Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information

Core-shell structure and hydrogen-evolution-suppressing zinc anode for high stability Zn-Ni secondary battery

Chun Guo, Zheng Li, Tao Wang, Hao Cheng, Yuan Zhu, Zhongliang Tian *

School of Metallurgy and Environment, Central South University, Changsha, 410083, China

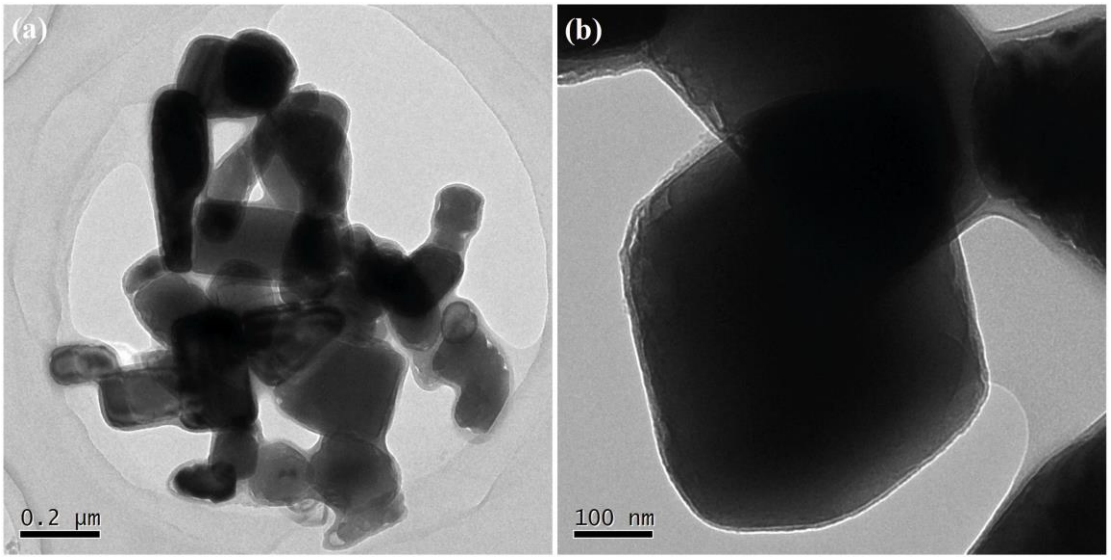

Figure. S1 TEM images of precursor

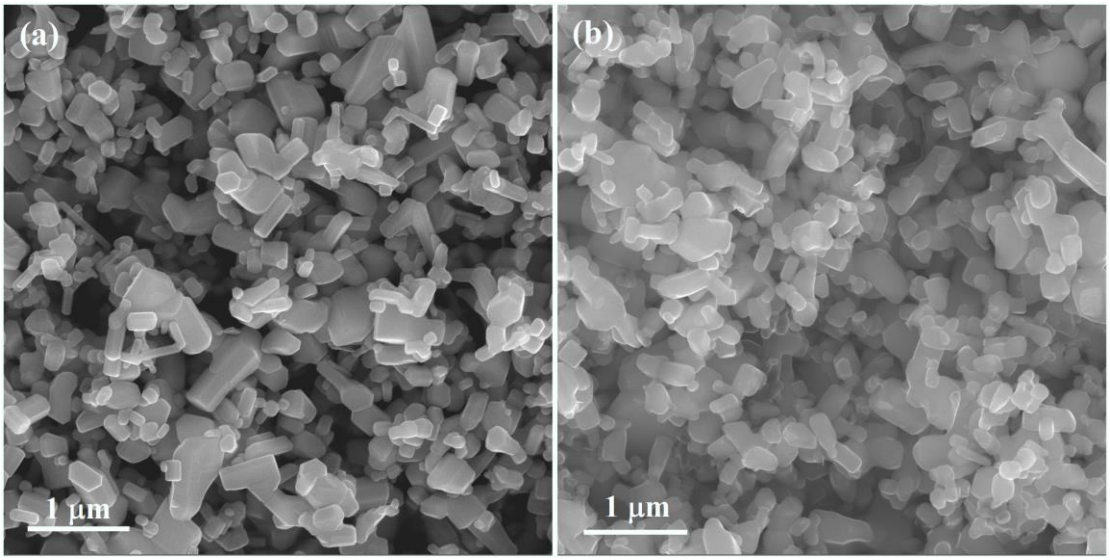

Figure. S2 (a)SEM image of pure ZnO, (b) SEM image of ZnO@C

