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

Supplementary Information

Waste to Wealth: Spent Catalyst as an Efficient and Stable Bifunctional Oxygen Electrocatalyst for Zinc-Air Battery

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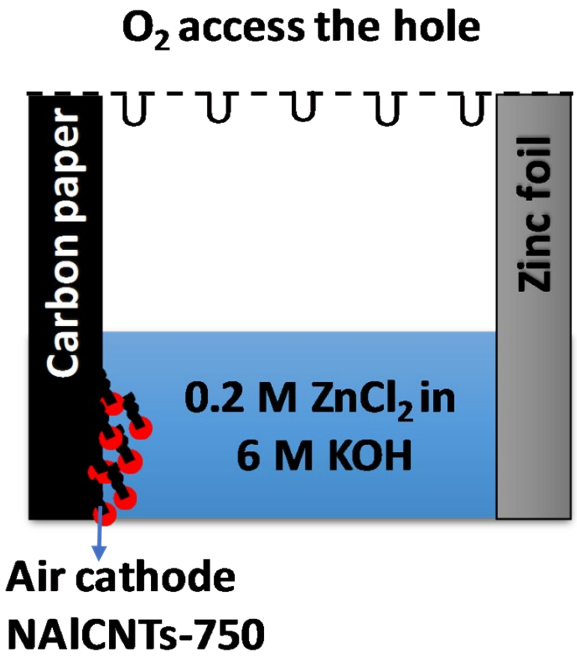

