Supplementary Information

γ-CD-MOF-Derived Heterostructure as Bifunctional Electrocatalyst for Rechargeable Zinc-Air Batteries

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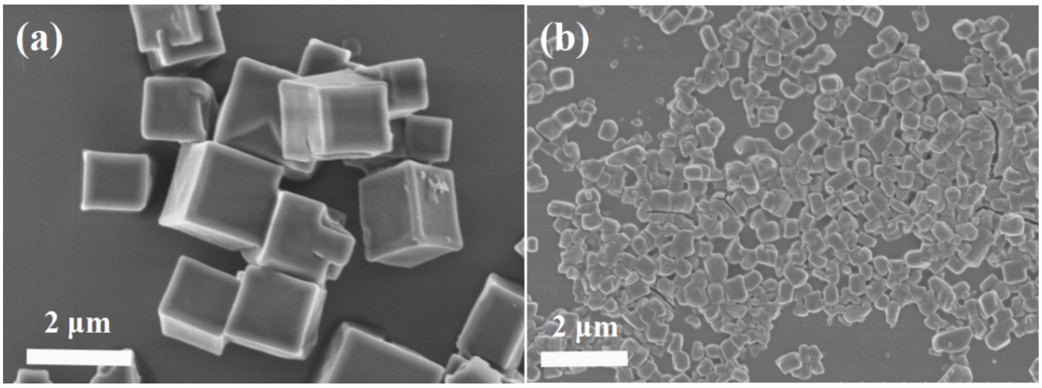

Fig. S1. SEM images of (a) γ-CD-MOF. (b) Co-CD-MOF.

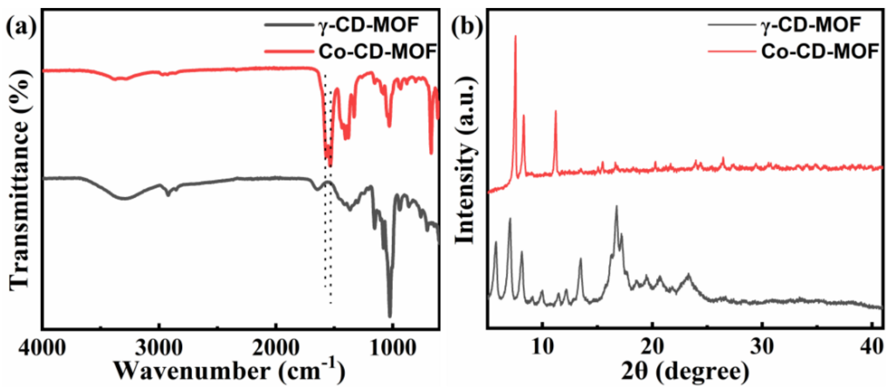

Fig. S2. (a) FT-IR spectra and (b) XRD patterns of γ-CD-MOF and Co-CD-MOF.

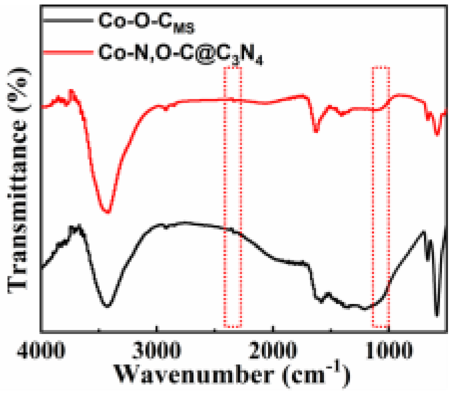

Fig. S3. FT-IR spectra of Co-O-C$_{MS}$ and Co-N,O-C@C$_3$N$_4$.

