Supporting Information

Interface-tuned Mo-based nanospheres for efficient oxygen reduction and hydrogen evolution catalysis

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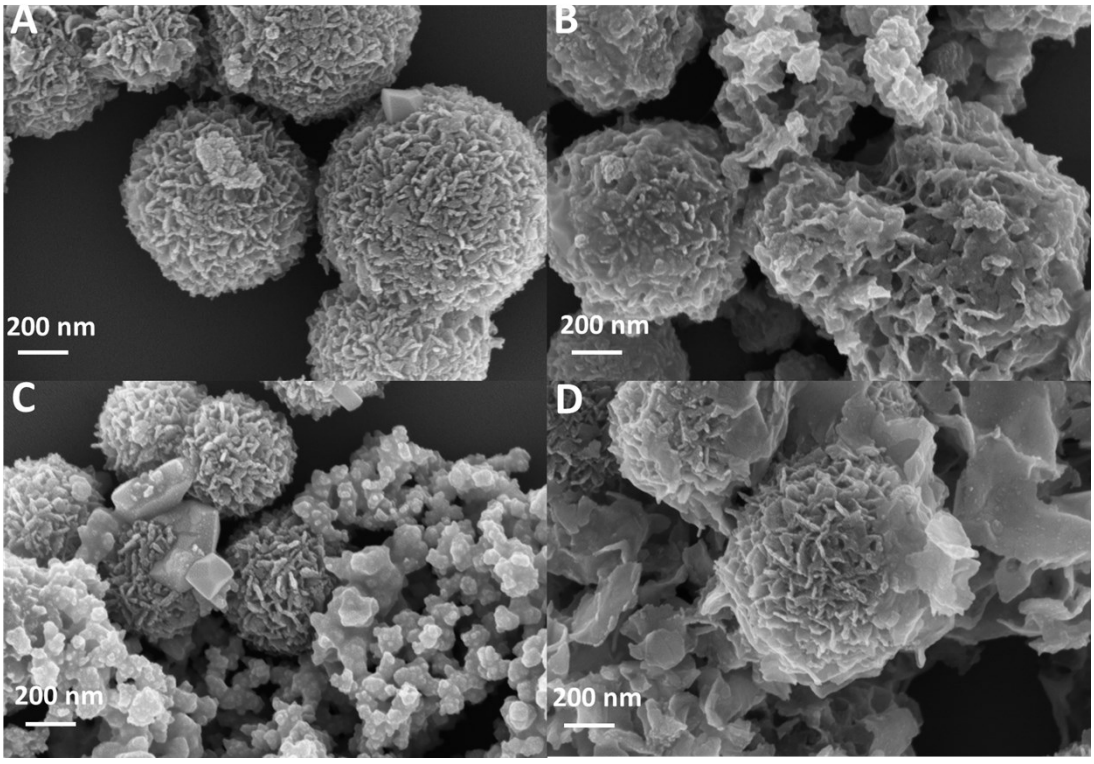


Figure S1 SEM images of (A) HNs-Co-2, (B) HNs-Co-6, (C) HNs-Co-10, and (D) HNs-Co-12 catalysts.