Figure S1. Schematic diagram of Zinc-air battery setup

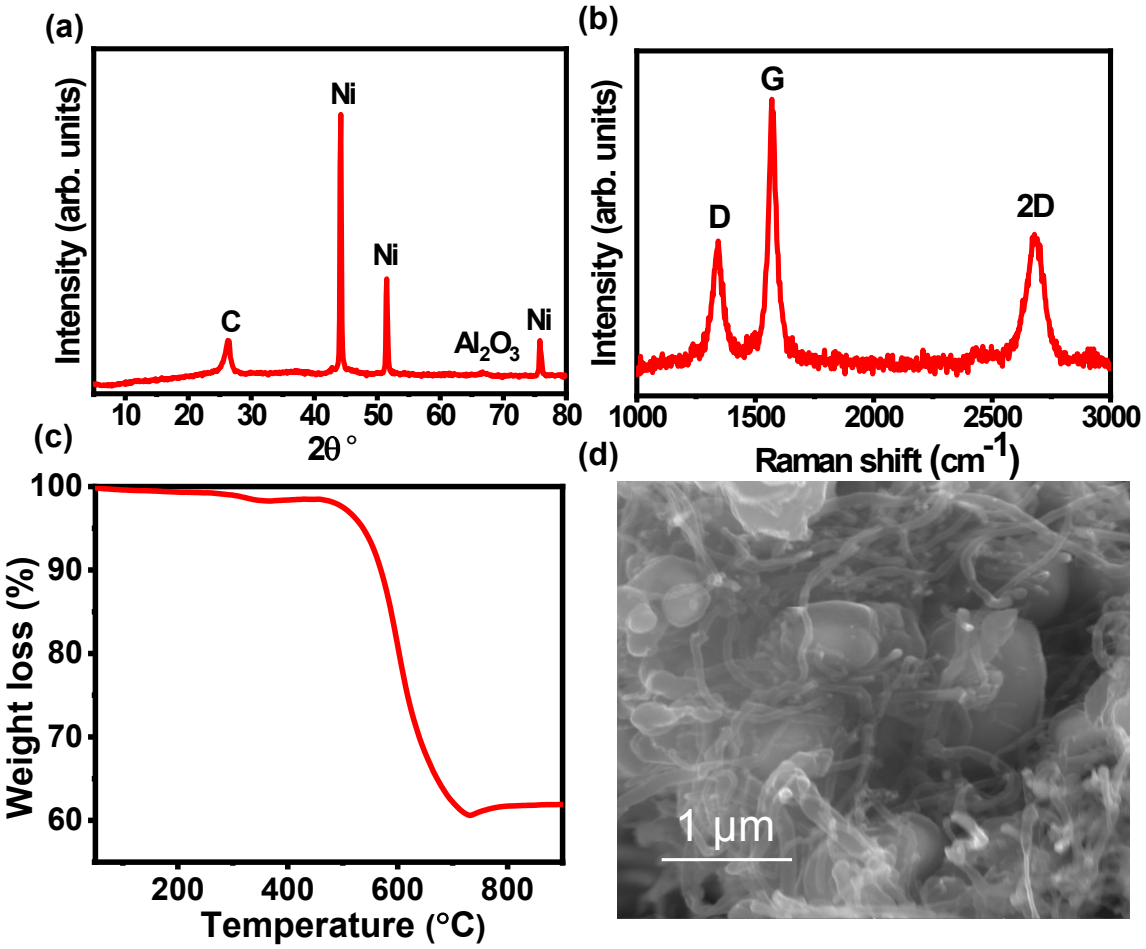

Figure S2. (a) XRD pattern (b) Raman spectra (c) TGA (d) FESEM of NAlCNTs-650.

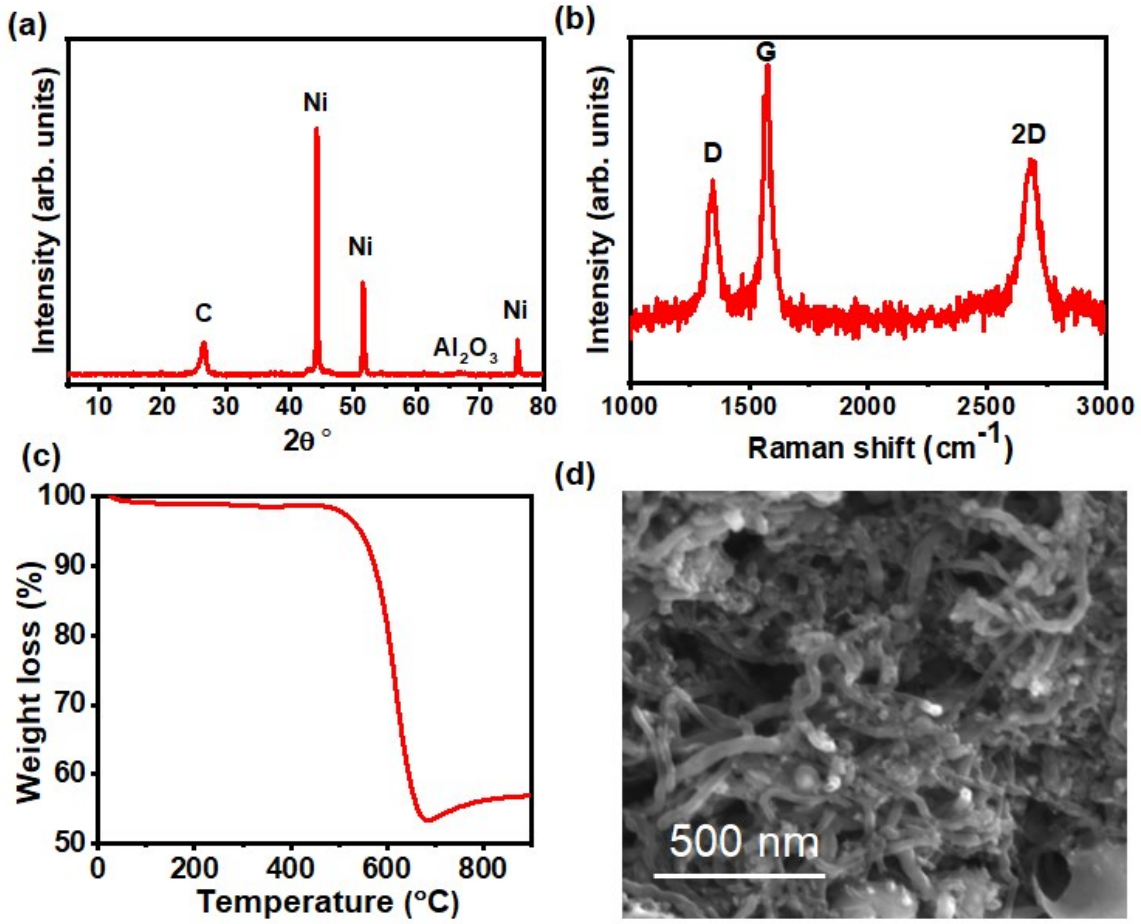

Figure S3. (a) XRD pattern (b) Raman spectra (c) TGA (d) FE-SEM of NAlCNTs-750/4h.