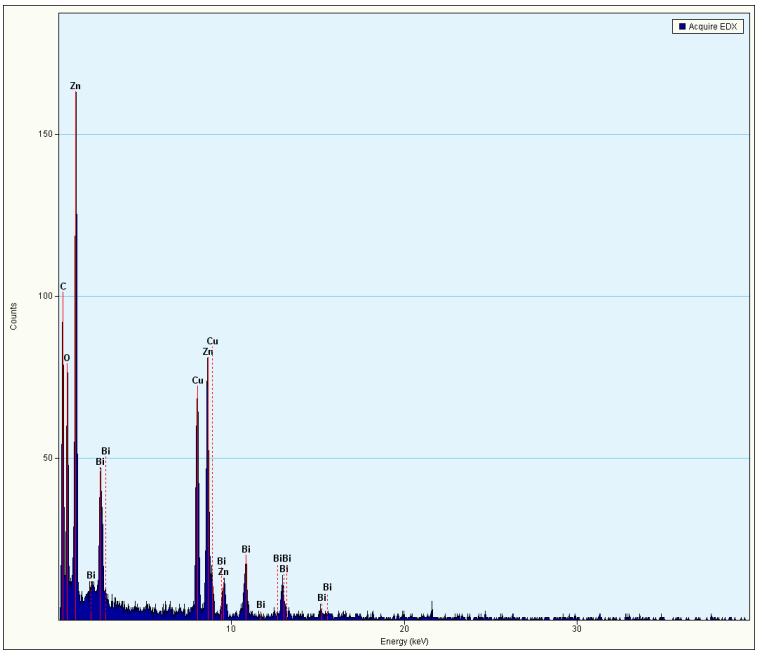

Figure. S3 EDX spectrum diagram of selected area in **Figure. 1f**

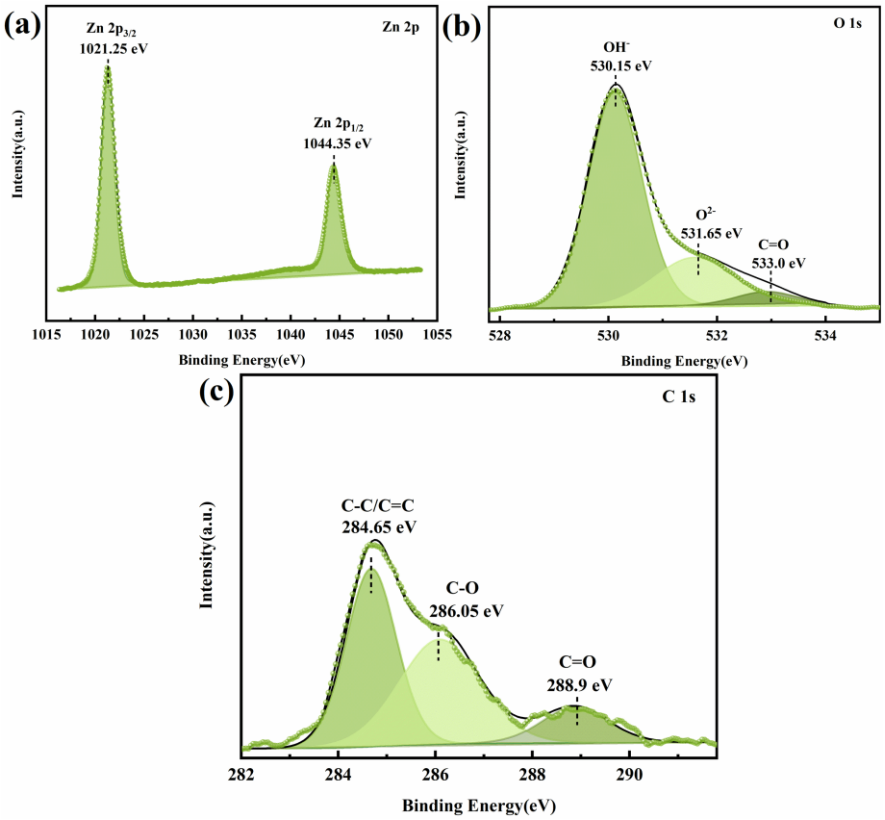

Figure. S4 High-resolution XPS spectrum of pure ZnO

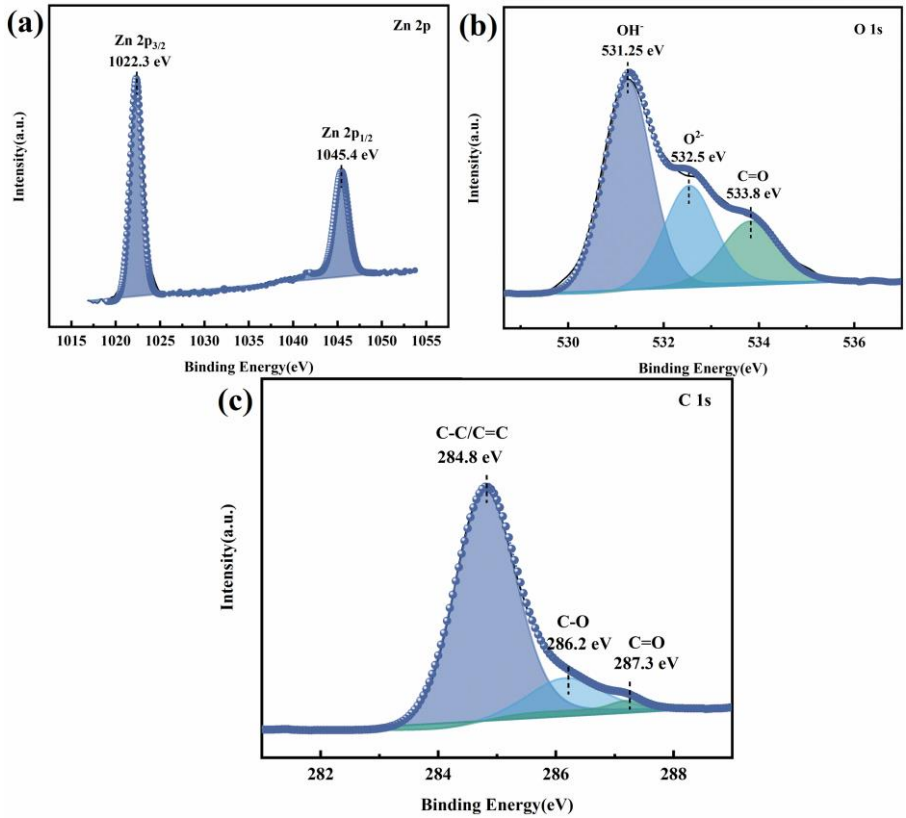

Figure. S5 High-resolution XPS spectrum of pure ZnO@C