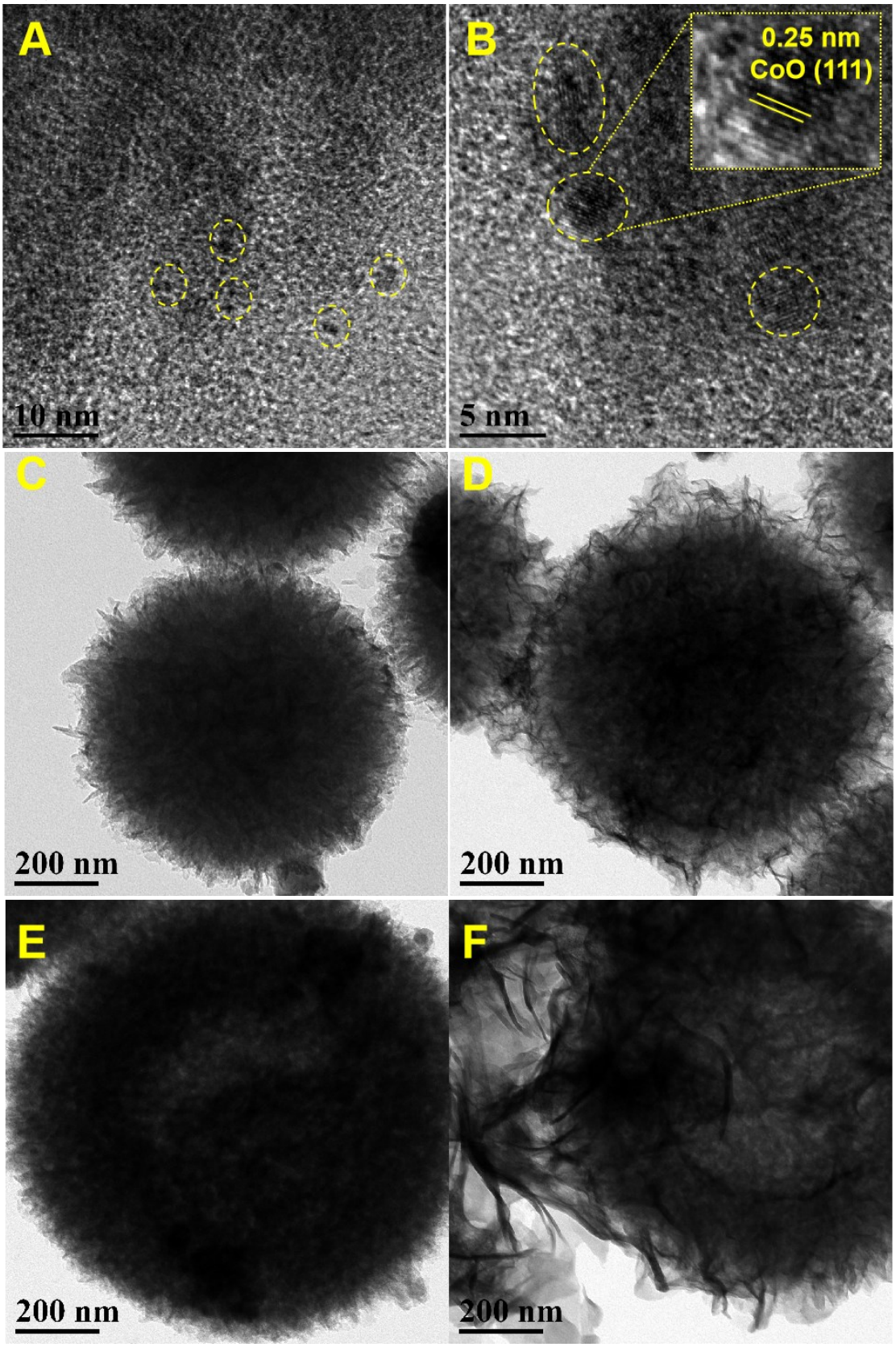


Figure S2 (A,B) High-resolution TEM images of (A) HNs and (B) HNs-Co; (C-F) HRTEM images of (C) HNs-Co-2, (D) HNs-Co-6, (E) HNs-Co-10, and (F) HNs-Co-12 catalysts.

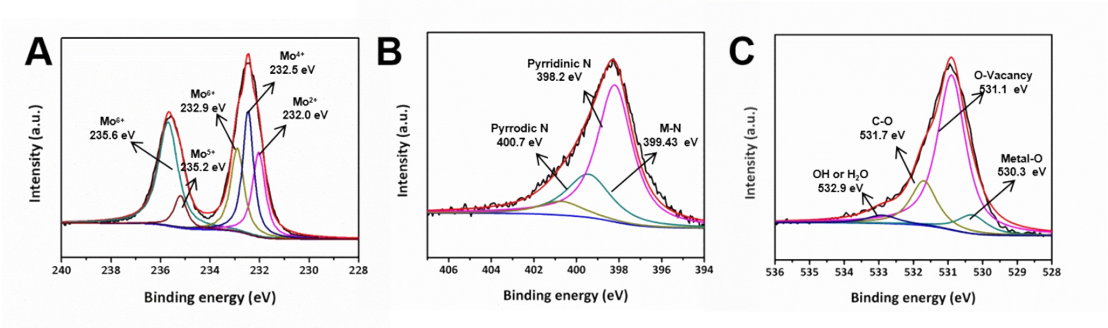


Figure S3 High-resolution (A) Mo 3d, (B) N 1s, and (C) O 1s XPS spectra of HNs.

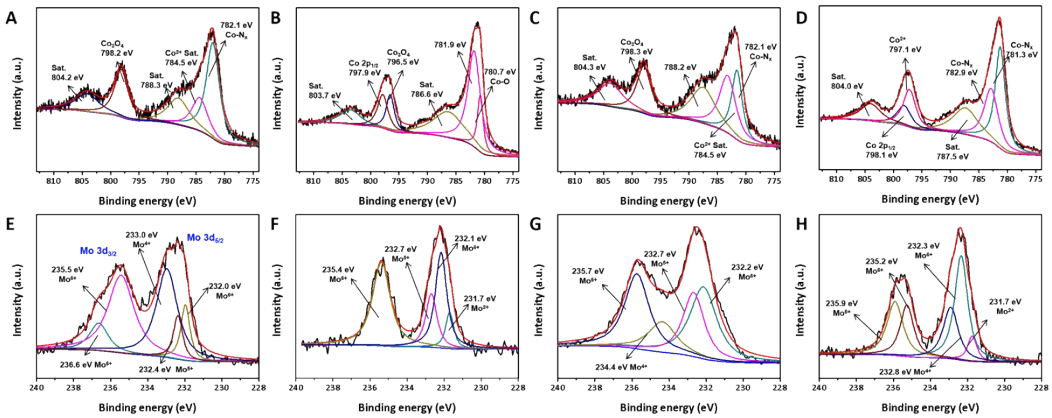


Figure S4 High resolution Co 2p and Mo 3d XPS spectra of (A, F) HNs-Co-2, (B, G) HNs-Co-6, (C, H) HNs-Co-10, and (F) HNs-Co-12 catalysts.

