Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supplementary Information

Co_3O_4 nanobelt arrays assembled with ultrathin nanosheets as high efficient and stable electrocatalyst for chlorine evolution reaction

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1. Test and Calculate the Faradic efficiency of the Cl_2 evolution through Iodometric method.

The Faradic efficiency of the Cl_2 evolution is confirmed through Iodometric method following the mechanism:

$NaOH + Cl_2 \rightarrow NaCl + H_2O + NaClO$ (1);

$NaClO + HCl \rightarrow NaOH + Cl_2$ (2);

$Cl_2 + 2KI \rightarrow 2KCl + I_2$ (3);

$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$ (4).

NaOH solution is used for absorbing Cl_2 and starch solution is used as the indicator for the formed I_2.

In a typical procedure, a sealed three-electrode glass cell is used for the CER at a potential of 1.60 V vs RHE. 5 mL gas was drawn off with a syringe every half an hour and then injected into a 100mL flask which is sealed with a rubber stopper and contains 25 mL NaOH solution (0.2 mmol/mL). Then keep stirring for 10 mins to make the Cl_2 reacted with NaOH solution. Then 2g KI and 5 mL HCl solution (2 mmol/mL) was added into the NaOH solution and keep stirring for 5 mins in the dark. $Na_2S_2O_3$ solution ($c_{Na2S2O3}$ =0.1mmol/mL) was dripped into with a burette until the solution turn into light yellow solution. Then 2 mL starch indicator (0.002g/mL) was added and the solution become blue. Continue dripping the $Na_2S_2O_3$ solution until the blue color disappearing. The dosage of $Na_2S_2O_3$ solution was marked as V(mL).

The Faradic efficacy of Cl_2 evolution:

$$\eta = \frac{\frac{V_{gas}}{5} \times \frac{c_{Na2S2O3} \times V}{1000} \times 6.02 \times 10^{23}}{\frac{j \times t}{6.24 \times 10^{-19}}} \times 100\%$$

In this formula, j is the current(A); t is the reaction time(s); Vgas is the total value (mL) of gases in the cell.

2. Supplementary Figures

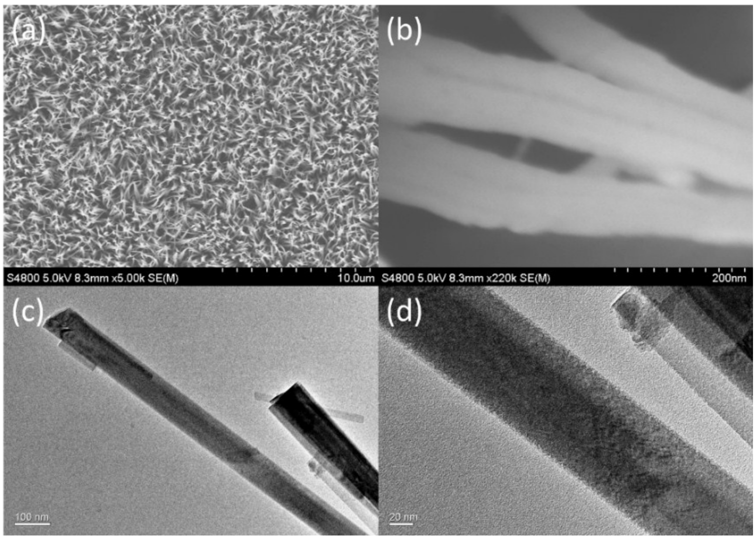

Figure S1. (a, b) SEM and (c, d) TEM images of the Co_3O_4 NBA precursor.

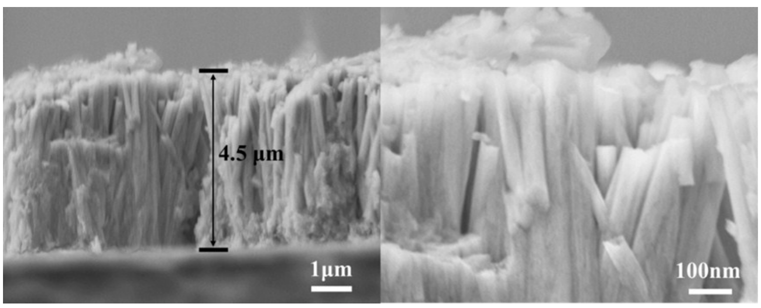

Figure S2. Side SEM images of the Co_3O_4 anode.