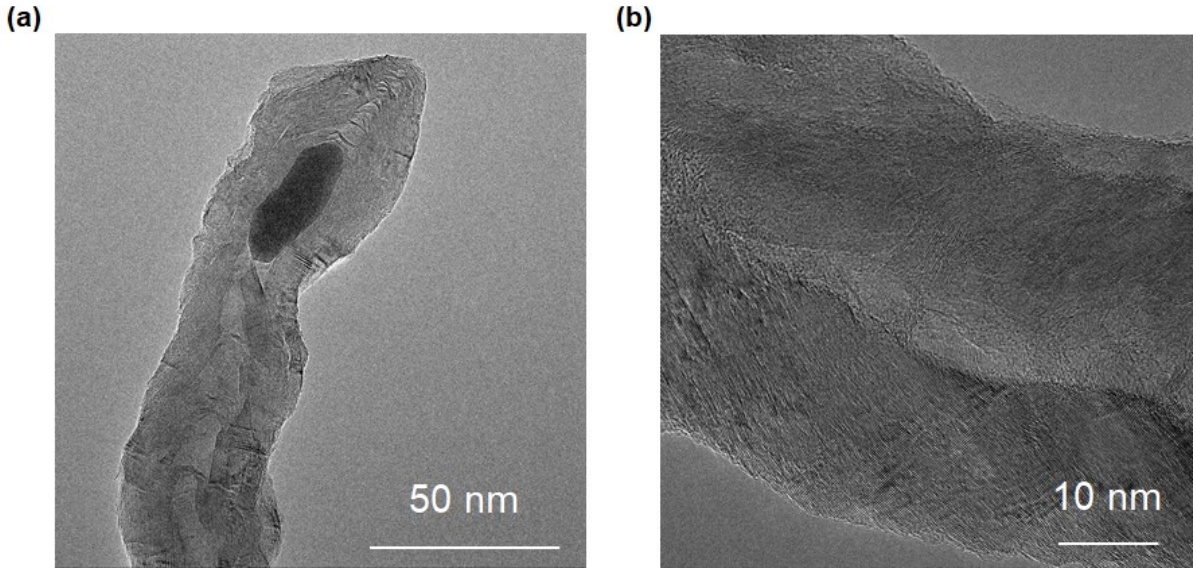

Figure S4. HRTEM image of NAlCNTs-750.

