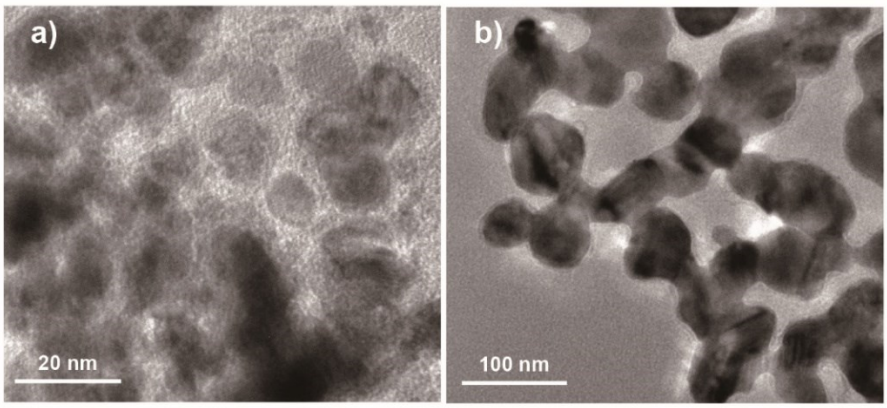

Fig. S5 TEM images of (a) Co/NC and (b) IrCo alloy.

Figure S6

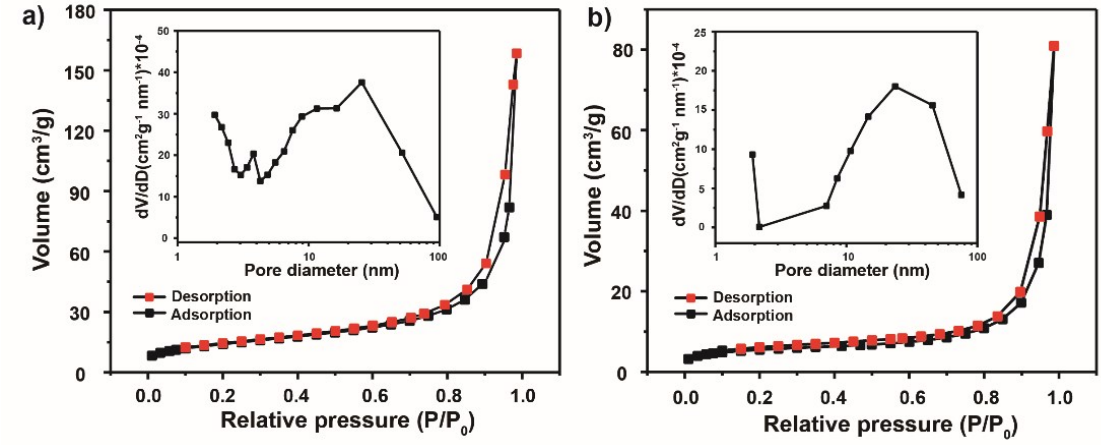

Fig. S6 Nitrogen adsorption/desorption isotherms and pore size distribution (inset) of (a) Co/NC and (b) IrCo alloy.

Figure S7

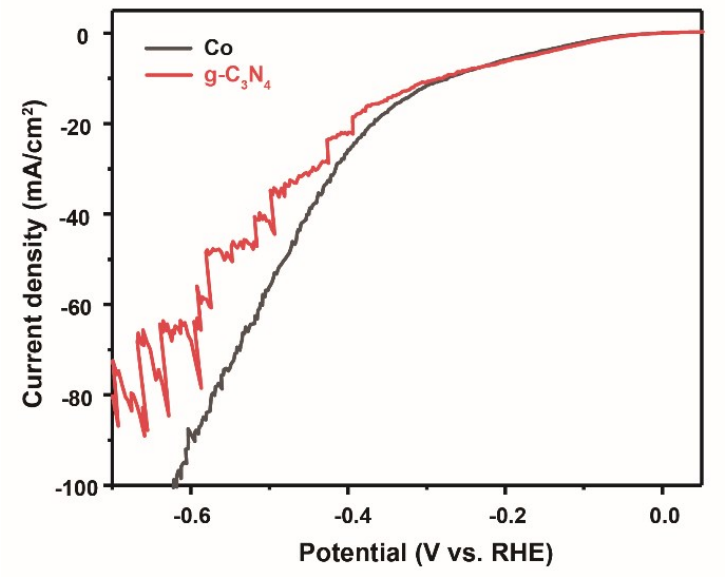

Fig. S7 Polarization curves the Co and g-C_3N_4 composite in 0.5 M H_2SO_4.

