-Electronic Supplementary Information-

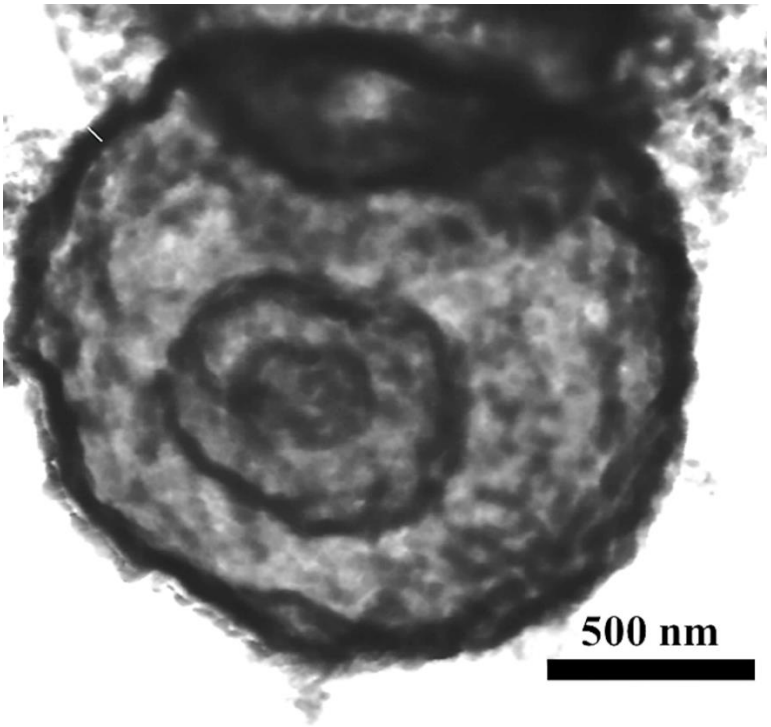

Figure S1. Enlarge TEM images of CeO_2/Co@NCH.

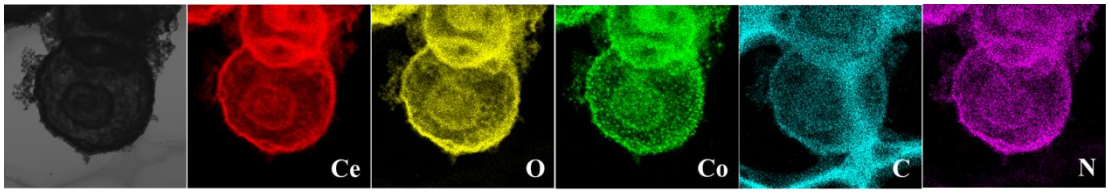

Figure S2. The element mapping of Ce, O, Co, C, N in CeO_2/Co@NCH.