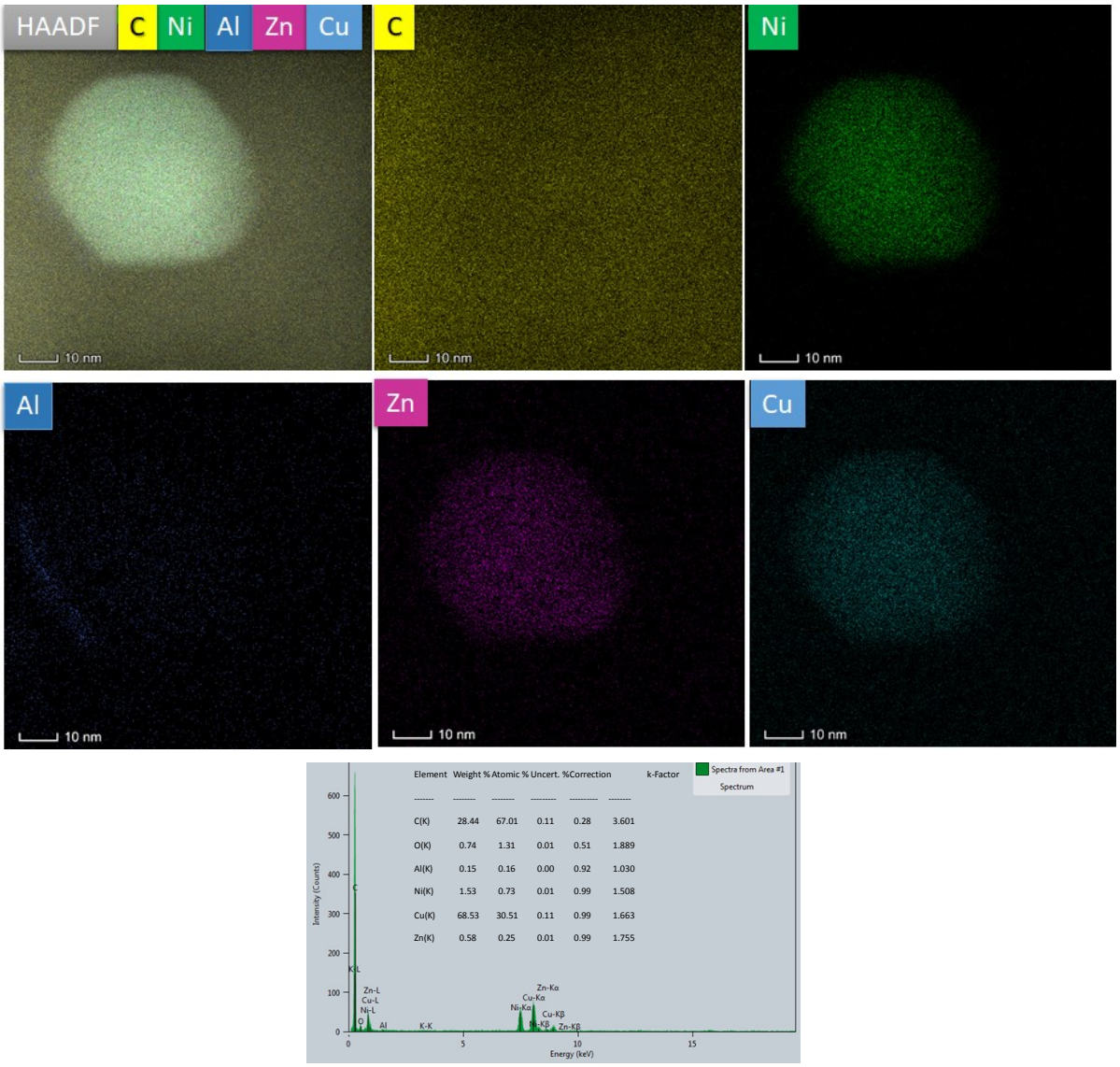

Figure S5. EDS elemental mapping of NAlCNTs-750 acquired in STEM mode.

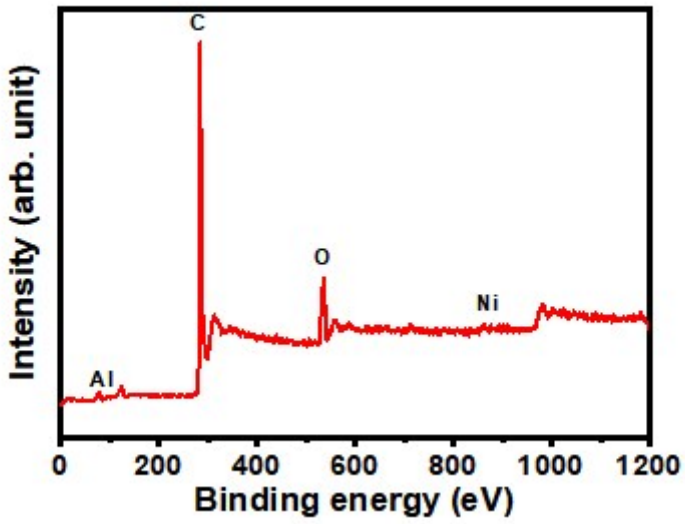

Figure S6. XPS survey spectrum of NAlCNTs-750.