Figure S8

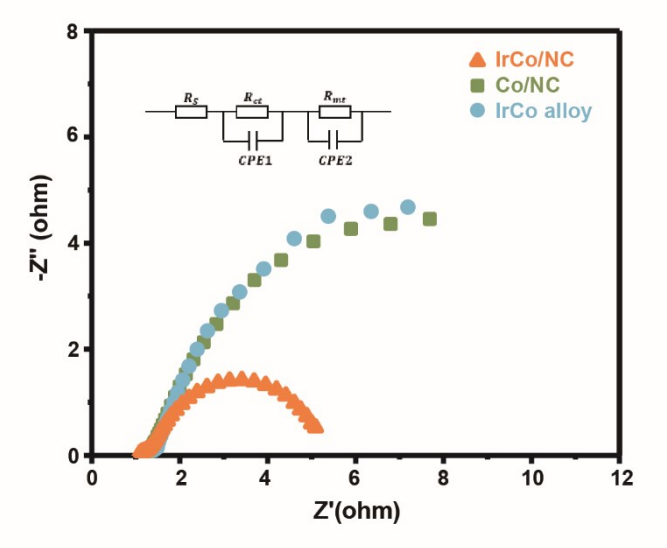

Fig. S8 Nyquist plots of Nyquist plots of the IrCo/NC, Co/NC and IrCo alloy with a fitted equivalent circuit (inset) in 0.5 M H_2SO_4 solution.

Figure S9

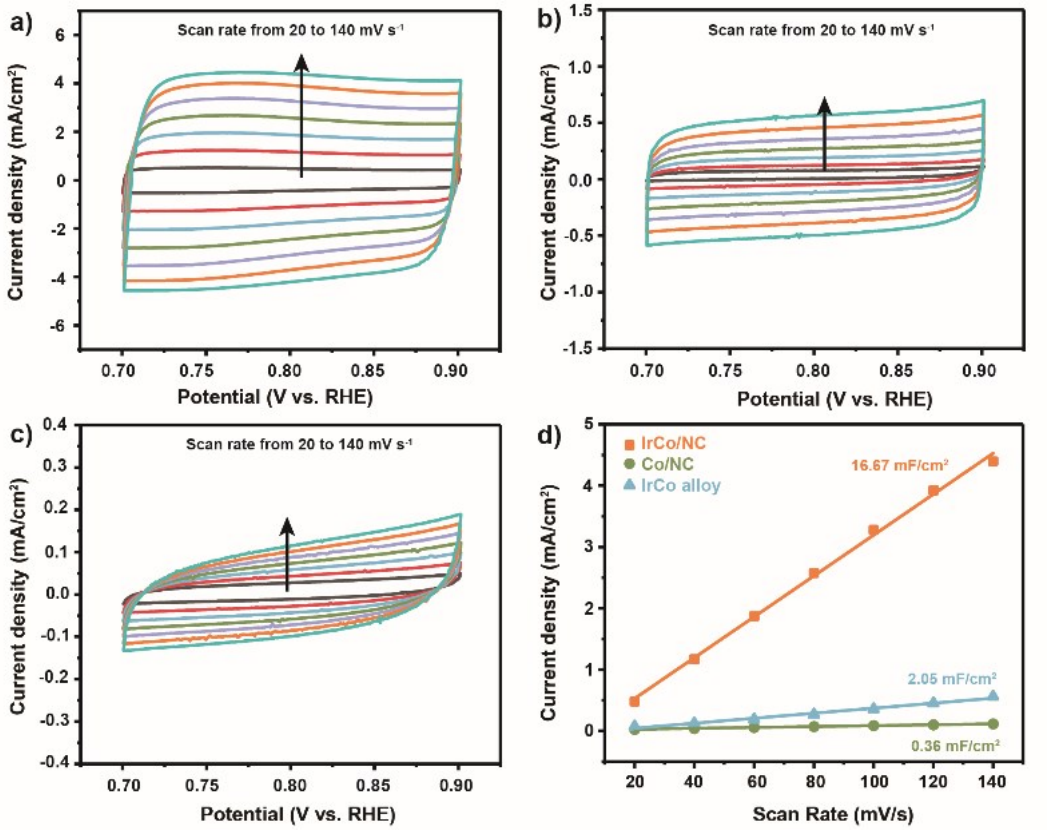

Figure S9 Estimation of electrochemical double-layer capacitance (C_{dl}) for IrCo/NC, Co/NC and IrCo alloy in 0.5 M H_2SO_4 solution.