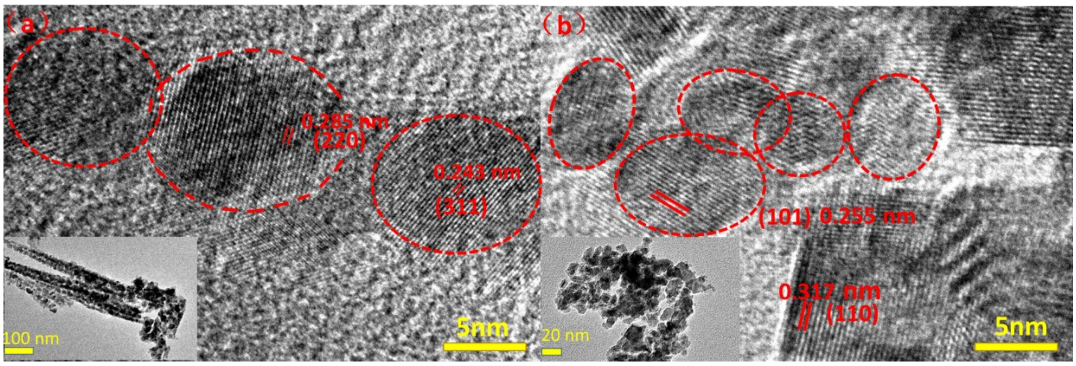

Figure S3. High magnification TEM images of the Co_3O_4 (a) and (b) RuO_2. The insert images are the low magnification TEM images of Co_3O_4 and RuO_2.

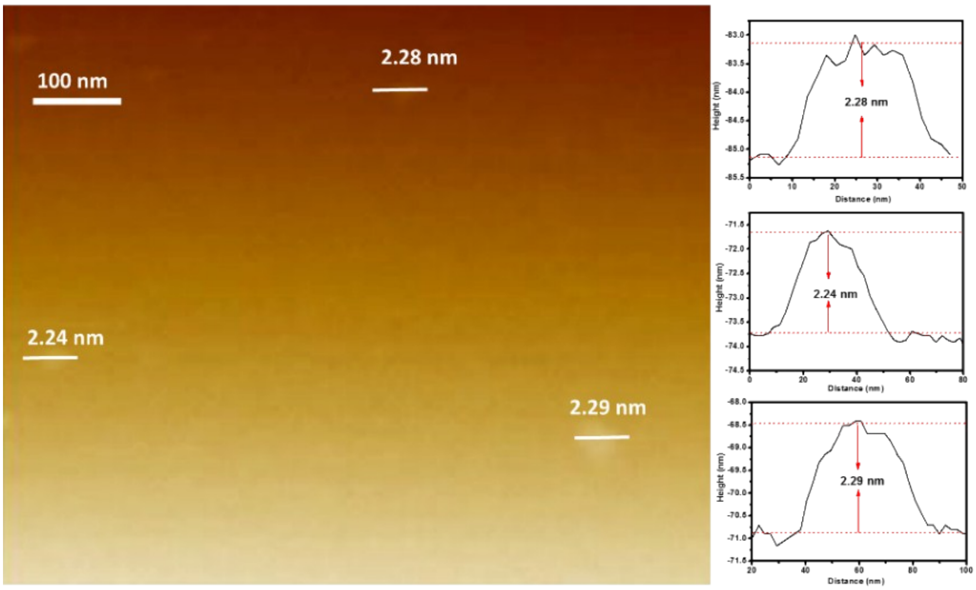

Figure S4. AFM image of the Co_3O_4 anode.

