Supplementary Material

ZIF-67-derived Se-doped $CoSe_2$ grown on carbon nanofibers as oxygen electrocatalysis for rechargeable Zn-air batteries

Wenjing Cui[a,b], Shaoshuai Xu[a,b] , Jie Bai[a,b] , Chunping Li[a,b] and Xingwei Sun*[a,b]

[a]Chemical Engineering College, Inner Mongolia University of Technology, Hohhot, 010051, People's Republic of China

[b]Inner Mongolia Key Laboratory of Industrial Catalysis, Hohhot, 010051, People's Republic of China

*Corresponding authors: Xingwei Sun

Tel: +86471 6575722.

Fax: +86471 6575722.

E-mail address: sxw@imut.edu.cn

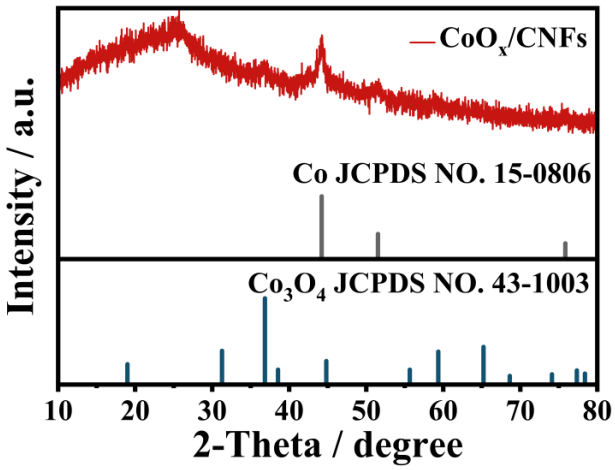

Fig. S1 XRD profiles of CoO_x/CNFs

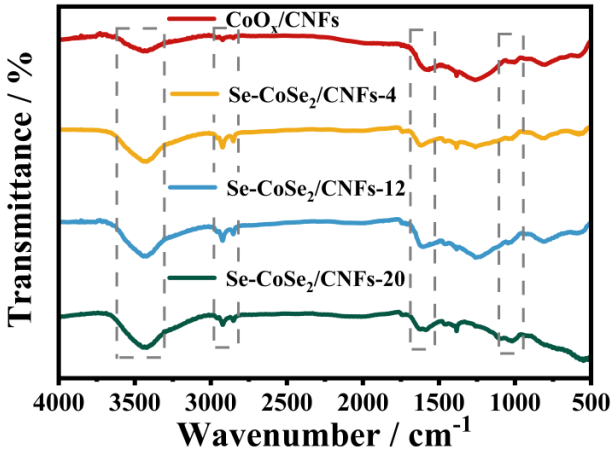

Fig. S2 FTIR spectra of CoO_x/CNFs, Se-$CoSe_2$/CNFs-4, Se-$CoSe_2$/CNFs-12, Se-$CoSe_2$/CNFs-20

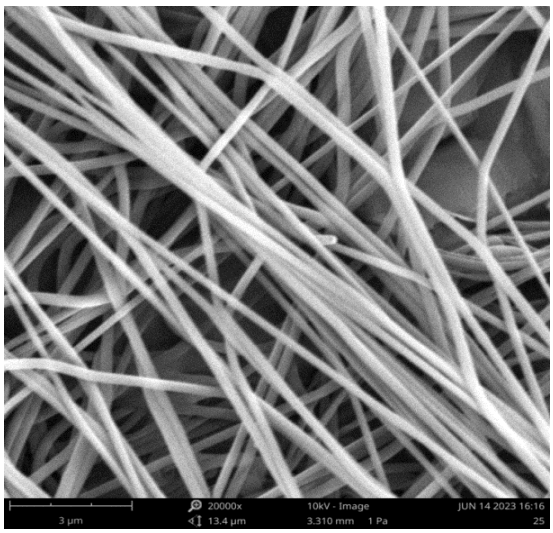

Fig. S3 SEM images of pure 2-MI/PAN

Table S1 ICP-OES of various Se-$CoSe_2$/CNFs

Sample name	Co loading/wt.%	Se loading/wt.%	Co/Se molar ratio
Se-$CoSe_2$/CNFs-4	6.65	17.16	1.1/2.2
Se-$CoSe_2$/CNFs-12	7.71	20.98	1.3/2.7
Se-$CoSe_2$/CNFs-20	9.25	27.92	1.6/3.5