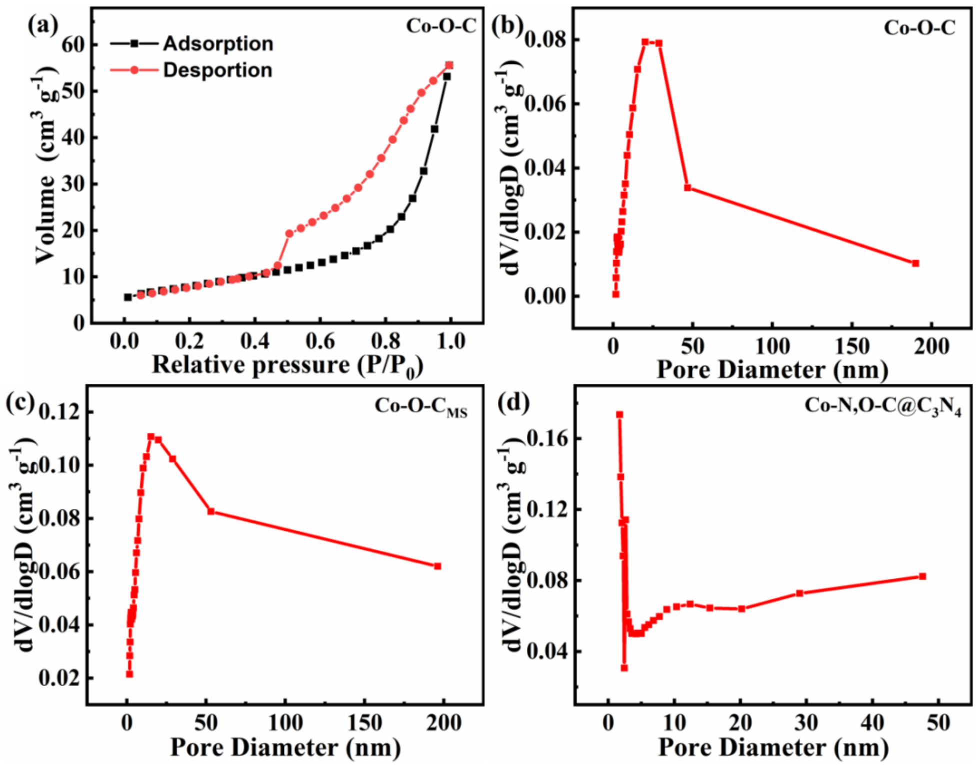

Fig. S4. (a) Nitrogen adsorption-desorption isotherms and (b) pore distribution curve of Co-O-C; Pore distribution curve of (c) Co-O-C$_{MS}$ and (d) Co-N,O-C@C$_3$N$_4$.

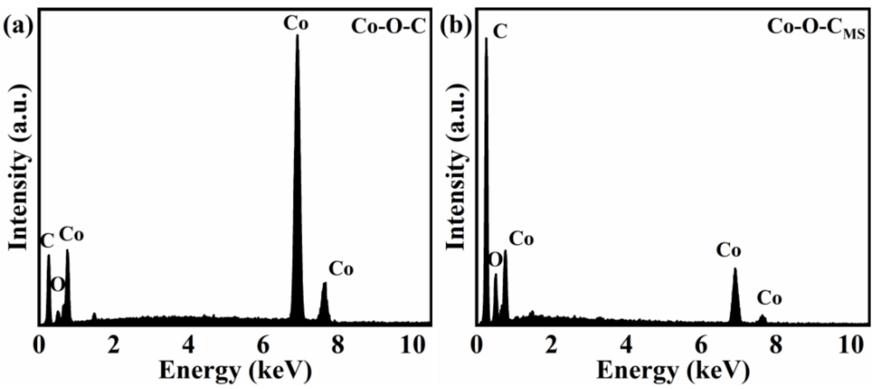

Fig. S5. EDS spectra of (a) Co-O-C and (b) Co-O-C$_{MS}$.