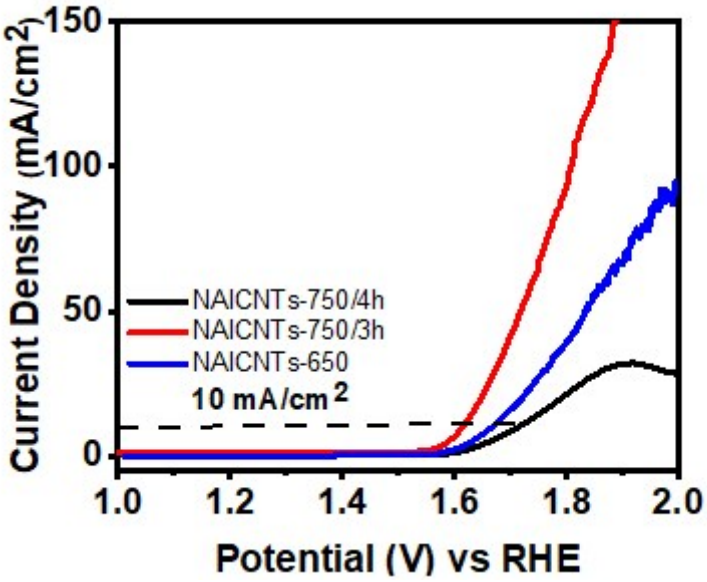

Figure S7. LSV curves of NAlCNTs-650, 750 and 750/4h acquired at 5 mV/s scan rate in 1 M KOH solution.

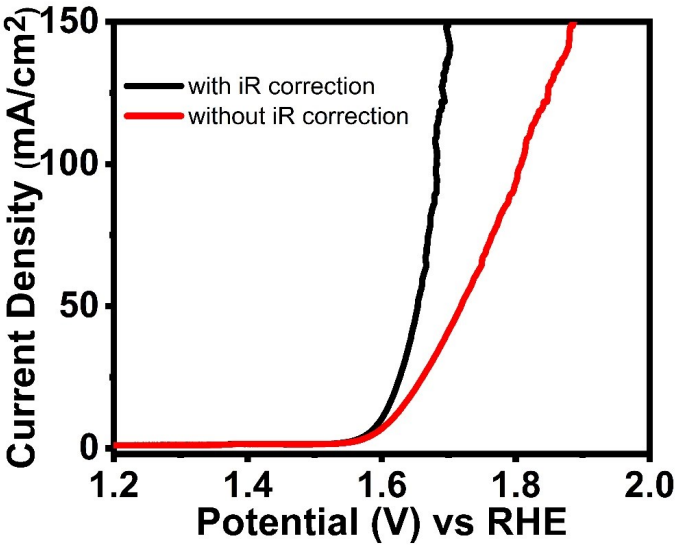

Figure S8. LSV curves of NAlCNTs-750 with and without iR correction.

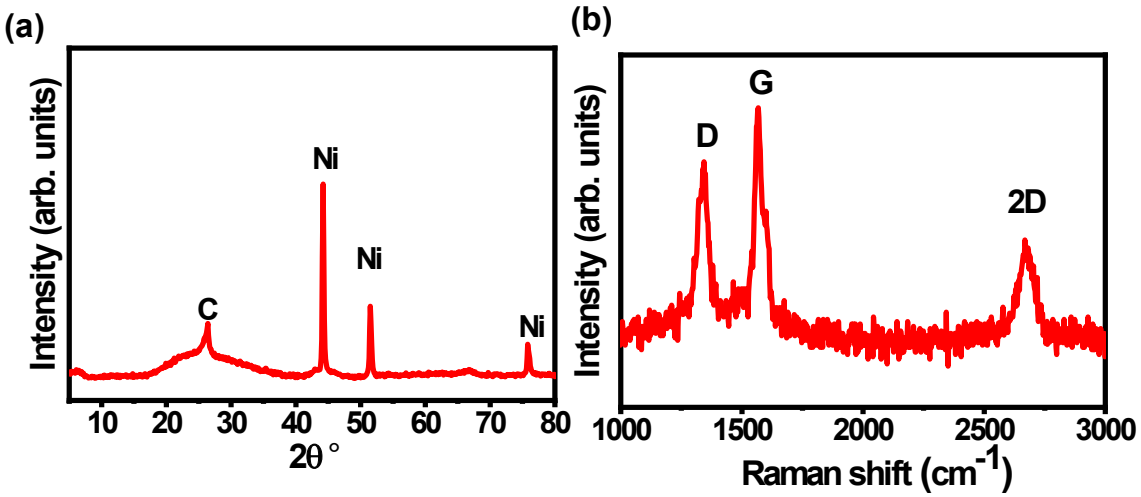

Figure S9. (a) XRD pattern (b) Raman spectra of NAlCNTs-750 after stability test.