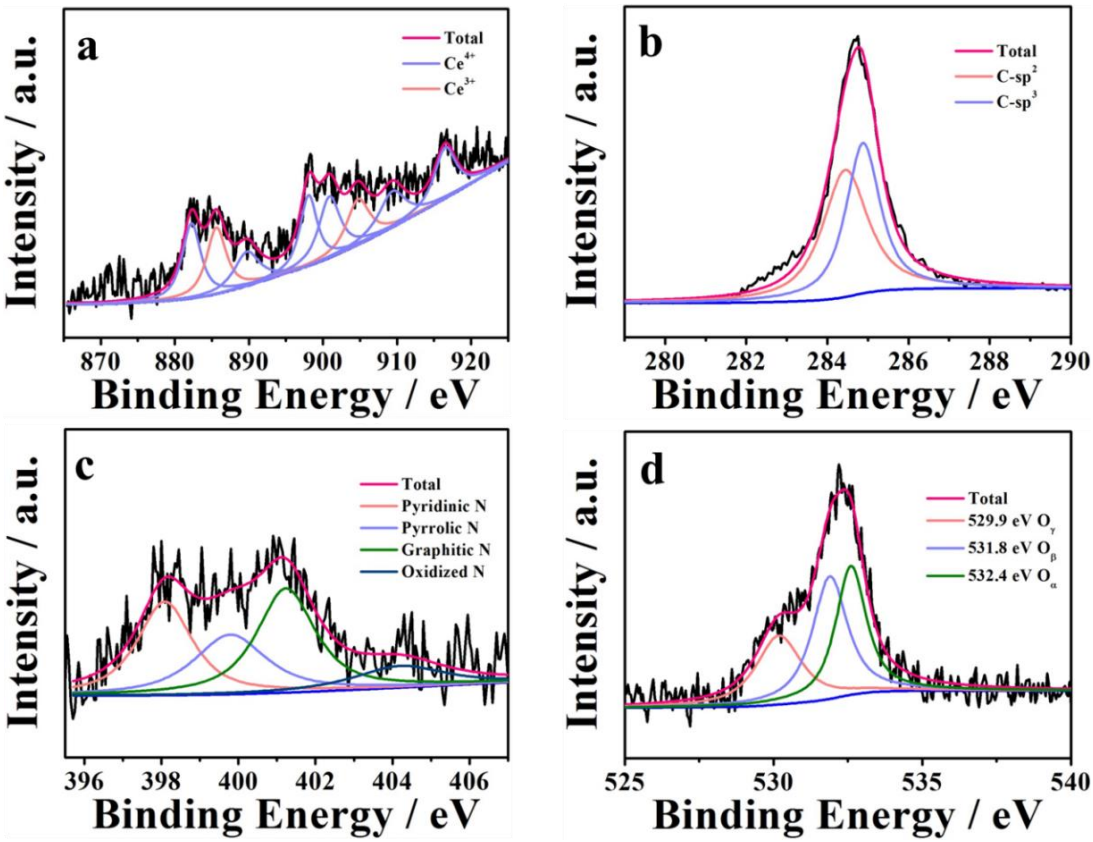

Figure S3. XPS high-resolution Ce 3d (a), C 1s (b), N 1s (c) and O 1s (d) spectra of CeO_2@NCH.

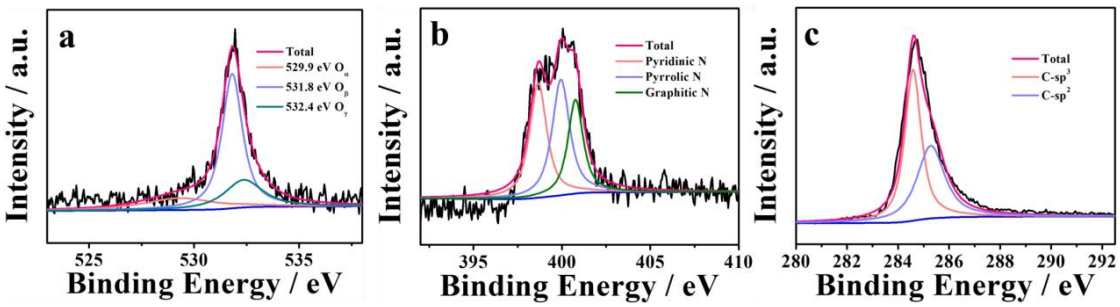

Figure S4. XPS high-resolution O 1s (a), N 1s (b) and C 1s (c) spectra of NCH.