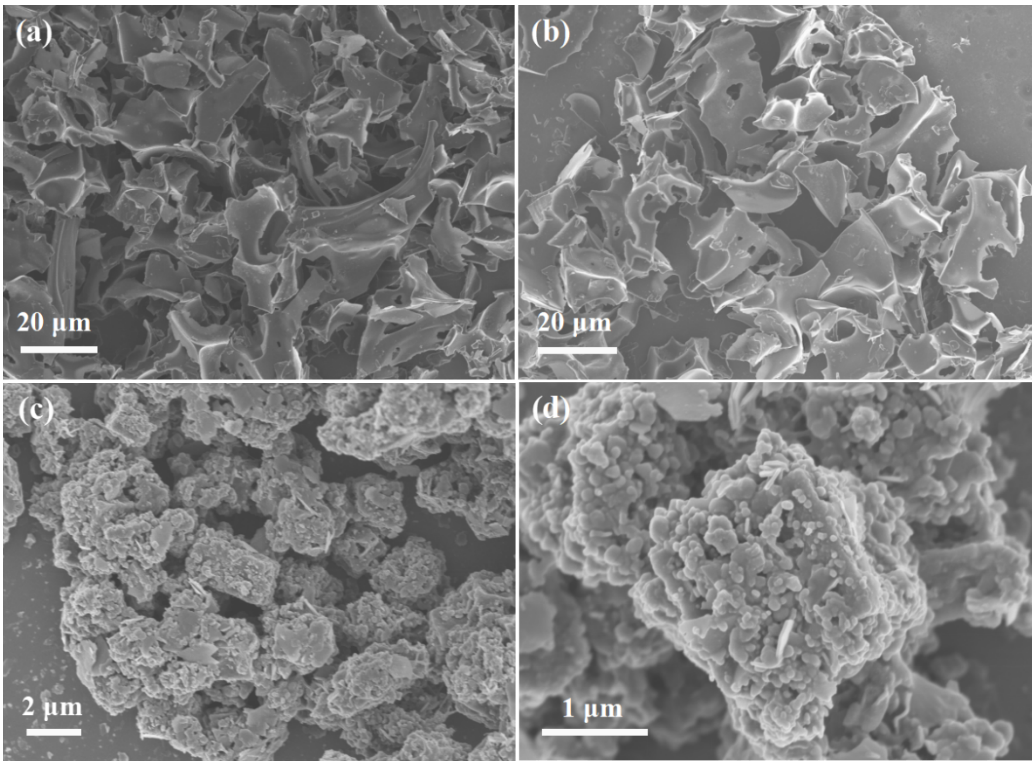

Fig. S6. SEM images of (a,b) Co-O-C and (c,d) Co-O-C_{MS}.