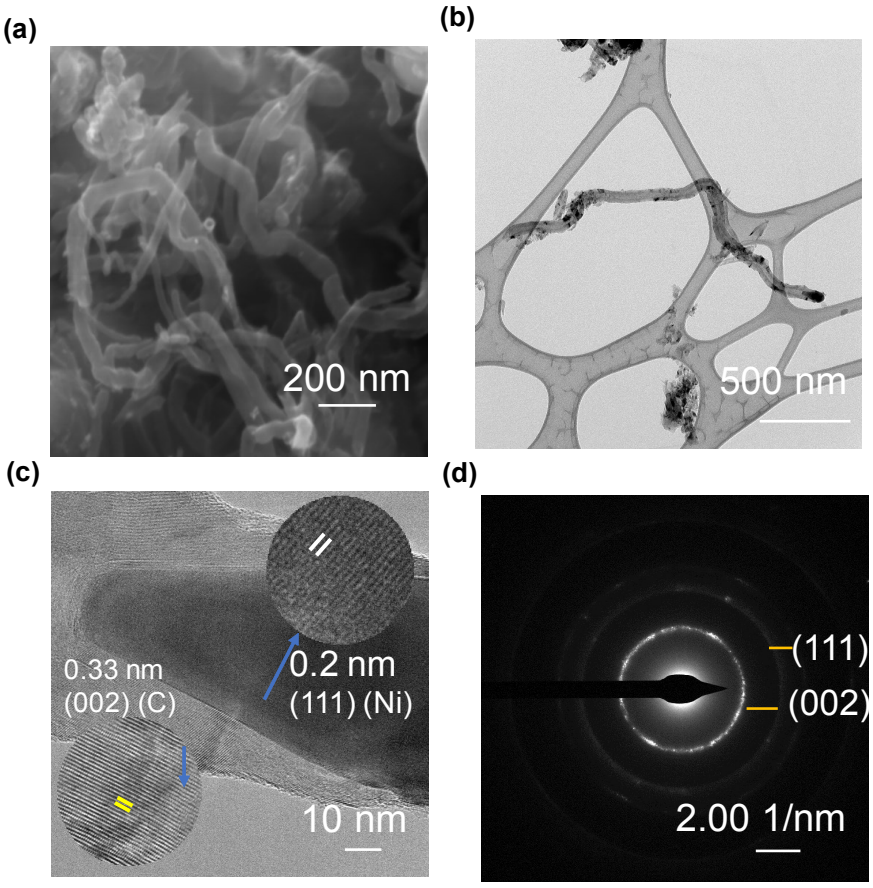

Figure S10. (a) FESEM and (b,c) HR-TEM (d) SAED pattern of NAlCNTs-750 after stability test.

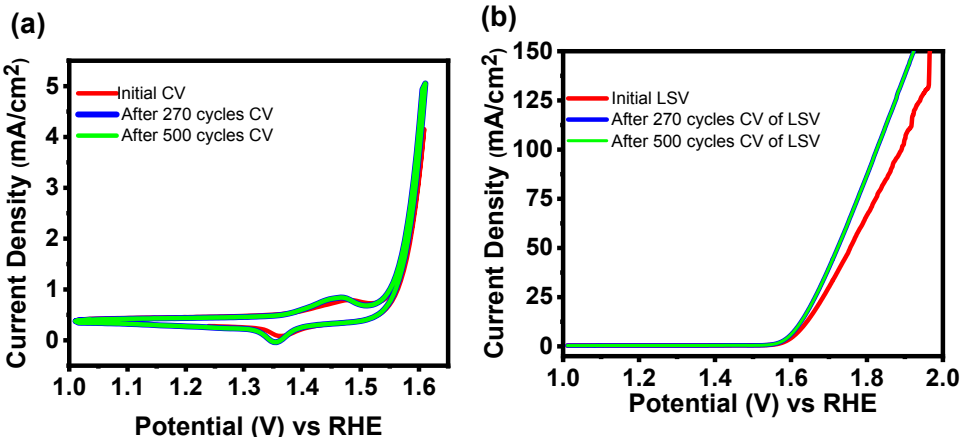

Figure S11. CV cycling of NAlCNTs-750 in 1 M KOH at 50 mV/s (a) Initial and after 270 and 500 CV cycles (b) The LSV of initial and after 270, 500 CV cycles of NAlCNTs-750 acquired in 1 M KOH at a scan rate of 5 mV/s.