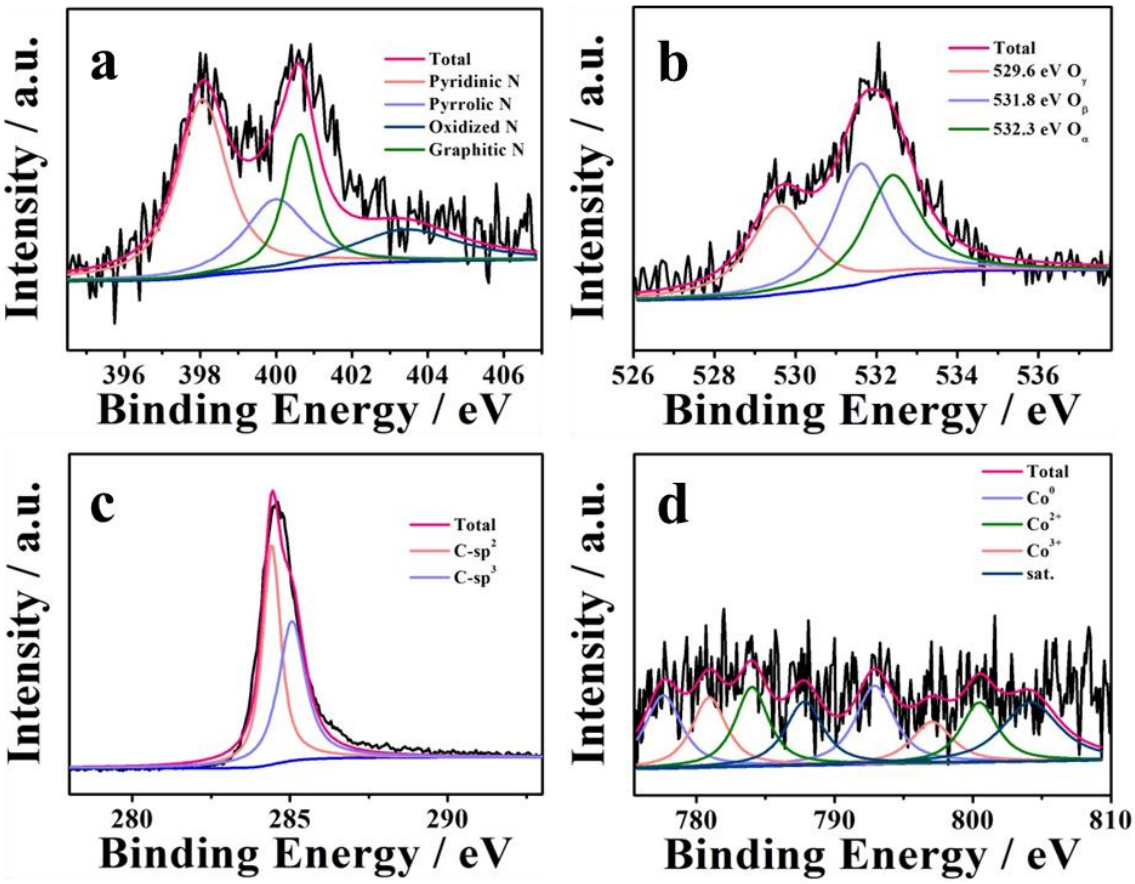

Figure S5. XPS high-resolution N 1s (a), O 1s (b), C 1s (c) and Co (d) spectra of Co@NCH.

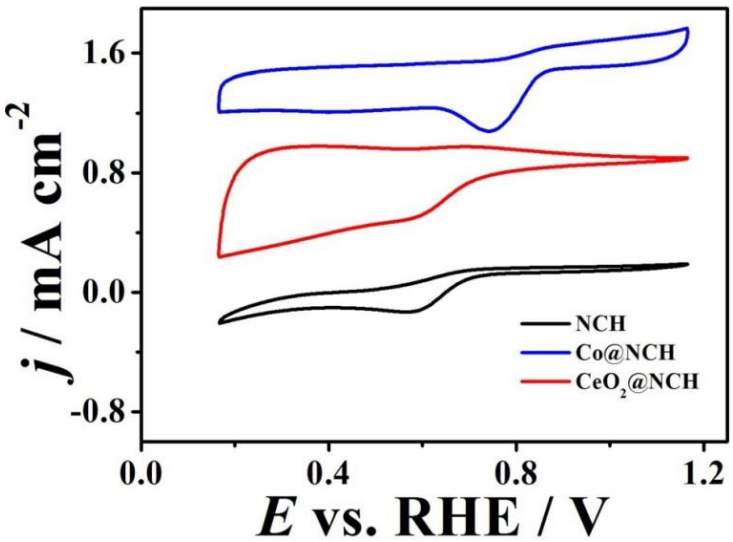

Figure S6. CV curves of NCH, Co@NCH and CeO_2@NCH recorded in O_2 saturated 0.1 M KOH.