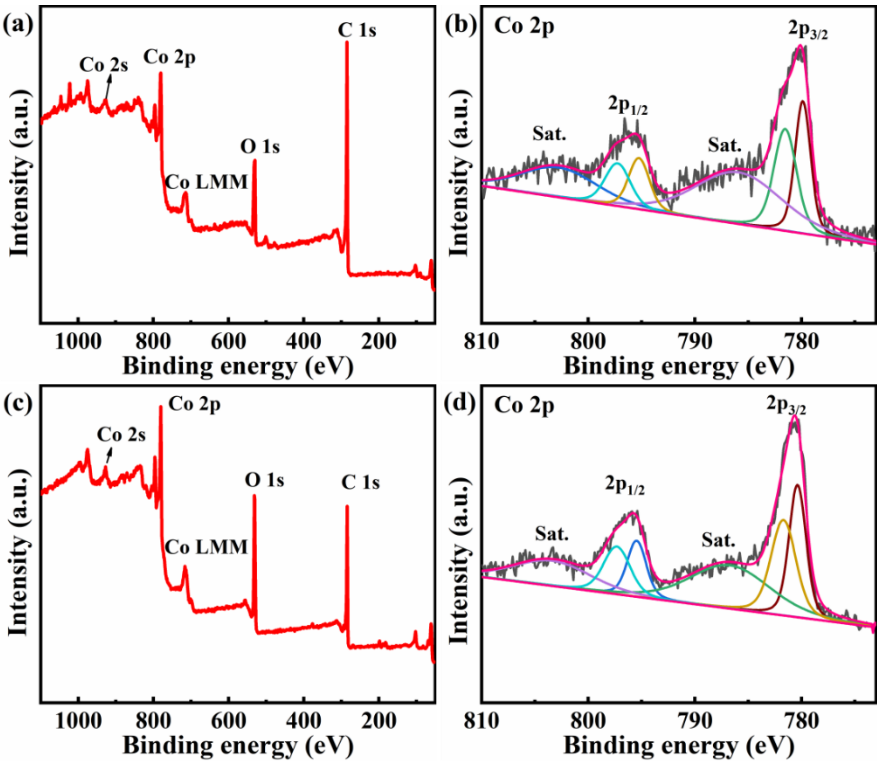

Fig. S7. (a,c) XPS survey spectra of Co-O-C and Co-O-C_{MS}, and (b,d) the corresponding high-resolution of Co 2p spectra.

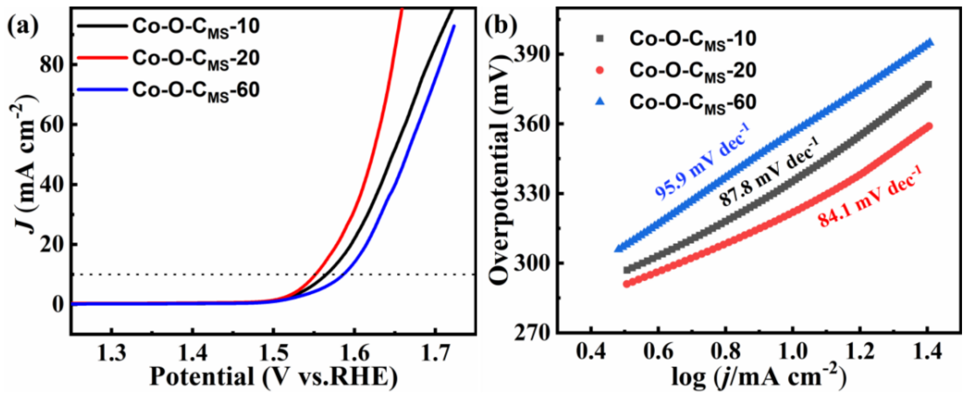

Fig. S8. (a) OER polarization curves and (b) Tafel slopes of Co-O-C_{MS} with different molten salt ratio.

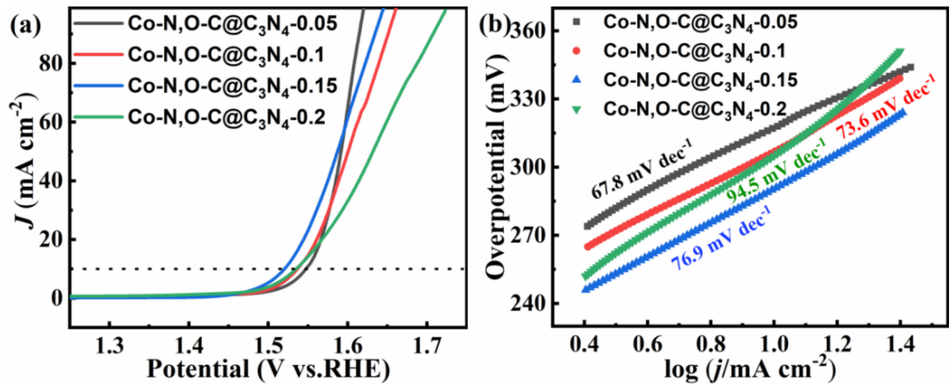

Fig. S9. (a) OER polarization curves and (b) Tafel slopes of Co-N,O-C@C_3N_4 with different melamine addition.