Figure S10

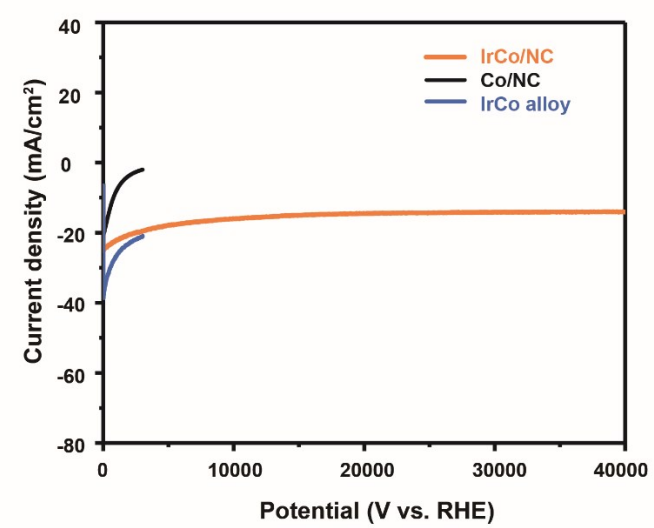

Fig. S10 The time-dependent chronoamperometric test at a static electrolysis potential of Co/NC, IrCo alloy, and IrCo/NC in 0.5 M H_2SO_4 solution.

Figure S11

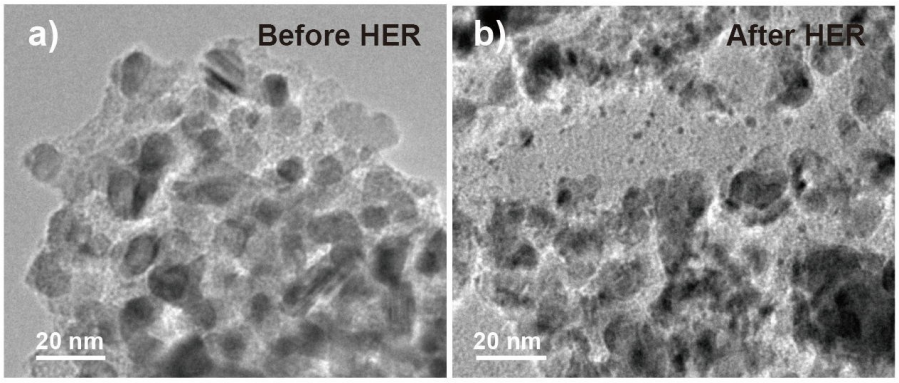

Fig. S11 TEM image of the IrCo/NC before and after time-dependent chronoamperometric test in 0.5 M H_2SO_4.

Figure S12

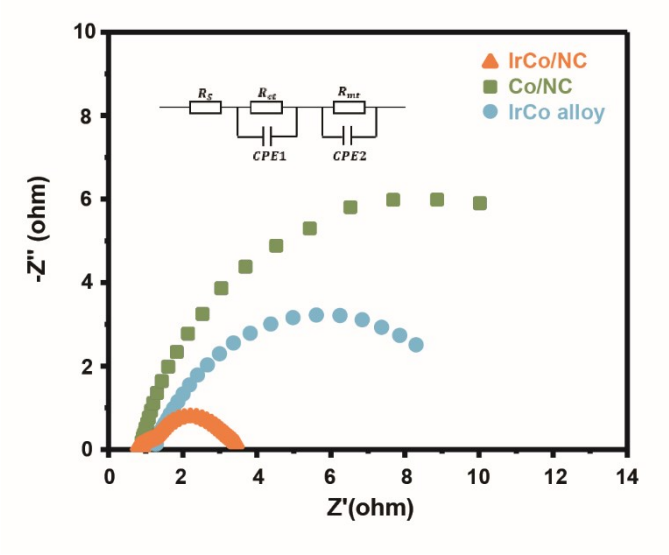

Fig. S12 Nyquist plots of Nyquist plots of the IrCo/NC, Co/NC and IrCo alloy with a fitted equivalent circuit (inset) in 1 M KOH solution.

