Electronic Supplementary Information (ESI)

Bifunctional Electrocatalysts of MOF-Derived Co-N/C on Bamboo-Like MnO Nanowires for High-Performance Liquid and Solid-State Zn-Air Batteries

Ya-Nan Chen, Yibo Guo, Huijuan Cui, Zhaojun Xie, Xin Zhang, Jinping Wei, and Zhen Zhou**

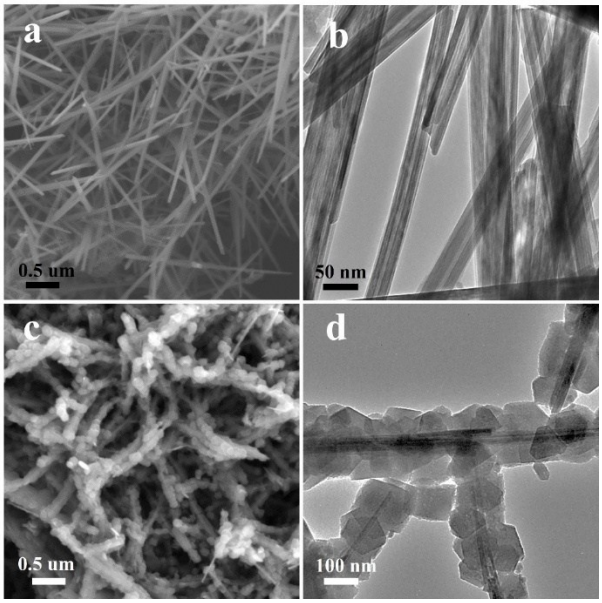


Fig. S1 (a) SEM and (b) TEM images of hollow MnO_2. (c) SEM and (d) TEM images of MnO_2@ZIF-67.

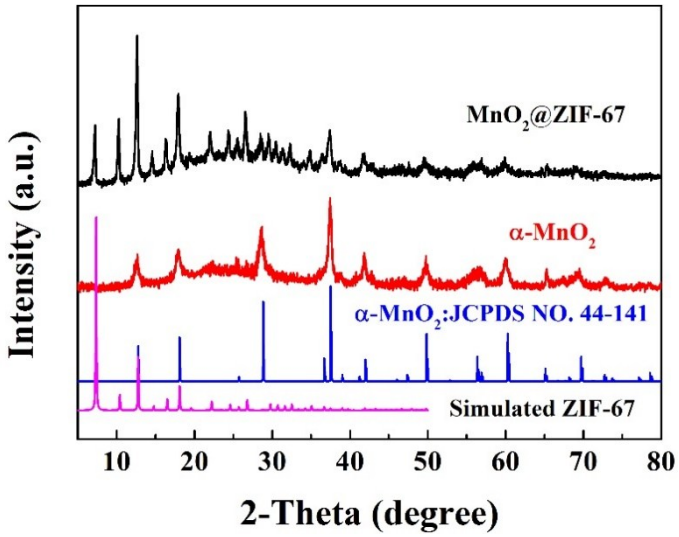


Fig. S2 XRD patterns for various samples.

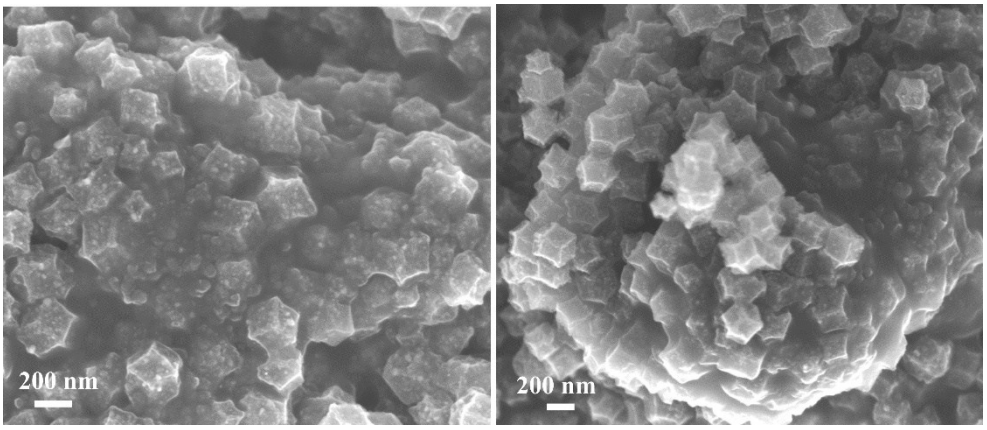


Fig. S3 SEM images of Co-N/C derived from ZIF-67.