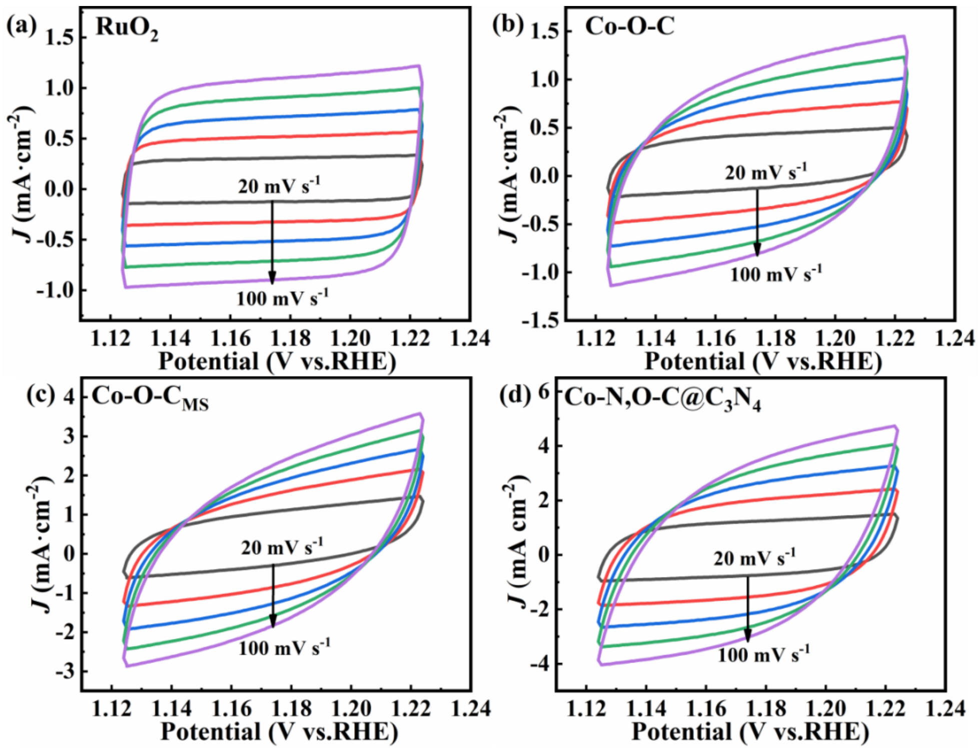

Fig. S10. CV curves of (a) RuO_2, (b) Co-O-C, (c) Co-O-C_{MS} and (d) Co-N,O-C@C_3N_4 at different sweeping rates from 20 mV s^{-1} to 100 mV s^{-1} in 1 M KOH.