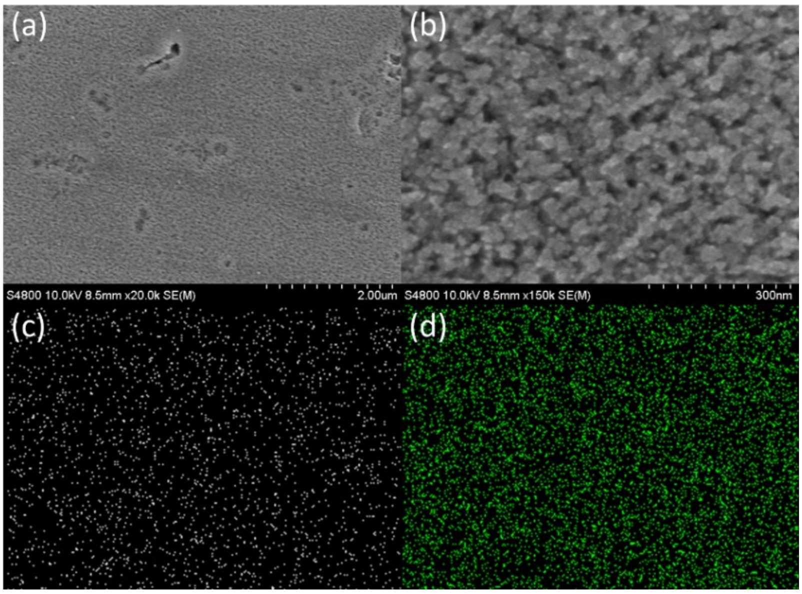

Figure S5. (a, b) SEM images of the RuO_2 anode. EDS images of the RuO_2 anode for (c) Ru and (d) O.

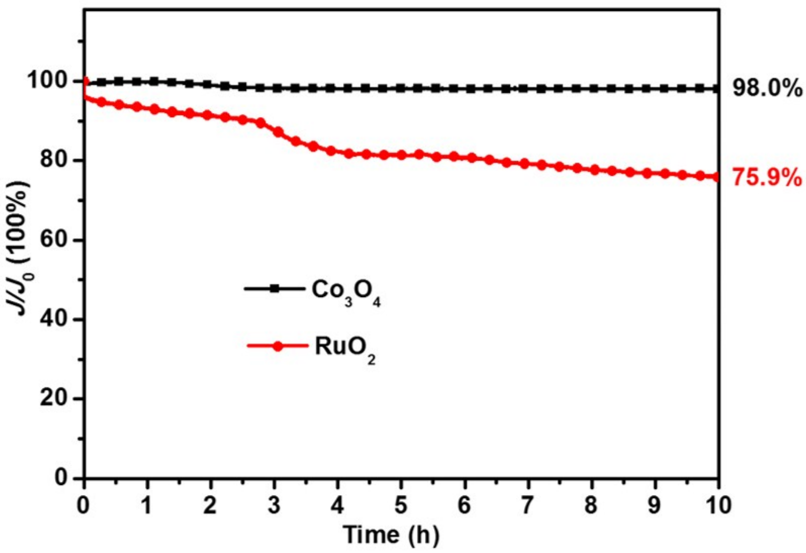

Figure S6. Stability measurements of the Co_3O_4 and RuO_2 anodes for CER at 1.60 V vs RHE.

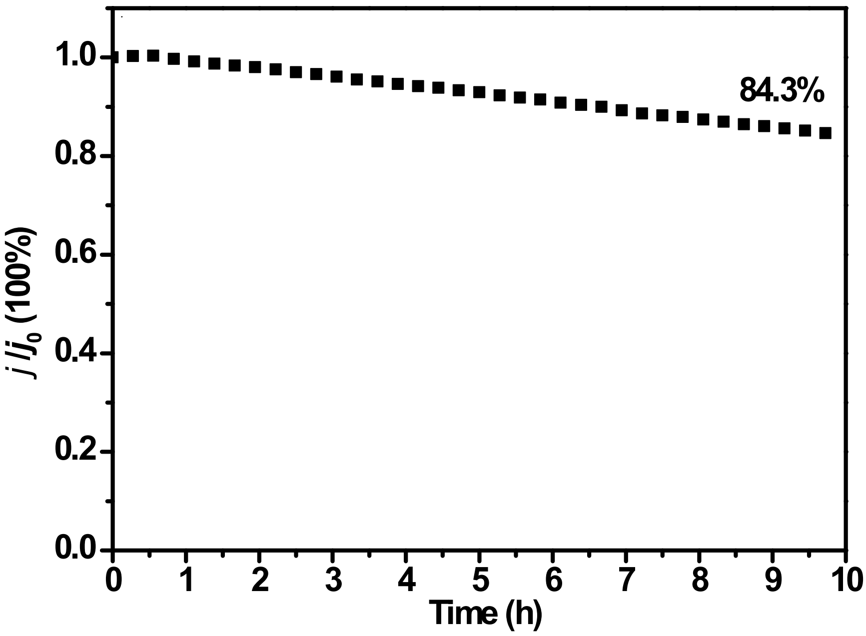

Figure S7. Stability test of the Co_3O_4 anode for OER in 1M KOH.