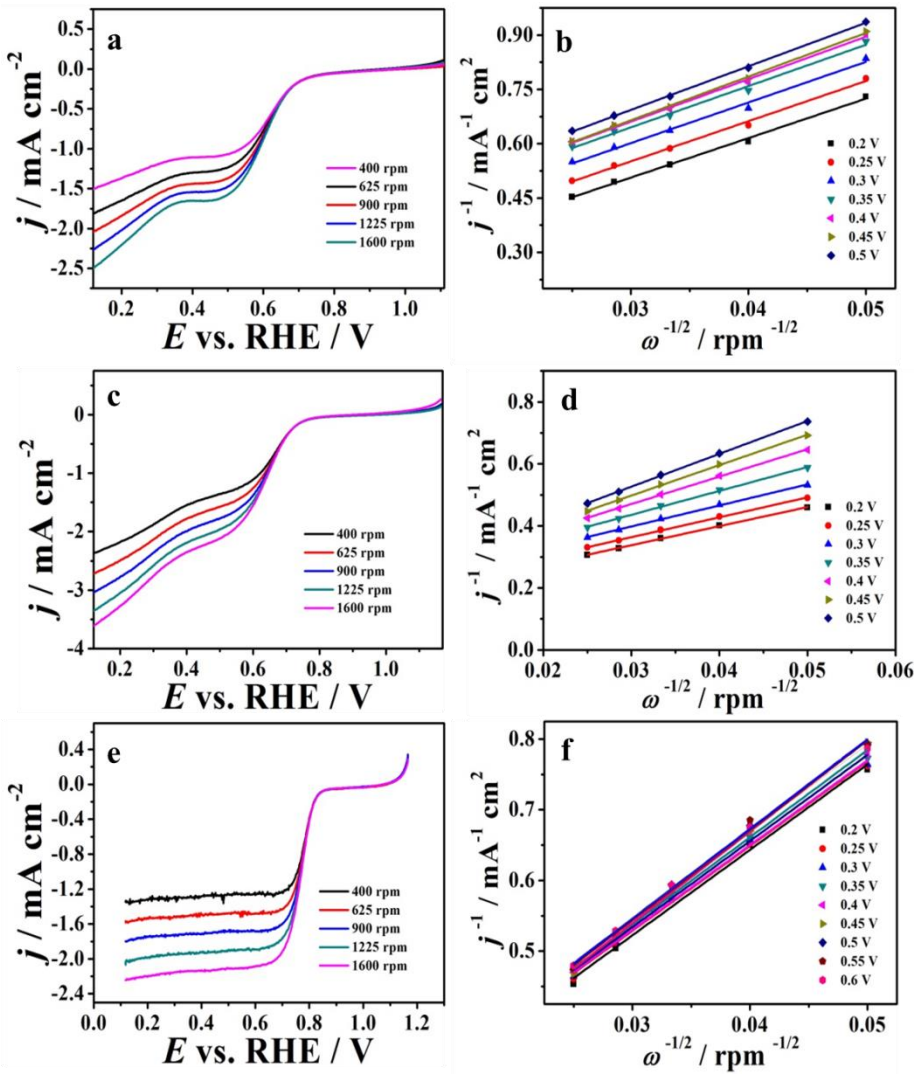

Figure S7. LSV curves of NCH, CeO_2@NCH and Co@NCH measured at different rotating rates and corresponding K-L plots at various potential range.

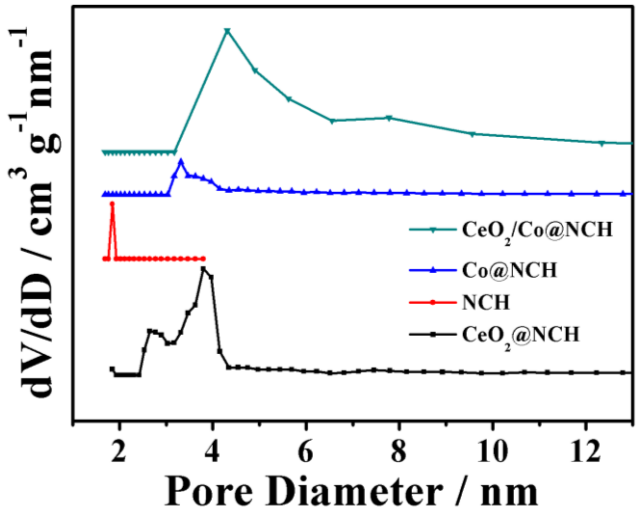

Figure S8. The pore size distribution curves of NCH, Co@NCH, CeO_2@NCH and CeO_2/Co@NCH.