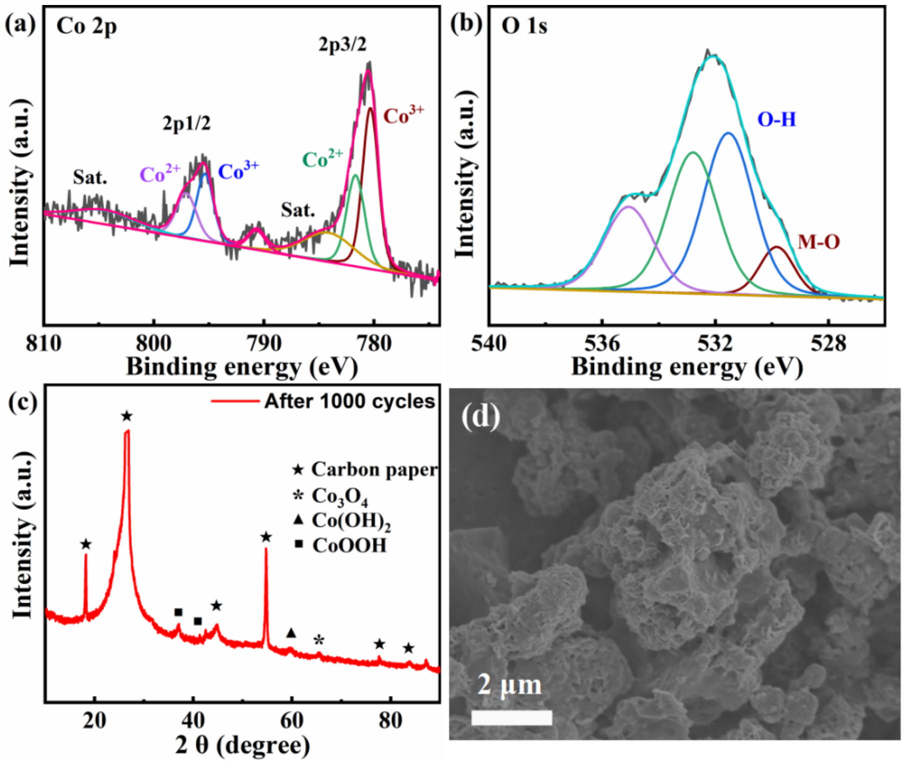

Fig. S11. (a) Co 2p and (b) O 1s spectra, (c) XRD and (d) SEM image of Co-N,O-C@C_3N_4 after 1000 CVs OER durability.

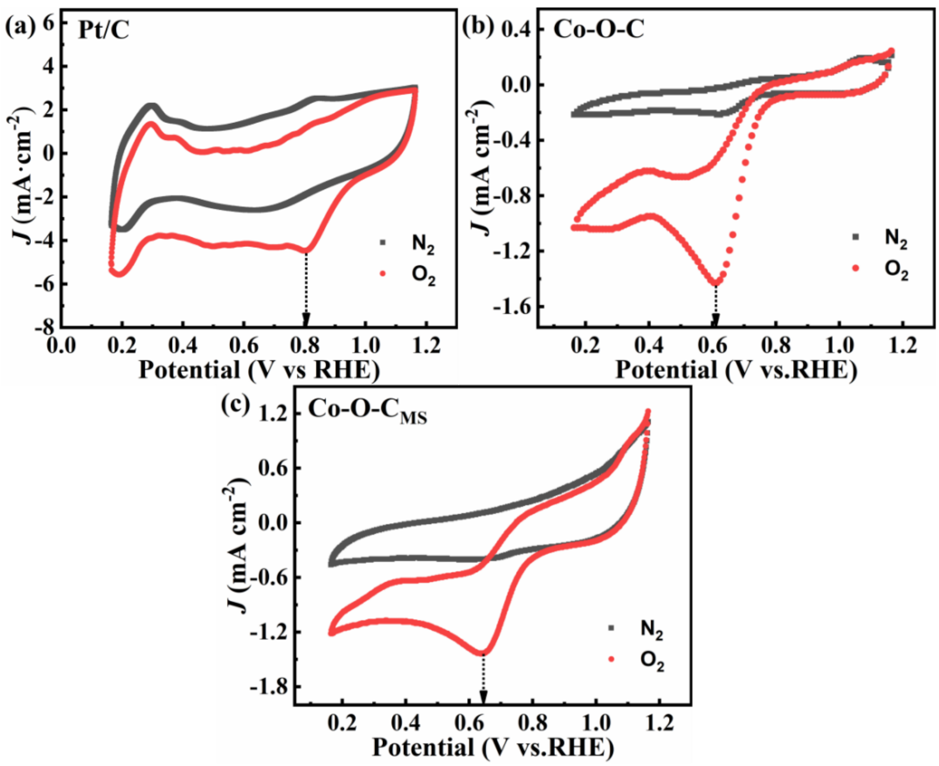

Fig. S12. CV curves of (a) Pt/C, (b) Co-O-C and (c) Co-O-C_{MS} in N_2 and O_2-saturated 0.1 M

KOH.

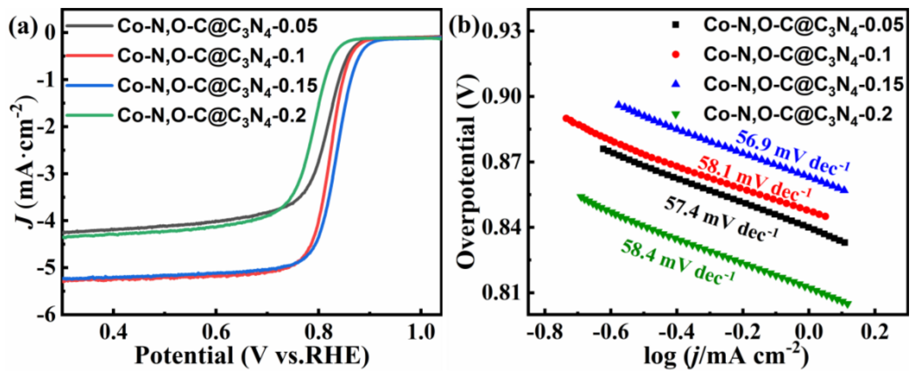

Fig. S13. (a) ORR polarization curves and (b) Tafel slopes of Co-N,O-C@C_3N_4 with different melamine addition.