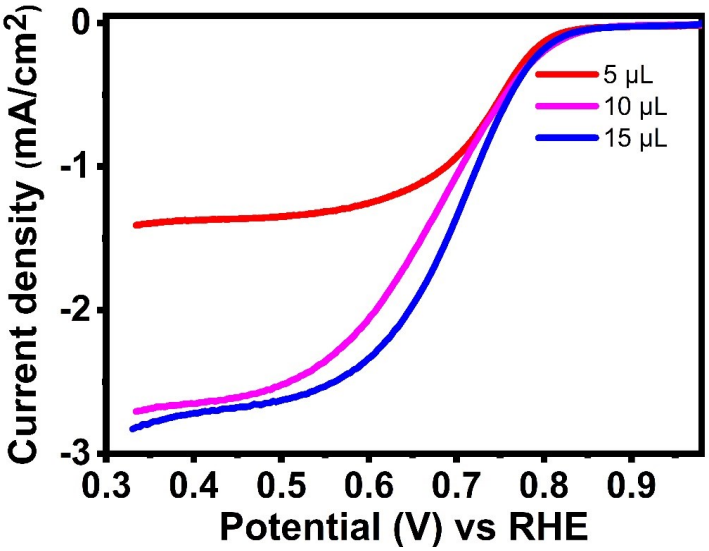

Figure S12. LSV of NAlCNTs-750 with various loading amounts acquired in 0. 1 M KOH acquired at 10 mV/s scan rate and 1600 rpm, electrode rotation speed.

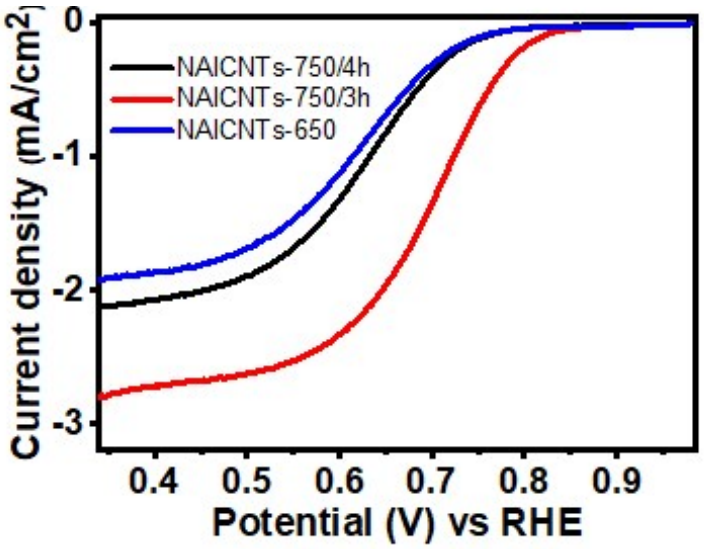

Figure S13. LSV curves of NAlCNTs-650, 750 and 750/4h with 15 µL loading amount in 0.1 M KOH acquired at 10 mV/s scan rate and 1600 rpm, electrode rotation speed.