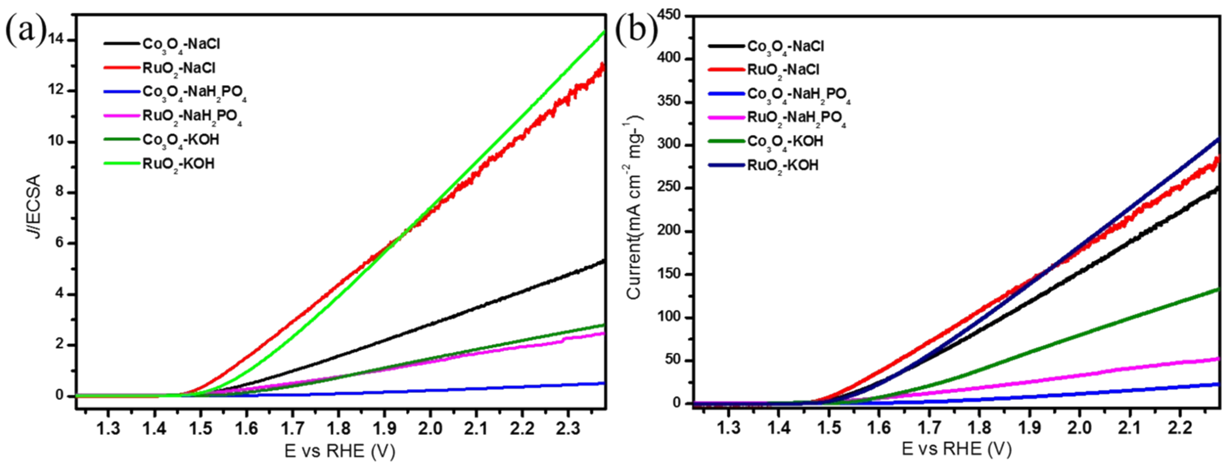

Figure S8. CER polarization curves of Co_3O_4 and RuO_2 electrodes normalized into ECSA(a) and catalysts mass(b).

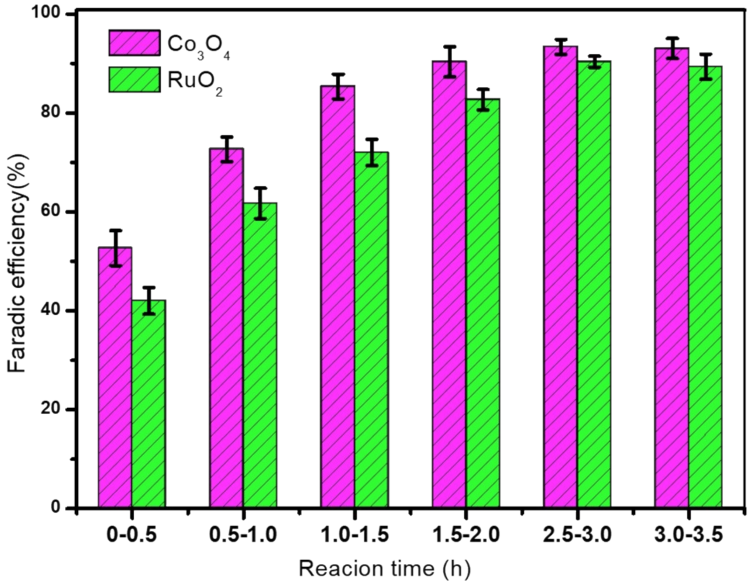

Figure S9. Faradic efficiency results for Cl_2 evolution of Co_3O_4 electrode and RuO_2 electrode in CER.