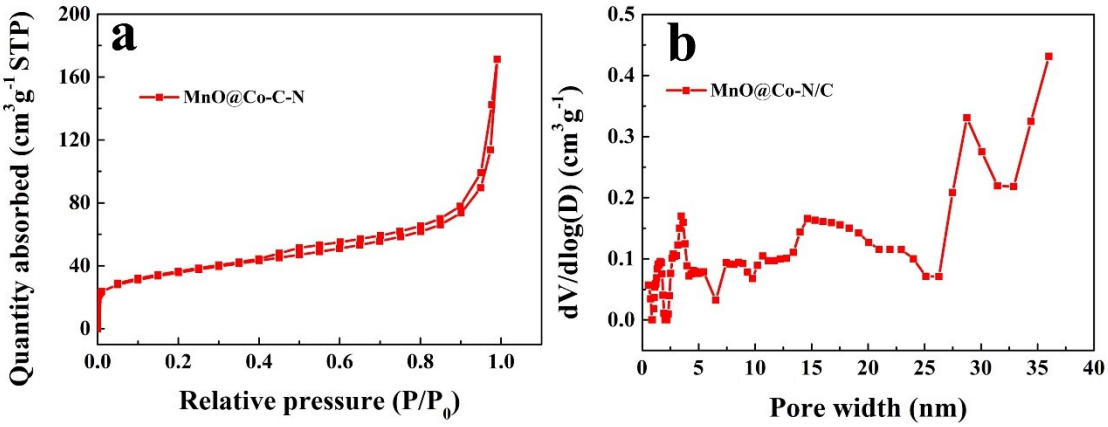


Fig. S4 (a) N_2 adsorption-desorption isotherms and (b) pore size distribution curve for MnO@Co-N/C.

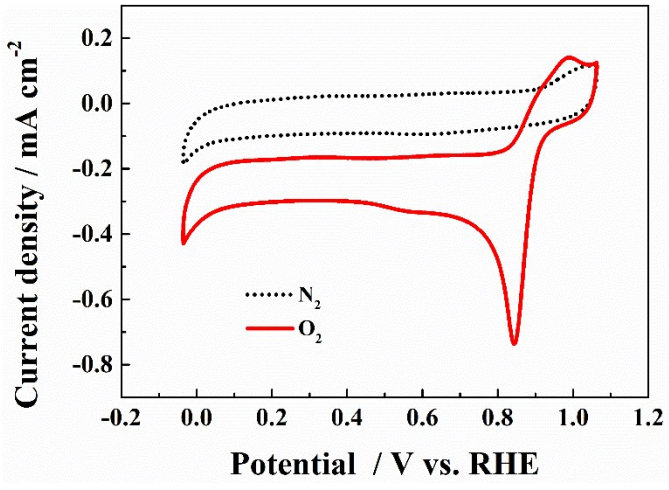


Fig. S5 CV curves in O_2-saturated (solid lines) or N_2-saturated (dashed line) in 0.1 M KOH at 5 mV s^{-1}.

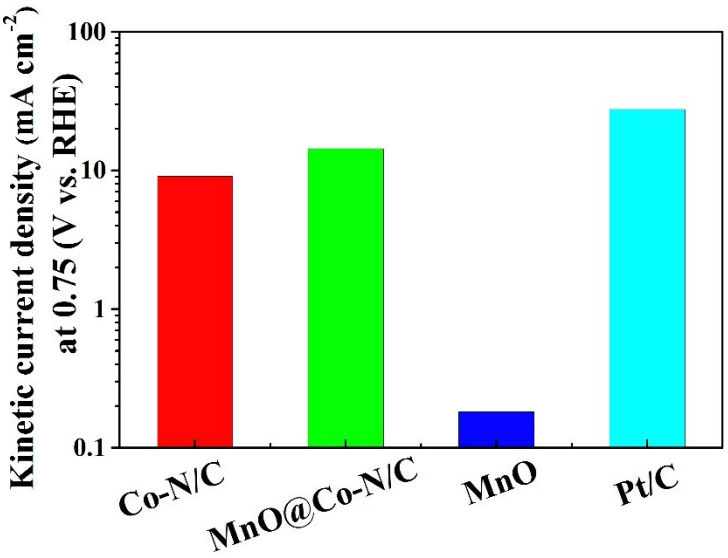


Fig. S6 Kinetic current density at 0.85 V for various catalysts.