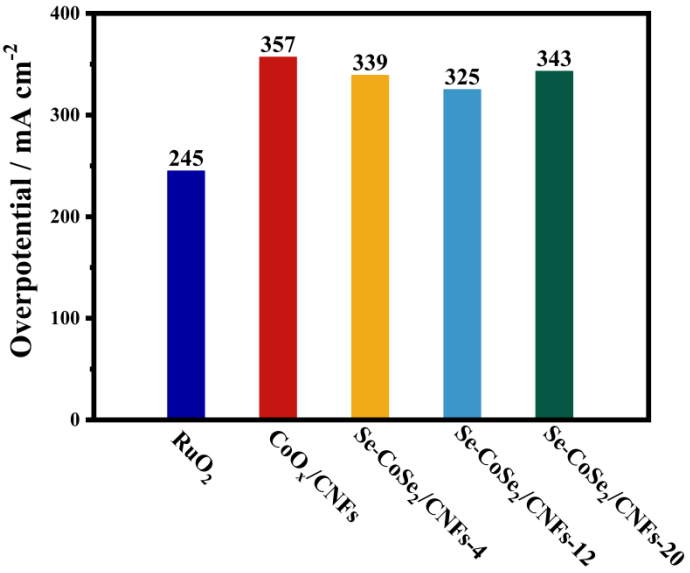

Fig. S4 Overpotentials at 10 mA cm^{-2} for four catalysts

Table S2 Comparison of the OER performance of different catalysts

catalyst	E_{OER}@10 mA cm^{-2} (V *vs.* RHE)	Reference
Se-$CoSe_2$/CNFs-12	1.55	This work
$CoSe/MoSe_2$	1.63	**ACS Sustainable Chemistry & Engineering** 2022, 10, 9980-9990
Se/Fe-Co_3O_4/N-CNs	1.59	**Journal of Colloid and Interface Science** 2022, 626, 475-485
$CoSe_2$@NC	1.57	**Nano Energy** 2022, 91, 106675
$CoSe_2$/CoNC	1.61	**Journal of Colloid and Interface Science** 2023, 643, 73.81
Co/CoSe@NC	1.58	**Chemical Engineering Journal** 2022, 450, 137991
$CoSe_2$@CoNi LDH HNA	1.58	**Advanced Science** 2022, 9, 2104522

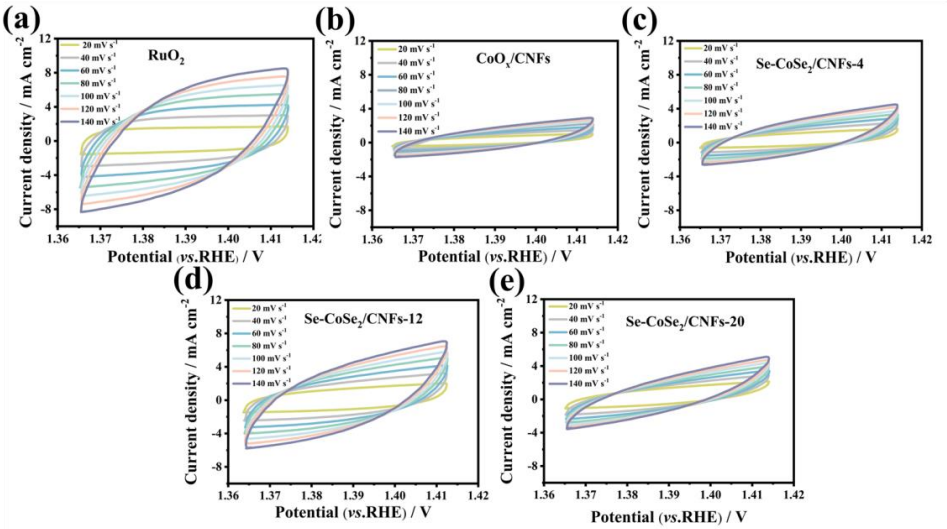

Fig. S5 The CV measurements in a non-faradic current region of (a) RuO_2,(b) CoO_x/CNFs, (c) Se-$CoSe_2$/CNFs-4, (d) Se-$CoSe_2$/CNFs-12, (e) Se-$CoSe_2$/CNFs-20 samples at different scan rates of 20, 40, 60, 80, 100, and 120 mV s^{-1}

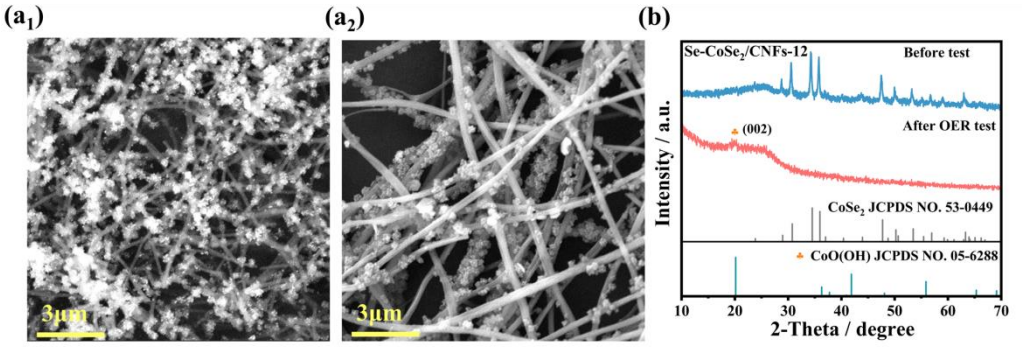

Fig. S6 SEM of (a_1) the fresh Se-$CoSe_2$/CNFs-12 and (a_2) the catalyst after the electrochemical test Se-$CoSe_2$/CNFs-12, (b) XRD of fresh Se-$CoSe_2$/CNFs-12 and Se-$CoSe_2$/CNFs-12 after electrochemical cycling in 1 M KOH solution