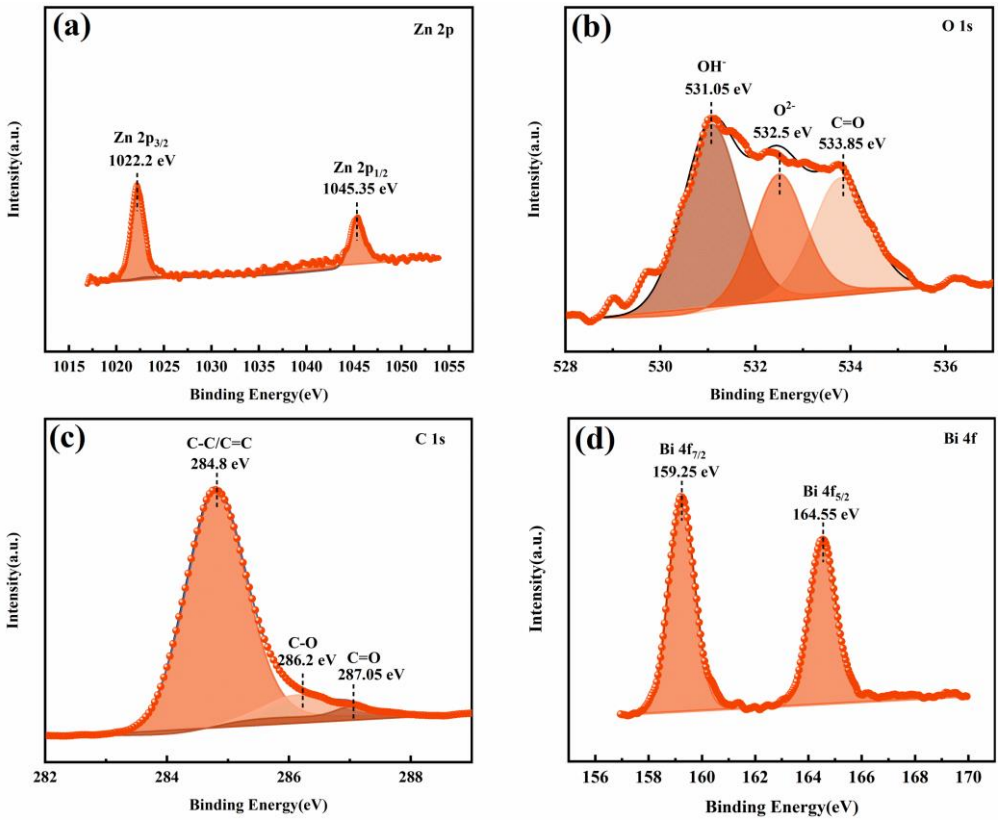

Figure. S6 High-resolution XPS spectrum of pure ZnO@C/Bi

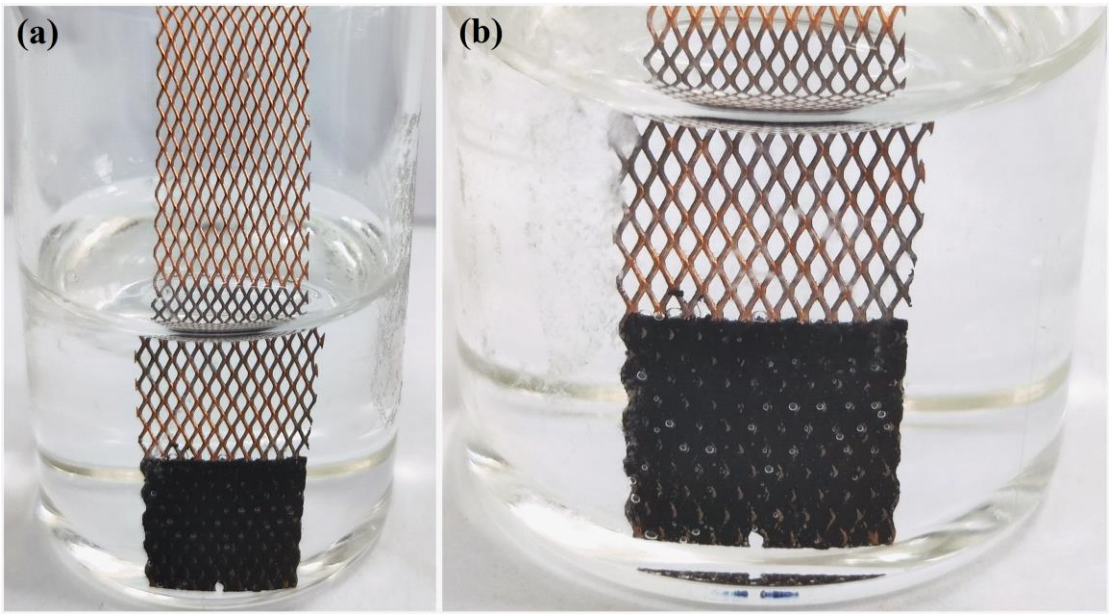

Figure. S7 Images of electrode of pure ZnO@C soaked in 6M KOH electrolyte

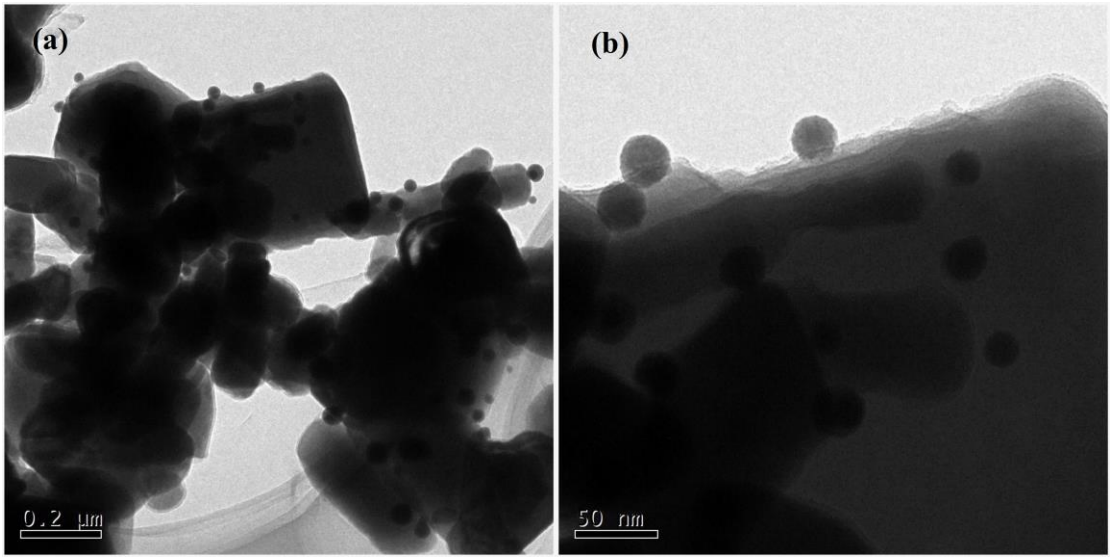