Table S1. Comparison of the ORR and OER performance of MnO@Co-N/C against previously reported bifunctional catalyst in 0.1M KOH solution.

Catalysts	$E_{ORR1/2}$/V half-wave potential	E_{OER} /V j=10 mA cm^{-2}	ΔE/V E_{OER} - $E_{ORR1/2}$	Reference
MnO@Co-N/C	0.83	1.76	0.93	This work
c-$CoMn_2$/C	0.85	1.80	0.95	[1]
NPMC-1000	0.85	1.90	1.05	[2]
3DOM Co_3O_4	0.64	1.67	1.00	[3]
ZnCoNC-0.1	0.84	1.75	0.91	[4]
Co_2P@CoNPG-900	0.81	1.73	0.92	[5]
RuO_2	0.29	1.64	1.27	[6]
Pt/C	0.9	1.90	1.0	[6]

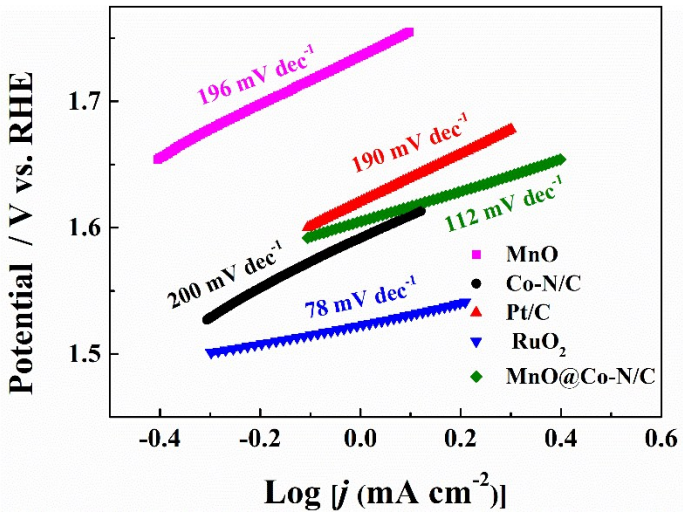


Fig. S7 Tafel plots calculated from OER curves.

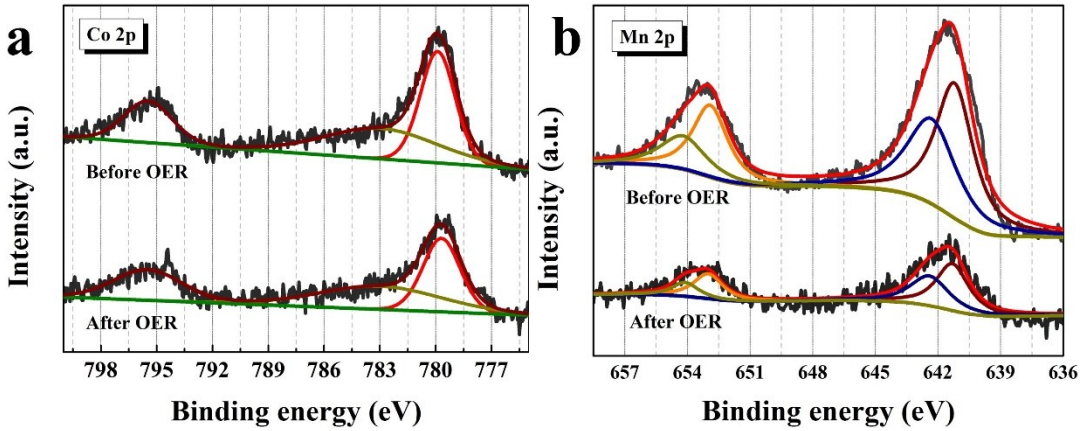


Fig. S8 XPS of Co2p and Mn2p before and after OER.