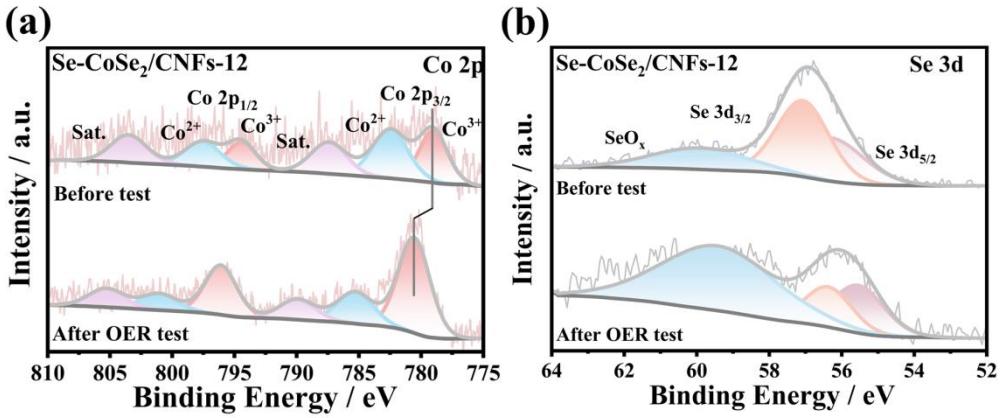

Fig. S7 XPS spectra of the fresh Se-$CoSe_2$/CNFs-12 and the catalyst after the electrochemical test Se-$CoSe_2$/CNFs-12 (a) Co 2p, (b) Se 3d

Table S3 Comparison of the ORR performance of different catalysts

catalyst	Half wave potential (V *vs.* RHE)	Reference
Se-$CoSe_2$/CNFs-12	0.80	This work
Se/Fe-Co_3O_4/N-CNs	0.80	**Journal of Colloid and Interface Science** 2022, 626, 475-485
$(Ni,Co)Se_2$	0.70	**Journal of Energy Chemistry** 2019, 38, 34-40
Fe-doped MOF CuCoSe nanostructure	0.76	**Applied Catalysis B: Environmental** 2021, 293, 120209
$Cu_{-14}Co_3Se_4$/GC	0.78	**ACS Catalysis** 2019, 9, 10761-10772
C@Co(OH)Se	0.79	**Chemical Engineering Journal** 2023, 467, 143359
CeO_2@$CoSe_2$-NCs	0.76	**Journal of Colloid and Interface Science** 2022, 625, 839-849

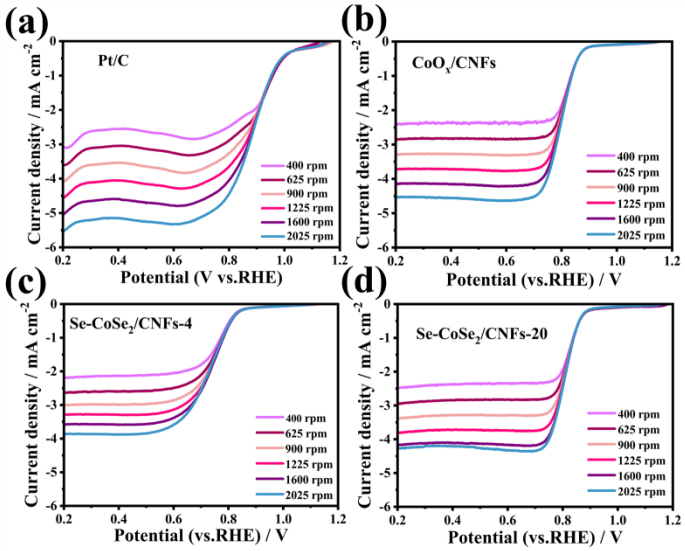

Fig. S8 LSV curves of (a) Pt/C, (b) CoO_x/CNFs, (c) Se-$CoSe_2$/CNFs-4, (d) Se-$CoSe_2$/CNFs-20 in O_2-saturated 0.1 M KOH at various rotation speeds, respectively

Table S4 A survey of the performance of Zn-air batteries with various electrocatalysts

catalyst	**Power Density ($mW\ cm^{-2}$)**	**Reference**
Se-$CoSe_2$/CNFs-12	149.4	This work
Co/CoSe@NC	145	**Chemical Engineering Journal** 2022, 450, 137991
P-$CoSe_2$/C@CC	124.4	**Journal of Colloid and Interface Science** 2023, 633, 424-431
$CoSe_2$@NC	137.1	**Nano Energy** 2022, 91, 106675
$CoSe_2$/Co@NCNF-3	79.0	**Journal of Alloys and Compounds** 2021, 875, 160056
O-$Co_{0.5}Mo_{0.5}Se_2$	120.28	**Small** 2020, 16, 2000797
C@Co(OH)Se	54.8	**Chemical Engineering Journal** 2023, 467, 143359