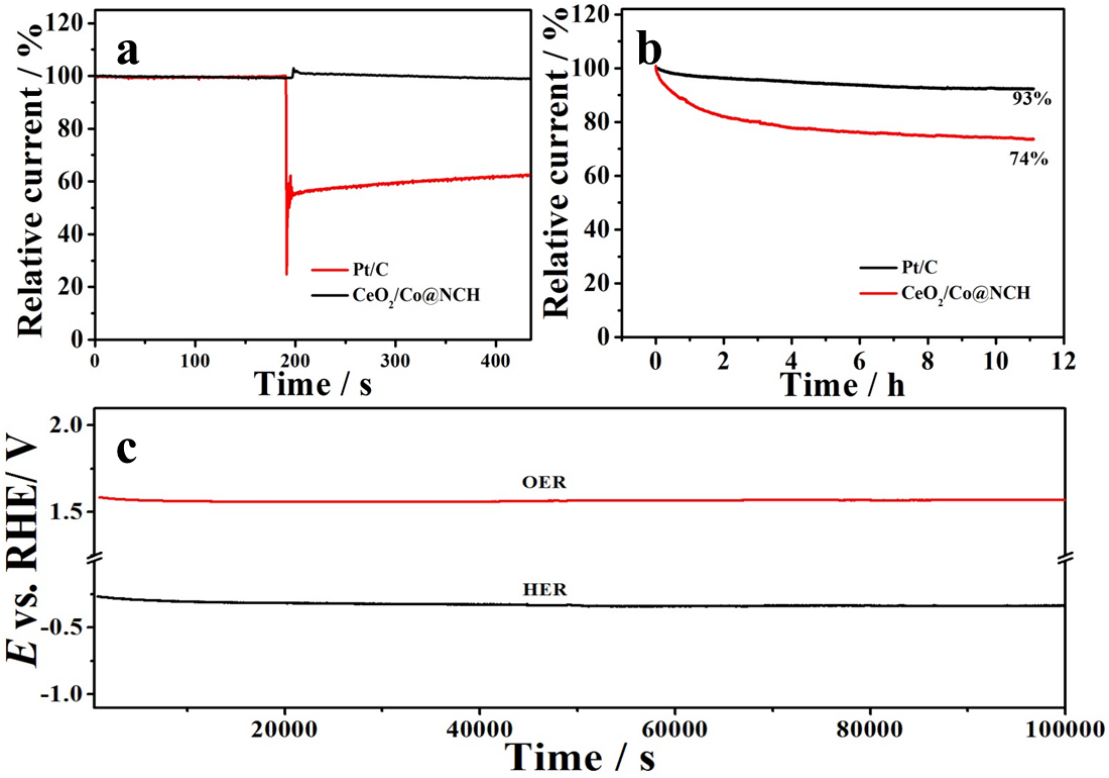

Figure S9. (a) methanol tolerance measurement of CeO_2/Co@NCH and Pt/C samples upon introducing 3M methanol after about 200 s at 0.6 V vs. RHE. (b) i-t chronoamperometric stability measurement of CeO_2/Co@NCH and Pt/C samples at 0.565 V vs. RHE. (c) The OER and HER stability of CeO_2/Co@NCH under a constant current density of 10 mA cm^{-2} for 100000 s.

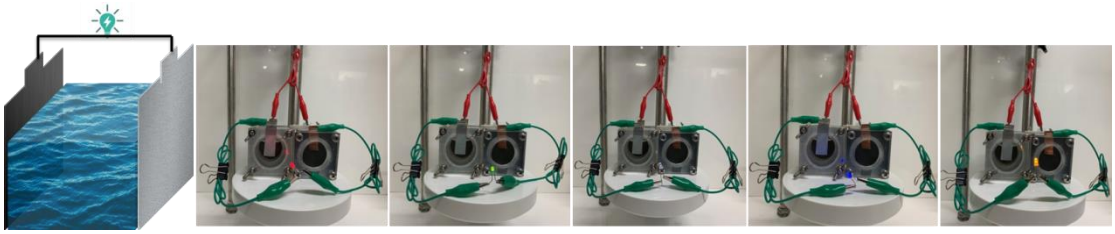

Figure S10. (a) Schematic illustration of the rechargeable zinc-air battery. (b) Photograph showing a series of LED powered by two liquid zinc-air batteries with the CeO_2/Co@NCH cathode connected in series.