Figure S13

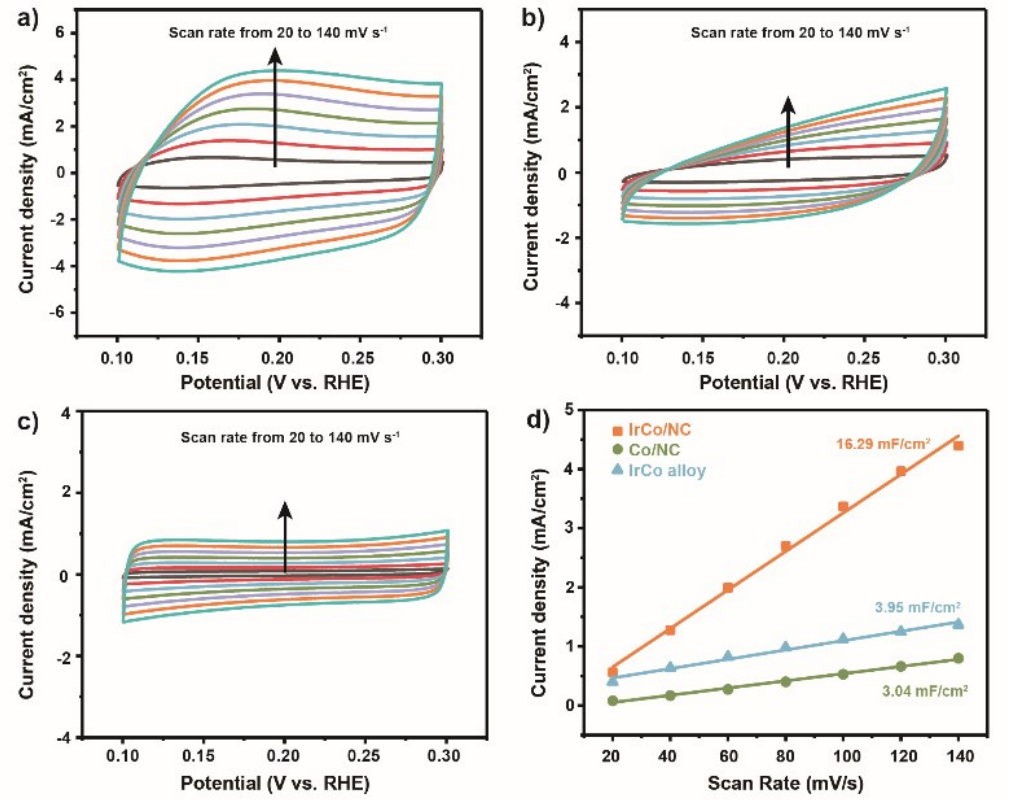

Figure S13 Estimation of electrochemical double-layer capacitance (C_{dl}) for IrCo/NC, Co/NC and IrCo alloy in 1M KOH solution.

Table S1.

Comparison of electrocatalytic performances for the HER between the electrocatalysts reported recently. The electrolyte is 0.5 M H_2SO_4.

Electrocatalysts	Electrolyte (H_2SO_4)	η_{10} (mV)	Tafel slope (mV dec^{-1})	References
RuP_2@N，P-doped carbon	0.5 M	38	38	1
RuNi Nanoalloys	0.5 M	41	31	2
W/Ru/C	0.5 M	85	46	3
hcp-Ru@N-doped carbon	0.5 M	27.5	37	4
CoRu@N-doped carbon	0.5 M	94	64	5
IrNi@O-doped carbon	0.5 M	35	27	6
IrCo@N-doped carbon	0.5 M	24	23	7
Ru@nitrogenated carbon	0.5 M	22	30	8
Co@N-doped graphene/N-doped RGO	0.5 M	62	91	9
IrCo/N-doped carbon	0.5 M	32	36	This work

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Table S2.

Comparison of electrocatalytic performances for the HER between the electrocatalysts reported recently. The electrolyte is 1.0 M KOH.

Electrocatalysts	Electrolyte (KOH)	$\eta_{10\ mA\ cm^{-2}}$ (mV)	Tafel slope (mV dec^{-1})	References
RuP_2@N,P-doped carbon	1 M	52	69	1
CoRu@N-doped carbon	1 M	27	74	2
IrNi@O-doped carbon	1 M	27	18	3
IrCo@N-doped carbon	1 M	45	23	4
Co@N-doped graphene/N-doped RGO	1 M	64	70	5
PtNi alloy	1 M	27.7	27	6
Ru/N-doped carbon	1 M	21	31	7
PtNi alloy	1 M	65	74	8
Pt-$Co(OH)_2$/C	1 M	32	70	9
Ru-ZIF-900	1 M	51.6	78.4	10
IrCo/NC	1 M	33	53	This work

References:

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Table S3

Comparison of overpotential and Tafel slope between the Ir-based alloy catalysts at a high current density of 100 mA cm^{-2} in 0.5 M H_2SO_4.

Electrocatalysts	Electrolyte (H_2SO_4)	η_{100} (mV)	Tafel slope (mV dec^{-1})	References
IrNi@O-doped carbon	0.5 M	95	27	1
CuCoPt alloy nanoparticles	0.5 M	48	20	2
IrCo/NC	0.5 M	113	36	This work

References:

1 S. Gong, C. Wang, P. Jiang, K. Yang, J. Lu, M. Huang, S. Chen, J. Wang and Q. Chen, *J. Mater. Chem. A*, 2019, **7**, 15079-15088.

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Table S4

Comparison of overpotential and Tafel slope between at a high current density of 100 mA cm^{-2} in 1 M KOH.

Electrocatalysts	Electrolyte (KOH)	η_{100} (mV)	Tafel slope (mV dec^{-1})	References
Cr-Co_4N NR/CC	1 M	99	38.1	1
Ni_3N NS	1 M	100	27	2
$Cu_xNi_{4-x}N$/NF	1 M	111	32	3
IrCo/NC	1 M	175	53	This work

References:

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