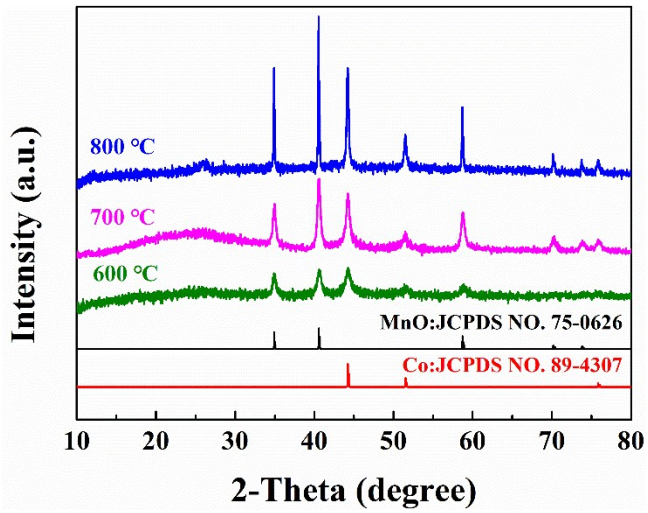


Fig. S9 XRD patterns of MnO@Co-N/C obtained at 600, 700, and 800 °C.

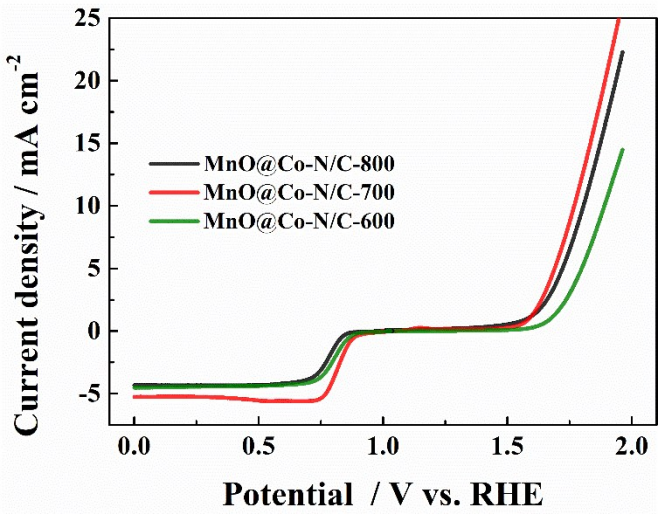


Fig. S10 LSV curves of MnO@Co-N/C prepared at different temperatures.

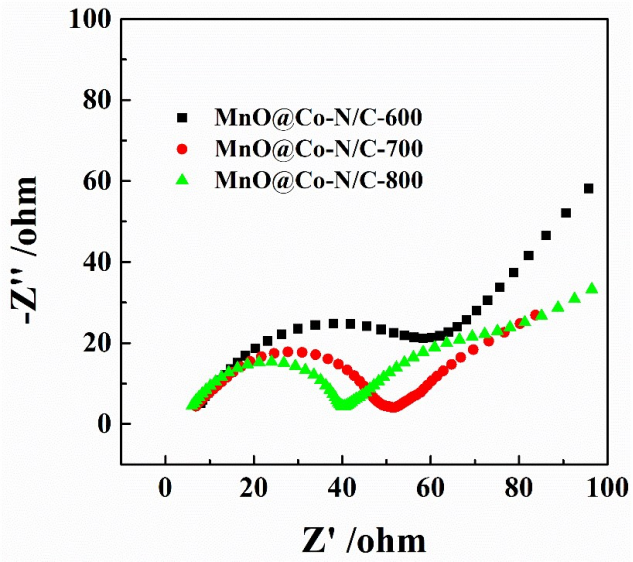


Fig. S11 EIS of MnO@Co-N/C prepared at different temperatures loaded on glass-carbon electrodes.

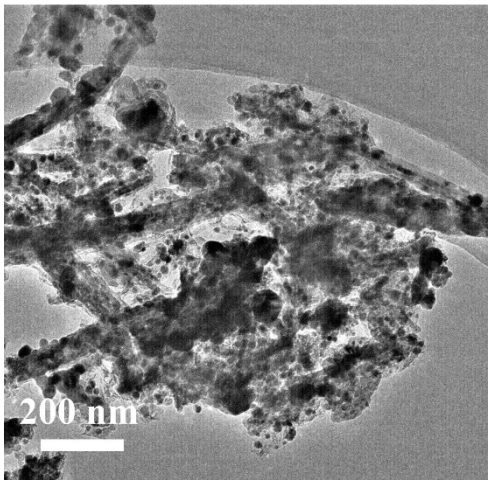


Fig. S12 TEM image of MnO@Co-N/C-800.