Table S1 Sample composition based on XPS results

Sample	Co-O-C_{MS} (atomic%)	Co-N,O-C@C_3N_4 (atomic%)
Co 2p	8.14	6.87
C 1s	68.84	70.95
N 1s	-	1.38
O 1s	23.02	20.80

Table S2 Comparison of the OER performances of Co-N,O-C@C_3N_4 with reported catalysts.

Catalyst	Overpotential/ mV (10 mA cm^{-2})	Tafel slope ($mV\ dec^{-1}$)	Mass loading (mg cm^{-2})	Reference
Co-N,O-C@C_3N_4	290	76.9	0.39	This work
Co_3N@AN-C NCs	280	69.6	2.6	1
Co/HNCP	383	81	0.204	2
Co/CNFs (1000)	320	79	0.3	3
Co_2P/Co-Foil	319	79	-	4

Co@N-CNTF	350	61.4	0.28	5
Co/CoO@NC@CC	284	76	0.19	6
S-CoO/Co_3O_4	275	92	0.38	7
CoO_x-ZIF/C	318	70.3	0.194	8
Co_3O_4@C-TMA	320	85.18	0.15	9
Co@HOPC	320	31.2	0.2	10

Table S3 Comparison of the ORR performances of Co-N,O-C@C_3N_4 with reported catalysts.

Catalyst	$E_{1/2}$ (V)	Mass loading (mg cm^{-2})	Reference
Co-N,O-C@C_3N_4	0.84	0.39	This work
ZIFCNDA	0.84	0.5	11
Co-SAs@NC	0.82	0.612	12
Co-NC@CoP-NC	0.78	0.28	13
Co-N_x-C	0.8	0.25	14
ACTP5@Co,N-800	0.891	0.3	15
Co_3O_4-C_3N_4/rGO	0.81	0.13	16
f-CoNC/GO	0.86	0.31	17
Co@Co_3O_4/NC-2	0.74	0.21	18
Co-CoO/N-rGO	0.78	0.21	19
C-MOF-C2-900	0.817	0.2	20

Table S4 Comparison of the rechargeable Zn-air Battery performance of Co-N,O-C@C_3N_4 with reported catalysts.

Catalyst	Electrolyte	Power density (mW cm^{-2})	Open-circuit voltage (V)	Reference
Co-N,O-C@C_3N_4	6.0 M KOH + 0.2 M $Zn(Ac)_2$	112	1.43	This work
Pt/C+RuO_2	6.0 M KOH + 0.2 M $Zn(Ac)_2$	92	1.39	This work
ZIFCNDA	6.0 M KOH + 0.1 M $ZnCl_2$	57	1.14	11
Co-SAs@NC	6.0 M KOH + 0.2 M $ZnCl_2$	105.3	1.46	12
f-CoNC/GO	6.0 M KOH + 1 M $Zn(OAc)_2$	152	1.38	17
C-MOF-C2-900	6.0 M KOH + 0.2 M $Zn(Ac)_2$	105	1.28	20
Co-N-CNTs	6.0 M KOH + 0.2 M $Zn(Ac)_2$	101	1.365	21
Co_3O_{4-x}@N-C-2	6.0 M KOH + 0.2 M $Zn(Ac)_2$	105.2	1.524	22
Co@CNT/MSC	6.0 M KOH + 0.2 M $Zn(Ac)_2$	128.6	1.46	23
HMT-Co@SiO_2-900	6.0 M KOH + 0.2 M $Zn(Ac)_2$	80.17	1.417	24

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