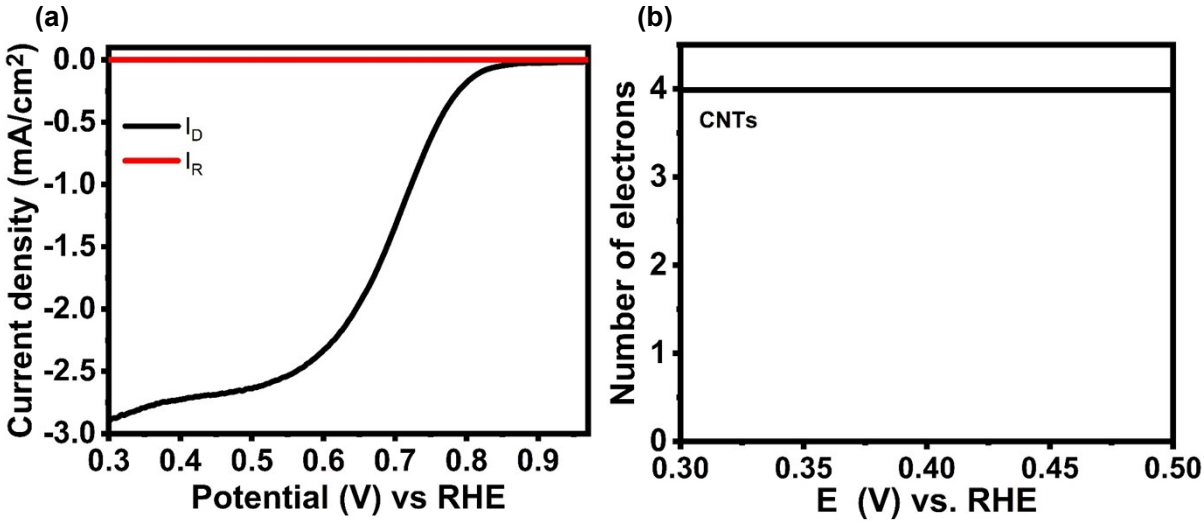

Figure S14. a) RRDE polarization curves at 1600 rpm for NAlCNTs-750 b) The number of electrons involved in ORR at various applied potentials for purified CNTs.

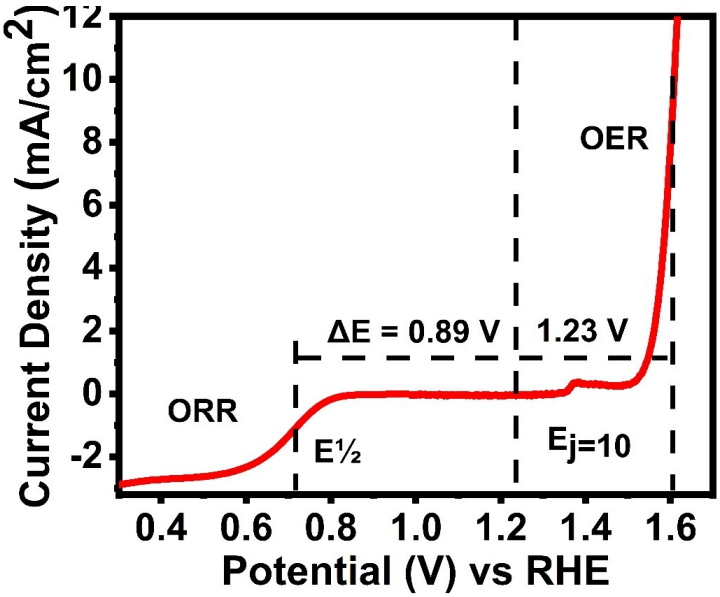

Figure S15. Overall oxygen electrocatalyst performance of NAlCNTs-750.

Table S1. Comparison of OER over potentials and Zn-air battery voltage gap for NAlCNTs-750 with related literature.

S.No.	Electrocatalyst	OER over potential (V vs RHE) @ 10 mA/cm^2	Zn-air battery charge and discharge voltage gap (V)	Reference
1	NAlCNTs-750	1.6	0.87	Present work
2	$ZnCo_2O_4$ /N-CNT	1.65	0.8	1
3	$NiCo_2O_4$	1.57	0.98	2
4	Co_9S_8/N,SDoped Graphene	1.61	0.86	3
5	Fe@C-NG/NCNTs	1.68	0.89	4
6	$CoFe_2O_4$/CNTs	1.74	0.8	5
7	Co@NCNTs	1.75	1.26	6
8	FCx-NC/CNTs	1.59	0.71	7
9	$NiCo_2S_4$/N-CNT	1.6	0.6	8
10	$Fe_{1.2}$Co@NC/NCNTs	1.585	0.74	9
11	CoFe@NCNTs	1.68	1.25	10
12	Co-N,B-CSs	1.64	1.35	11
13	CNTf-N-170	1.59	0.81	12
14	CNT arrays/grapheme	1.68	0.7	13

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