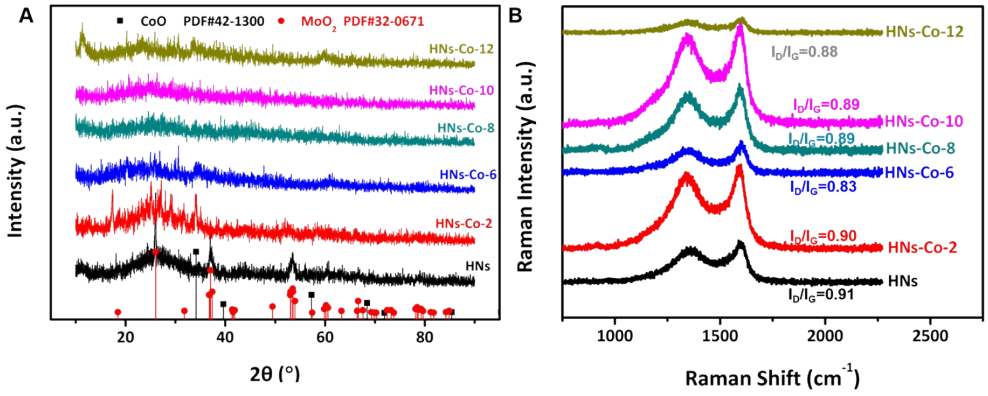


Figure S5 (A) XRD patterns and (B) Raman spectra of HNs and HNs-Co-X with different Co contents.

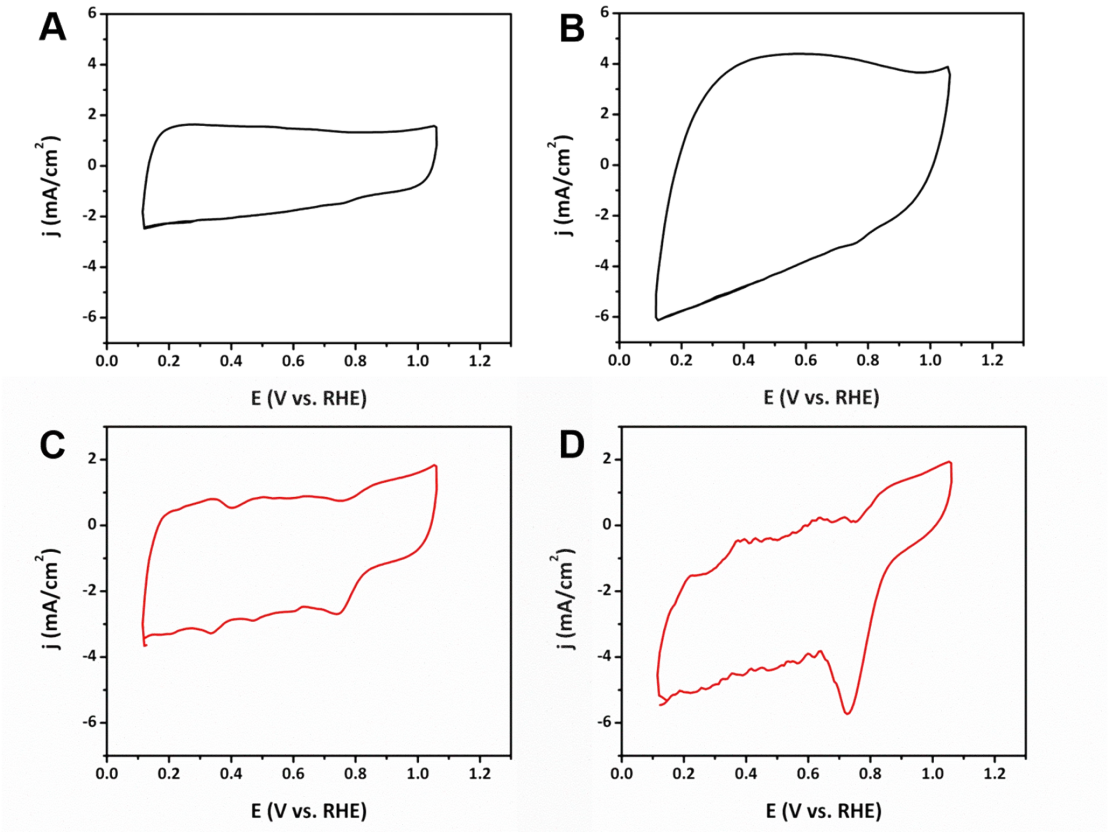


Figure S6 (A, C) CV curves of HNs and (B, D) HNs-Co catalysts in N_2 and O_2-saturated 0.1 M KOH solution.