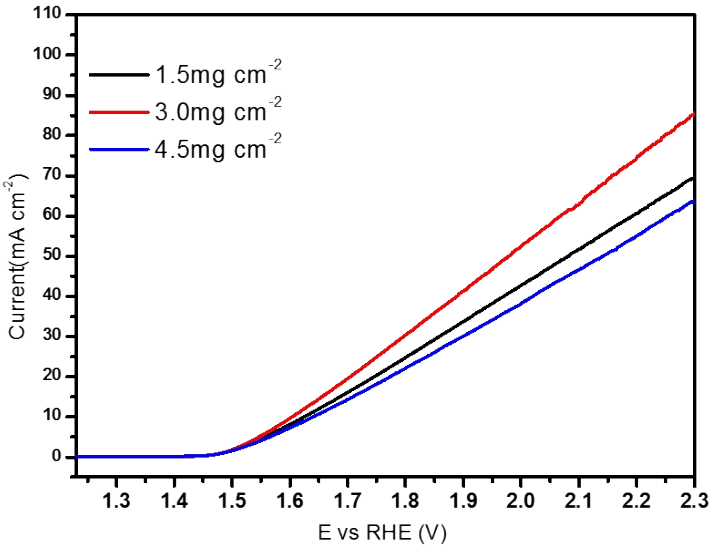

Figure S10. CER polarization curves of RuO_2 electrode with loading different amount of RuO_2.

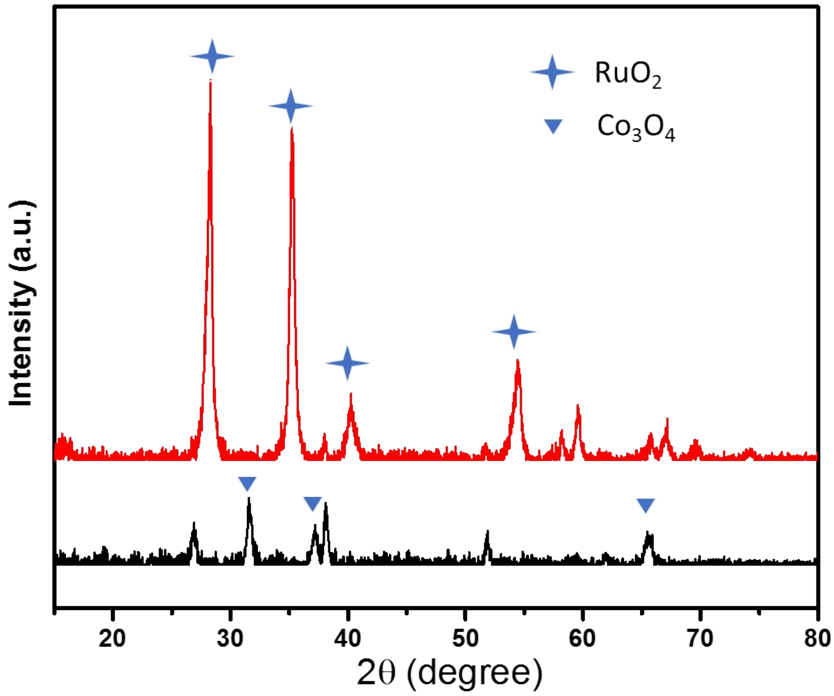

Figure S11. XRD pattern of RuO_2 electrode and Co_3O_4 electrode.

Table S1.Comparison of the electrochemical OER properties of Co3O4 with previous reports (In order to eliminate the influence coming from the BET surface area of the substrates, all the comparison electrodes were prepared on flat substrate).

Catalyst	Onset potential (V vs. RHE)	Potential @10 mA cm^{-2} (V vs. RHE)	Electrolyte	Substrate	Reference
Co_3O_4 nanobelt	1.52	1.65	1 M KOH	FTO	**This Work**
Graphene-CoO	N.A.	1.65	1 M KOH	glassy carbon	S1
Co_3O_4 nanoparticles	1.58	1.74	0.1 M KOH	glassy carbon	S2
Co_3O_4/Carbon Nanotubes	N.A.	>1.80	1 M KOH	ITO	S3
Mesoporous Co_3O_4	N.A.	1.75	0.1 M KOH	Gold disk	S4
mesoporous Co_3O_4 spinels	N.A.	1.64	0.1 M KOH	glassy carbon	S5
Co_3O_4/ N and B doped graphene	1.60	>1.70	0.1 M KOH	glassy carbon	S6
Co_3O_4/Co_2MnO_4 nanocomposites	N.A.	1.77	0.1 M KOH	glassy carbon	S7
Co_3O_4 tubes	N.A.	1.67	0.1MNaOH	glassy carbon	S8
Co_3O_4	1.64	1.70	1 M KOH	glassy carbon	S9

Co_3O_4 nanospheres	N.A.	1.63	0.1 M KOH	glassy carbon	S10
Co_3O_4 nanowires	1.58	>1.8	1 M KOH	glassy carbon	S11
Co_3O_4 honeycomb	~1.50	1.68	0.1 M KOH	glassy carbon	S12

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