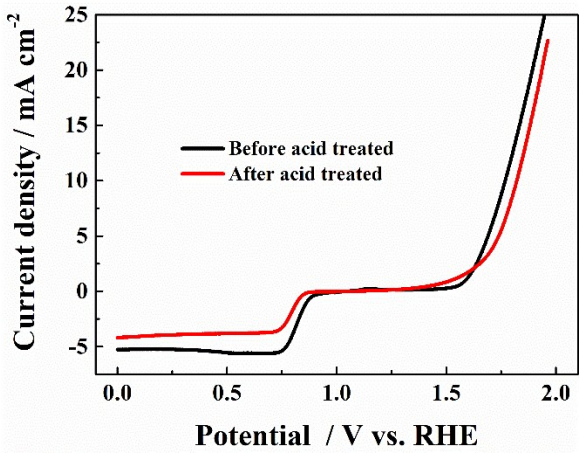
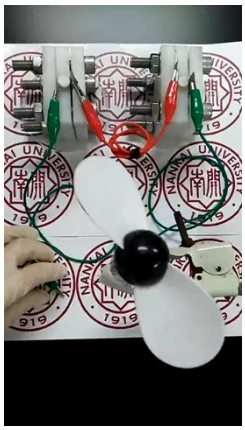


Fig. S13 LSV curves of MnO@Co-N/C before and after 0.5 M H_2SO_4 treatment.



Video S1 The video of a mini fan driven by two Zn-air batteries (Double click the picture to watch the video).

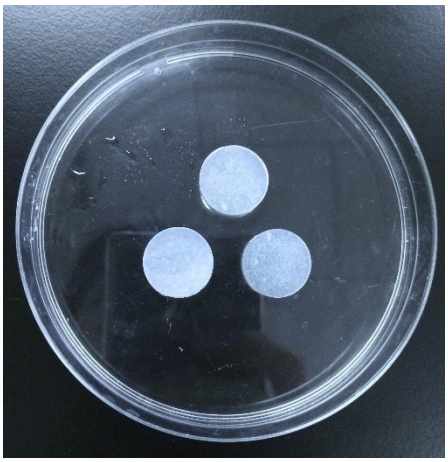


Fig. S14 The photograph of the PVA gel electrolyte.

Fig. S15 Open circuit potential of a liquid Zn-air battery with MnO@Co-N/C catalysts.

Table S2. Cycle performance of rechargeable Zn-air batteries with various catalysts.

catalyst	Peak power density (mW cm^{-2})	Cycling conditions (mA cm^{-2})	Cycling performance	Reference
MnO@Co-N/C	130.3	5	20 min per cycle for 1900 Cycles (633 h)	This work
		10	2 h per cycle for 89 cycles (178 h)	This work
Co_3O_4/N-rGO	-	3	20 min per cycle for 75 cycles (25 h)	[7]
$Fe_{0.5}Co_{0.5}O_x$/NrGO	86	10	2 h per cycle for 60 cycles (120 h)	[8]
$Co_3FeS_{1.5}(OH)_6$	113.1	2	20 min per cycle for 108 cycles (36 h)	[9]
Co_3O_4/N-CNTAs	-	5	10 min per cycle for100 cycles (16.7 h)	[10]
Co-N_x-C	152	2	20 min per cycle for 180 cycles (60 h)	[11]
CoS_x@PCN/rGO	-	10	6.6 min per cycle for 394 cycles (43.8 h)	[12]
NPMC-1000	55	2	10 min per cycle for 180 cycles (30 h)	[13]
RuO_2-coated MCNAs	-	4	20 min per cycle for 100 cycles (34 h)	[14]
C-MOF-C2-900	105	10	20 min per cycle for 90 cycles (30 h)	[15]
S-GNS/$NiCo_2S_4$	216.3	10	40 min per cycle for 150 cycles (100 h)	[16]

References

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