Figure. S8 TEM images of the materials obtained by one-step hydrothermal and calcination process

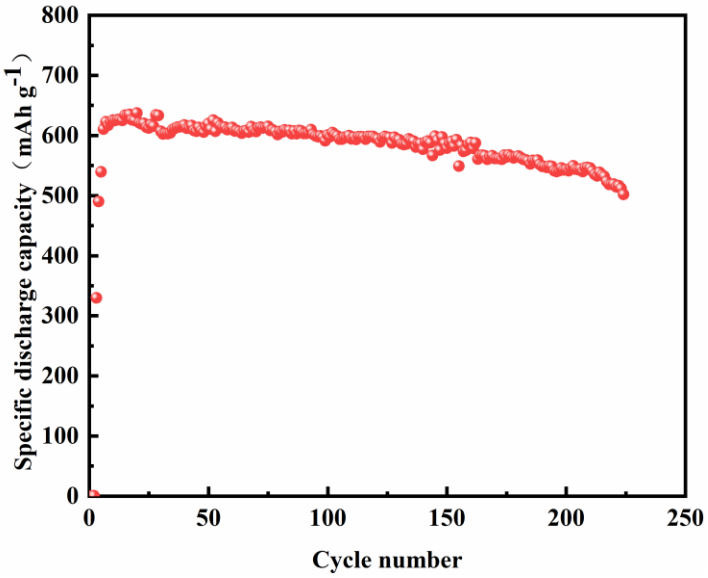

Figure. S9 Cycle performance of the materials obtained by one-step hydrothermal and calcination process