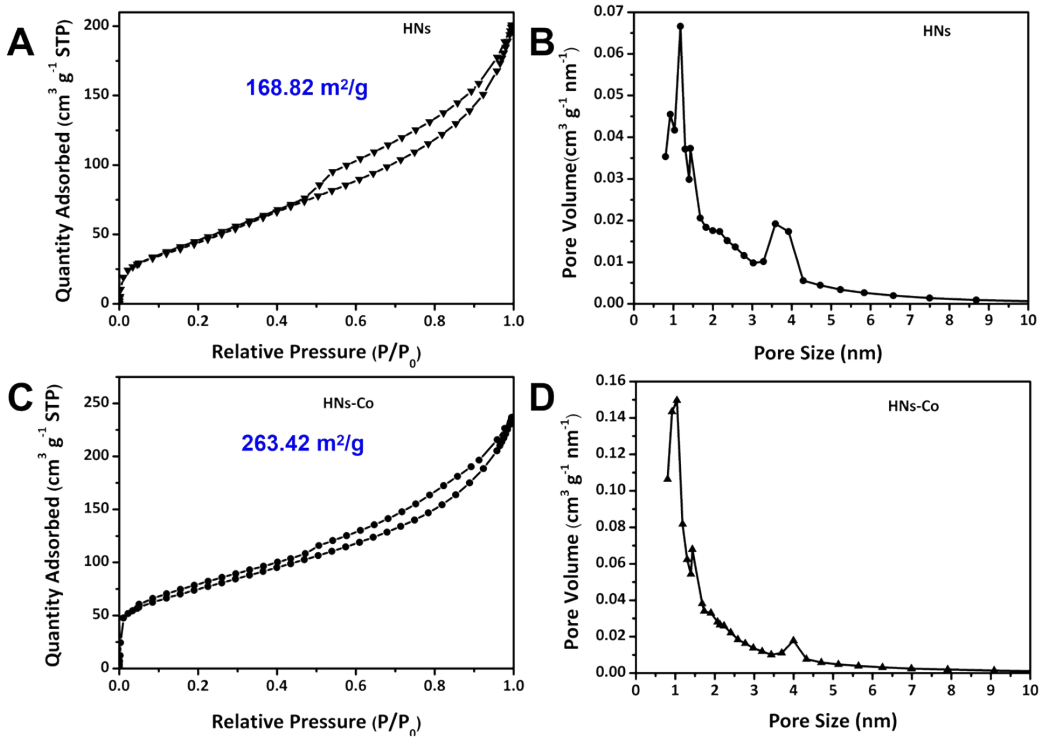


Figure S7 N_2 adsorption–desorption isotherms and pore size distributions of HNs (A, C) and HNs-Co (B, D) catalysts.

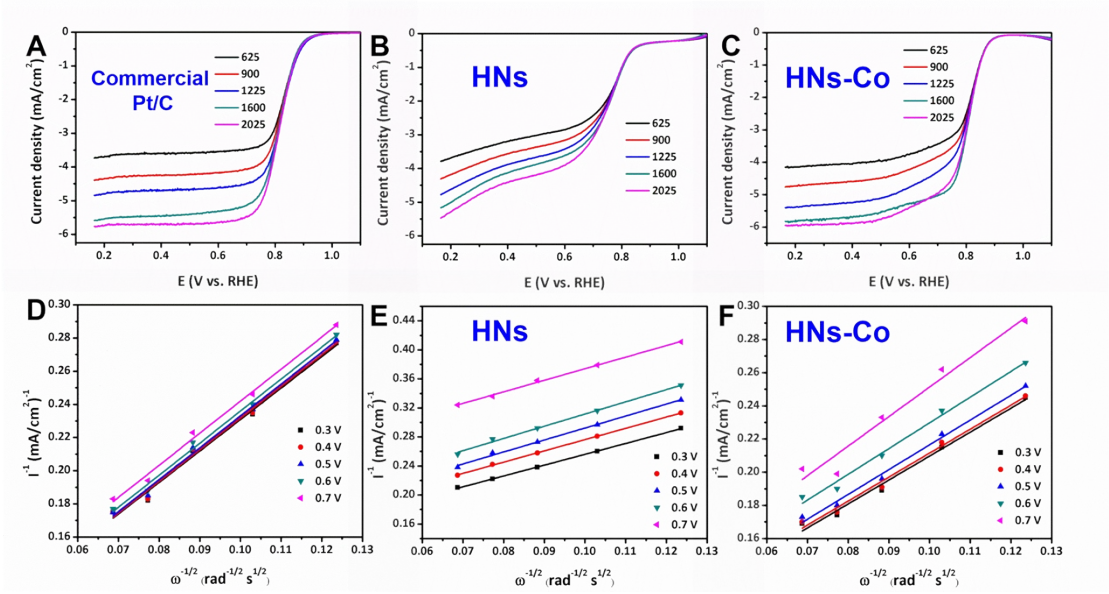


Figure S8 LSV curves in O_2-saturated 0.1 M KOH solution and the corresponding Koutecky–Levich plots of commercial Pt/C (A, D), HNs (B, E), and HNs-Co (C, F) catalysts.