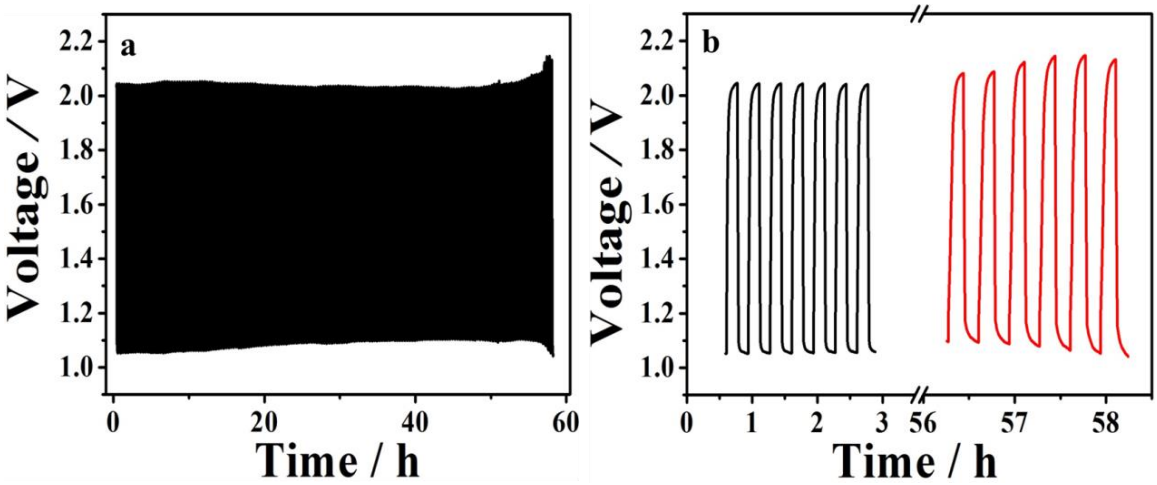

Figure S11. Galvanostatic discharge-charge cycling curves at 5 mA cm^{-2} of recharged Zn-air batteries with the Pt/C catalyst on carbon paper.

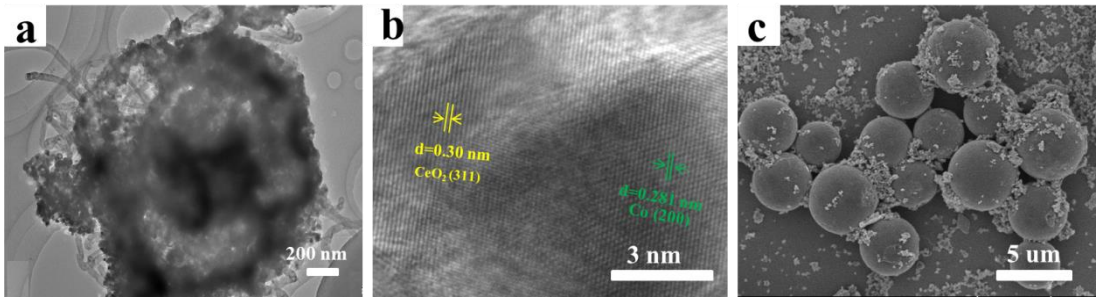

Figure S12. TEM (a) HRTEM (b) and SEM (c) images for CeO_2/Co@NCH after 40000 s chronoamperometric test.

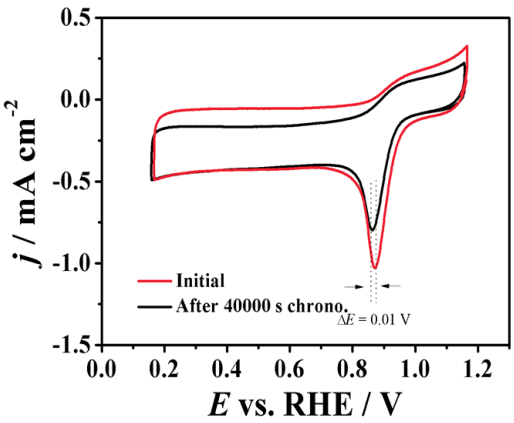

Figure S13. CV curves of CeO_2/Co@NCH in O_2 saturated 0.1 M KOH solution

before and after 40000 s chronoamperometric test.