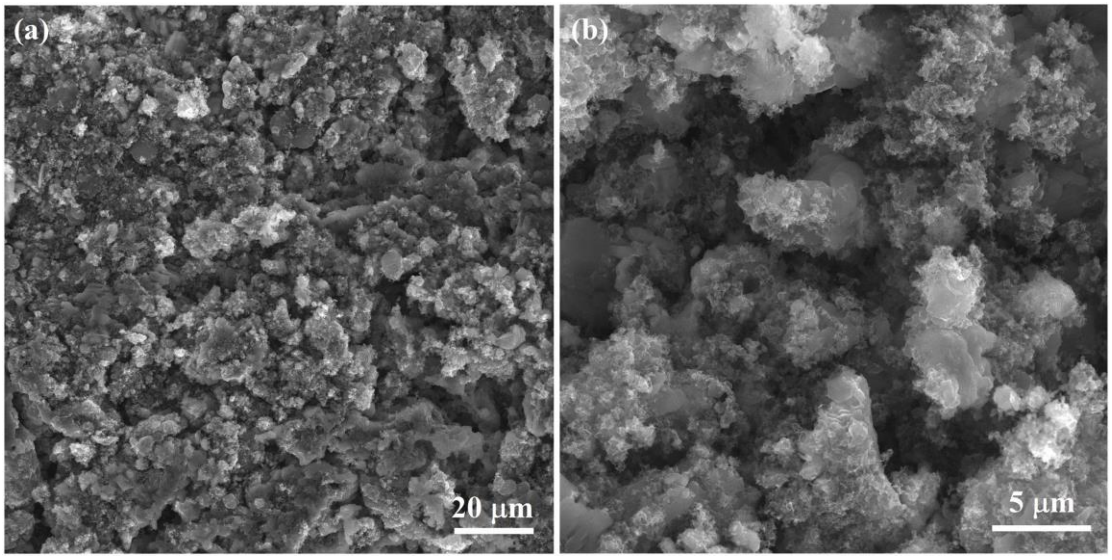

Figure. S10 SEM images of ZnO@C after 110 cycles.

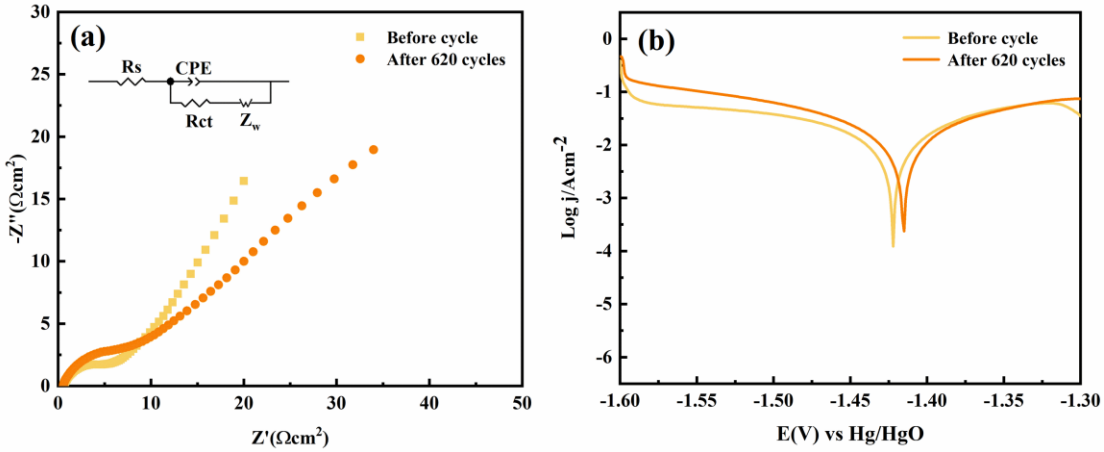

Figure. S11 (a) The typical Nyquist plots and equivalent circuit of ZnO@C/Bi before cycle and after 620 cycles; (b) Tafel plots of ZnO@C/Bi before cycle and after 620 cycles.

Samples	BET Surface Area/$m^2 \cdot g^{-1}$	Median pore width/nm
Pure ZnO	1.5510	0.9192
ZnO@C	40.0280	0.7826
ZnO@C/Bi	50.1724	0.7615

Table. S1 Table of BET Surface Area and Median pore width for pure ZnO, ZnO@C and ZnO@C/Bi

Samples	Cathode peak position/V	Cathode peak height/A·g^{-1}	Anode peak position/V	Anodic peak height/A·g^{-1}	Peak potential difference/V
Pure ZnO	-1.576	-0.1407	-1.232	0.1736	0.344
ZnO@C	-1.555	-0.09003	-1.233	0.1622	0.322
ZnO@C/Bi	-1.579	-0.1334	-1.273	0.1734	0.306

Table. S2 Table of Cyclic voltammetry curve parameters of pure ZnO, ZnO@C and ZnO@C/Bi.