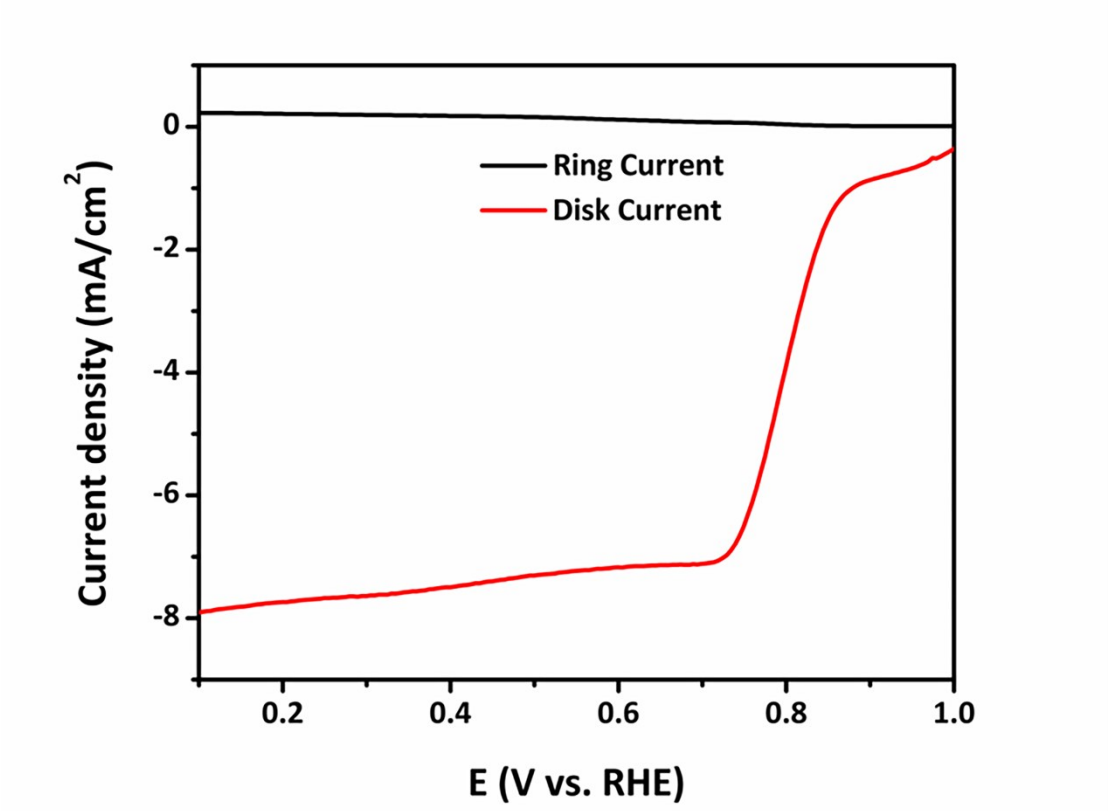
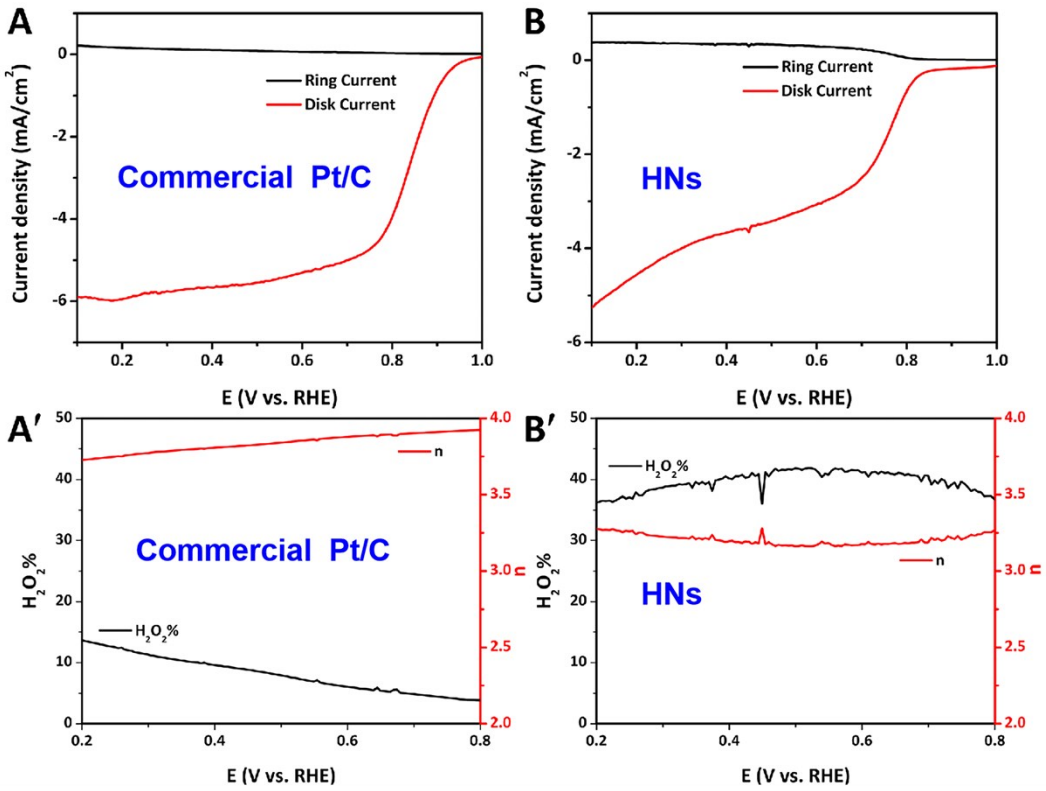


Figure S9 RRDE curve of HNs-Co catalyst.



FigureS 10 RRDE curves of commercial JM Pt/C (A, A′) and HNs (B, B′) catalysts.

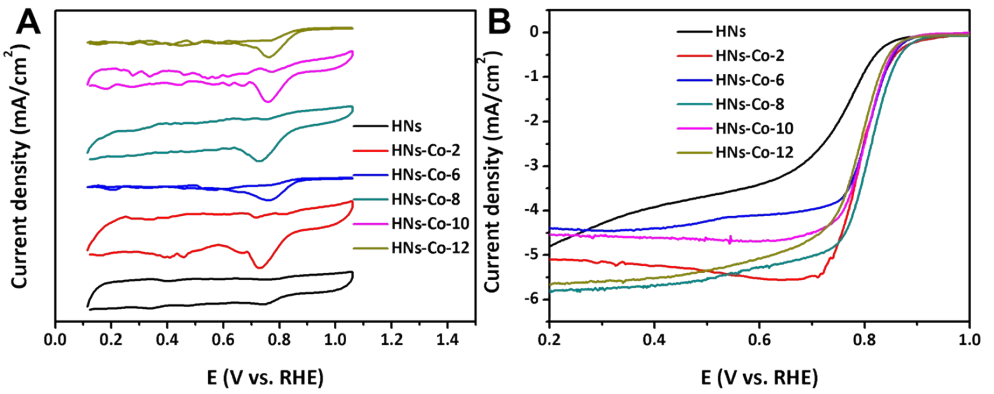


Figure S11 (A) CV and (B) LSV curves of HNs and HNs-Co-X catalysts with different Co contents.