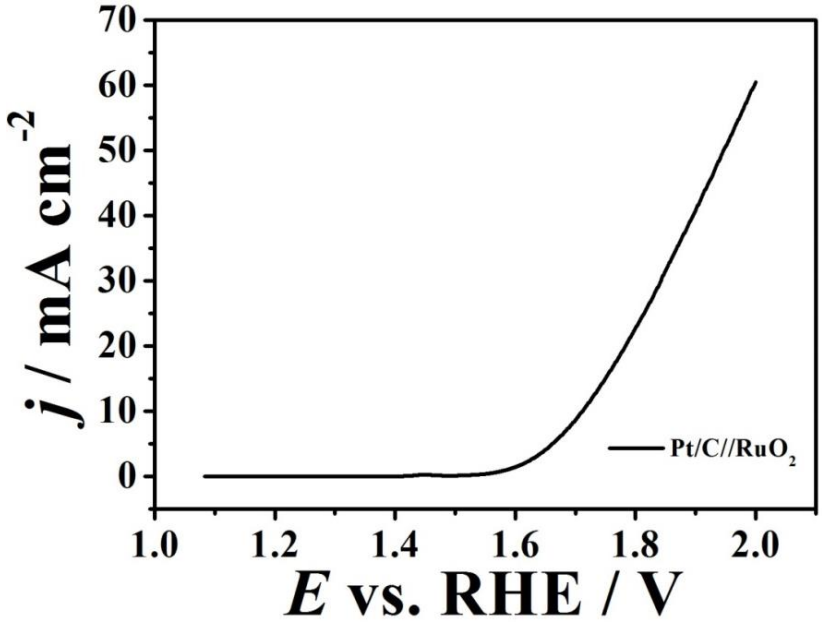

Figure S14. Polarization curves of Pt/C||RuO_2 in N_2-saturated 1M KOH.

Table S1 Comparison of ORR/OER performances of some reported CeO_2-based electrocatalysts.

Electrocatalysts	E_{onset} [V]	$E_{1/2}$ [V]	Medium	η_{OER},[mV]@ j[mA·cm^{-2}]	η_{HER},[mV]@ j[mA·cm^{-2}]	Medium	Refs.
$CeO_2/Co(OH)_2$ HCs				410@10	317@10	1M KOH	[1]
MoS_2-G-Ni					>600@10	0.1M KOH	[2]
Ni-Zn/CeO_2					410@2.74	1M KOH	[3]
g-C_3N_4/CeO_2/Fe_3O_4				400@10	310@10	1M KOH	[4]
3D-rGO-CeO_2					341@10	1 M KOH	[5]
Co_3O_4@Z67-NT@CeO_2	~0.95	0.88	0.1 M	350@10		0.1M KOH	[6]
Ni_2P−CeO_2/TM					84@20	1 M KOH	[7]
Fe_xNi_y/CeO_2/NC				240@10	240@10	1 M KOH	[8]
Co-CeO_2/N-CNR	~0.90	0.82		410@10		0.1M KOH	[9]
Co@NPC-900	0.88	0.76		380@10		0.1M KOH	[10]
Ni/CeO_2/CNTs					~220@10	1 M KOH	[11]
CoCe-600N_2	~0.97	~0.86	0.1 M	274@10		0.1M KOH	[12]
CeO_2–Cu_3P/NF					~91@10	1 M KOH	[13]
Co-W/CeO_2					166@10	1 M NaOH	[14]
Co-CeO_2-N-C	0.89	0.82	0.1 M	326@10		1 M KOH	[15]
CeO_2/rGO	0.946	0.84	0.1 M	500@10		0.1M KOH	[16]
CeO_2 nanowires	0.756	0.666	0.1 M	700@10		0.1M KOH	[17]

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