Samples	Rs/Ω cm^2	Rct/Ω cm^2
Pure ZnO	0.5935	8.89
ZnO@C	0.7258	4.18
ZnO@C/Bi	0.6787	3.45

Table. S3 Table of EIS parameters of pure ZnO, ZnO@C and ZnO@C/Bi.

Samples	Corrosion potential (E_{corr}) /V	Corrosion current density (I_{corr}) /mA·cm^{-2}	Inhibition efficiency/%
Pure ZnO	-1.4405	26.55	/
ZnO@C	-1.4326	20.89	21.31
ZnO@C/Bi	-1.4227	18.57	30.10

Table. S4 Table of corrosion potential and corrosion current density of pure ZnO, ZnO@C and ZnO@C/Bi.

	Rate	Electrolyte	Separator	Activation cycles
ZnO-N_2@C	1 C (500 mAg^{-1})	4 M KOH, 1.6 M K_2BO_3,0.9 M KF, 0.1 M LiOH, saturated with ZnO	Polyolefin microporous membrane	5
ZnO@RFC	1 C (600 mAh g^{-1})	6 M KOH saturated with 0.5 M ZnO	Polypropylene microporous membrane	10 (Charge at 0.2 C, discharge at 0.5 C)
Zn-Pb	1 C (600 mAh g^{-1})	6 M KOH, 5 wt% ZnO	Glass fiber membrane	5
Ag/ ZnO	1 C (659 mAh g^{-1})	6 M KOH saturated with 0.5 M ZnO	Polypropylene microporous membrane	5 (Charge at 0.2 C, discharge at 0.5 C)
SnO_2/ ZnO	1 C (659 mAh g^{-1})	6 M KOH saturated with 0.5 M ZnO	Polypropylene microporous membrane	5 (Charge at 0.2 C, discharge at 0.5 C)
Bi_2O_3@ZnO	1 C (659 mAh g^{-1})	6 M KOH saturated with ZnO	Polypropylene microporous membrane	5(Charge at 0.2 C, discharge at 0.2 C)
ZnO@C/Bi	1 C (659 mAh g^{-1})	6 M KOH saturated with ZnO	Polypropylene microporous membrane	5(Charge at 0.2 C, discharge at 0.2 C)
ZnO@C	1 C (658 mAh g^{-1})	6 M KOH saturated with ZnO	polypropylene microporous membranes	5(Charge at 0.1 C, discharge at 0.2 C)
This work	1 C (659 mAh g^{-1})	6 M KOH saturated with 0.5 M ZnO	polypropylene microporous membranes	5 (Charge at 0.2 C, discharge at 0.5 C)

Table. S5 The test conditions for the comparison of the battery performance in figure 5(b).

Samples	Pure ZnO	ZnO@C	ZnO@C/Bi
Median voltage of charge /V	1.8666	1.8624	1.8376
Median voltage of discharge /V	1.7208	1.7346	1.7138
Median voltage difference /V	0.1458	0.1278	0.1238
Specific discharge capacity/ $mAh \cdot g^{-1}$	526.7	514.1	576.3

Table. S6 Charge and discharge data of pure ZnO, ZnO@C and ZnO@C/Bi at 50th.

ZnO@C/Bi	Median voltage of charge /V	Median voltage of discharge /V	Median voltage difference /V	Specific discharge capacity/ $mAh \cdot g^{-1}$
50 th	1.8376	1.7138	0.1238	576.3
100 th	1.8232	1.7083	0.1149	601.6
200 th	1.8451	1.7326	0.1125	567.9
300 th	1.8480	1.7302	0.1178	560.2
400 th	1.8528	1.7326	0.1202	543.6
500 th	1.8232	1.713	0.1102	576.4
600 th	1.8561	1.7239	0.1322	531.1

Table. S7 Charge and discharge data at 50 th, 100 th, 200 th, 300 th, 400 th, 500 th and 600 th for ZnO@C/Bi