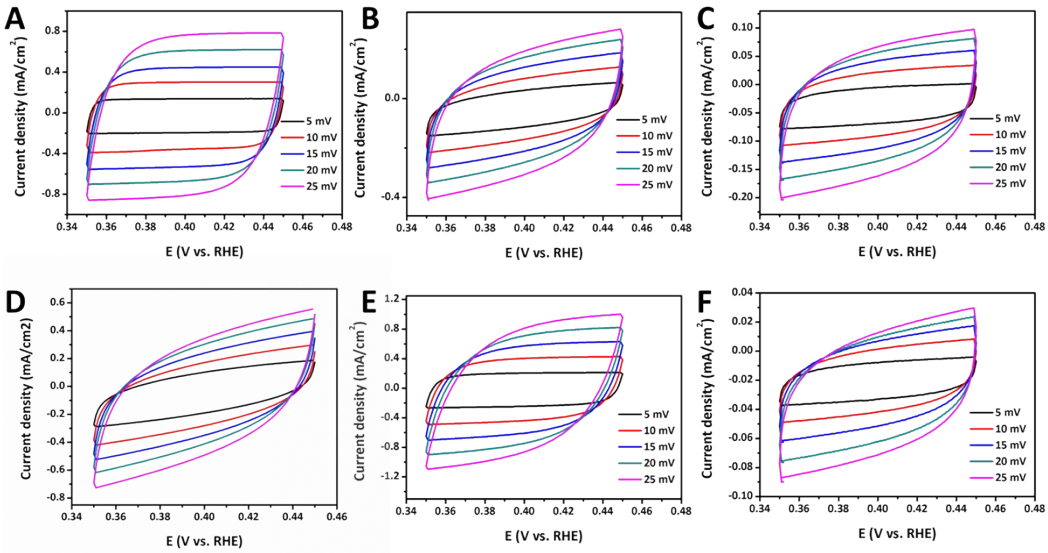


Figure S12 CV curves of (A) HNs, (B) HNs-Co-2, (C) HNs-Co-6, (D) HNs-Co-8, (E) HNs-Co-10, and (F) HNs-Co-12 catalysts at different scan rates between 0.35 V and 0.45 V.

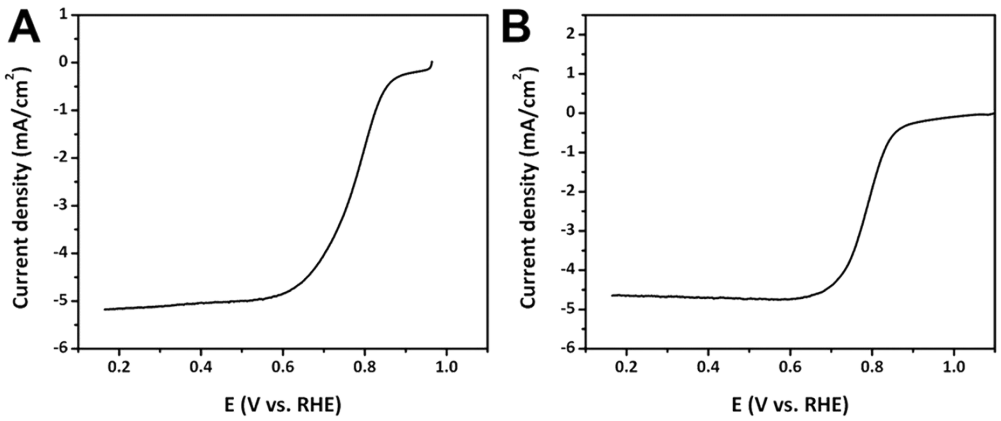


Figure S13 LSV curves of (A) CNN and (B) CNN-Co for ORR.

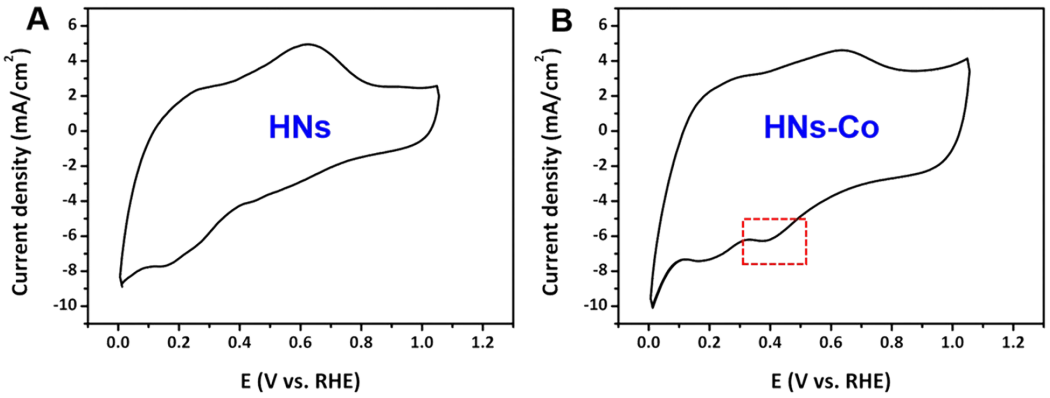


Figure S14 CV curves of (A) HNs and (B) HNs-Co catalysts recorded in 0.1 M $HClO_4$ aqueous solution.

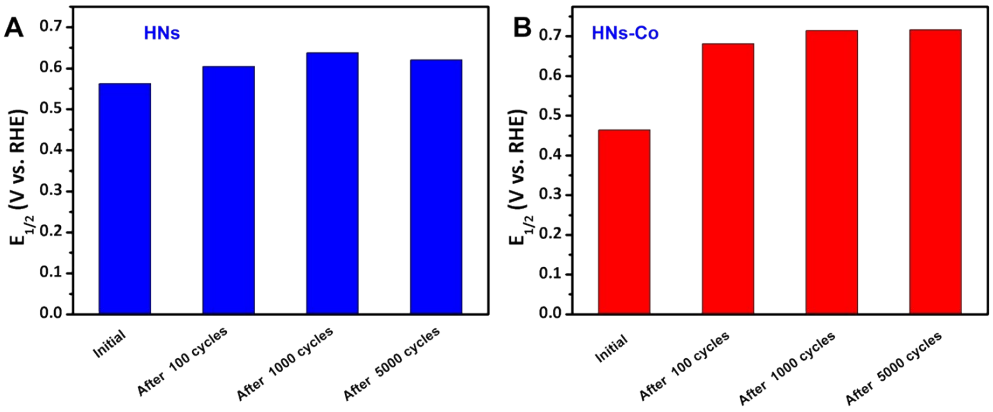


Figure S15 $E_{1/2}$ comparison of (A) HNs and (B) HNs-Co catalysts before and after potential cycling in 0.1 M $HClO_4$ aqueous solution.

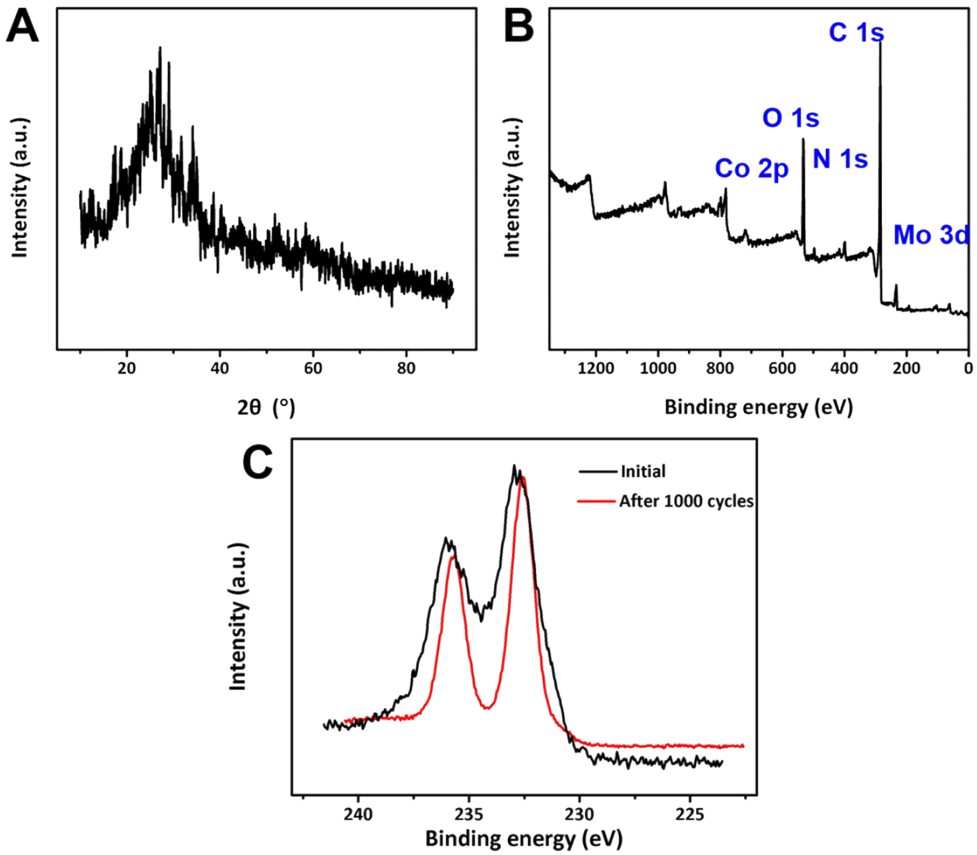


Figure S16 (A) XRD pattern, (B) XPS survey, and (C) high resolution Mo 3d XPS spectra of HNs-Co after 1000 cycles in acidic medium.

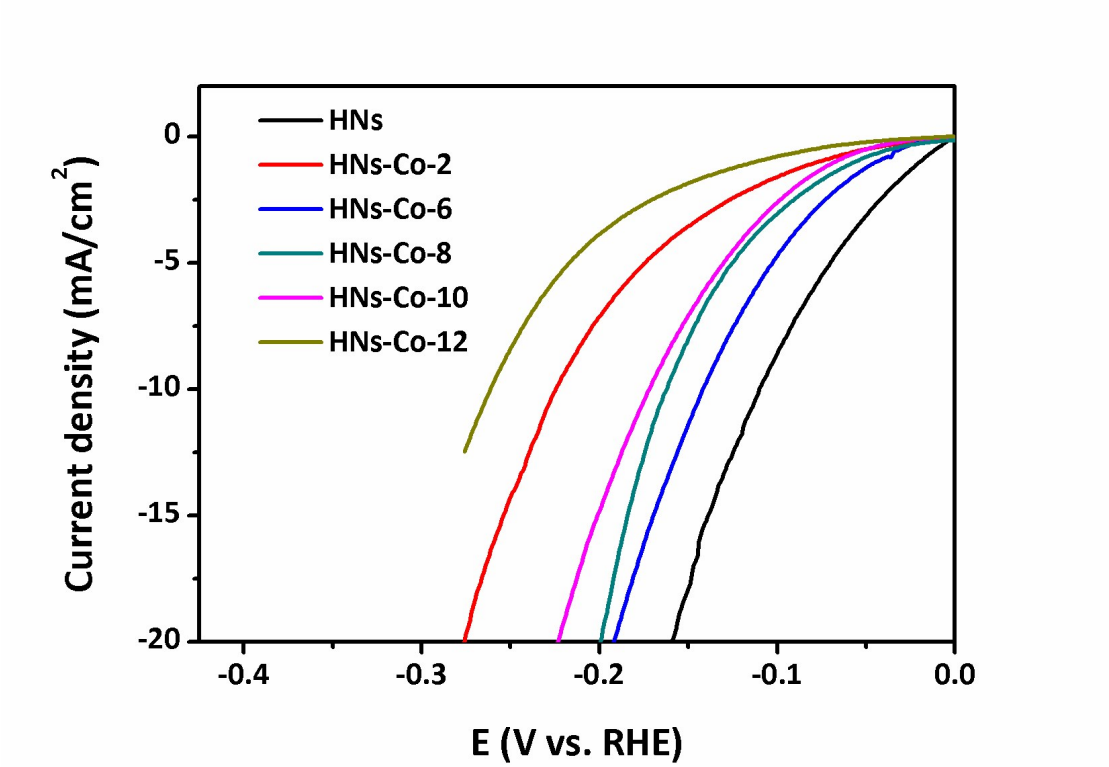


Figure S17 HER LSV curves of HNs, and HNs-Co-X with different Co contents in 1 M KOH aqueous solution.

Table S1 Surface compositions of HNs and HNs-Co-X catalysts measured by XPS.

Catalysts	C	N	O	Mo	Co
HNs	67.06	13.18	14.26	5.17	0
HNs-Co-2	77.11	4.25	15.05	0.96	2.63
HNs-Co-6	59.82	3.1	30.63	0.69	5.77
HNs-Co-8	82.54	4.15	10.73	0.59	1.98
HNs-Co-10	67.65	7.87	18.79	2.44	3.25
HNs-Co-12	53.78	2.68	33.75	0.74	9.05

Table S2 Electronical conductive information of the all samples.

Samples	Resistivity (Ω·cm)	Conductivity (s/cm)
HNs	0.15	$6.67*10^{-3}$
HNs-Co-2	0.12	$8.33*10^{-3}$
HNs-Co-6	0.09	$1.11*10^{-3}$
HNs-Co-8	0.06	$1.67*10^{-3}$
HNs-Co-10	0.07	$1.43*10^{-3}$
HNs-Co-12	0.08	$1.25*10^{-3}$

Table S3 ORR catalysis comparison of HNs-Co and reported Mo-based catalysts in 0.1 M KOH solution.

Catalyst	$E_{1/2}$ (mV)	Reference
HNs-Co	**0.81**	**This work**
Mo_2C−GNR	0.80	[1]
V-MoS_2-15	0.73	[2]
Mo_2C–C-5	0.71	[3]
Mo–N/C@MoS_2	0.81	[4]
MoO_2-G-20 h	about 0.66	[5]
rGMS-600	0.70	[6]

Table S4 ORR catalysis comparison of HNs-Co and reported Mo-based catalysts in acidic medium.

Catalyst	$E_{1/2}$ (mV)	Electrolete	Reference
HNs-Co	**720**	**0.1 M $HClO_4$**	**This work**
$Co_{0.6}Mo_{1.4}N_2$	about 500	0.1 M $HClO_4$	[7]
MoN	About 325	0.1 M $HClO_4$	[8]
$Co_{0.50}Mo_{0.50}N_y$/NCNC	about 560	0.5 M H_2SO_4	[9]
(Fe,Mo)−N/C-3	674	0.5 M H_2SO_4	[10]
Mo_2C−GNR	600	0.5 M H_2SO_4	[1]

Table S5 HER catalysis comparison of HNs, HNs-Co, and repored Mo-based catalysts in 1 M KOH solution.

Catalyst	Overpotential (mV)	Reference
HNs	**111**	**This work**
HNs-Co	**163**	**This work**
MoO_2-Ni NWs	58.4	[11]
MoO_2/PDDA-rGO	57	[12]
$MoSe_2$/MoO_2	142	[13]
porous MoO_2	27	[14]
Mo_2C/C hybrids	140	[15]

Reference

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