Electronic Supplementary Material (ESI) for RSC Advances.

Two-step facile synthesis of Co_3O_4@C reinforcing PbO_2 coated electrode to promote efficiently oxygen evolution reaction for zinc electrowinning

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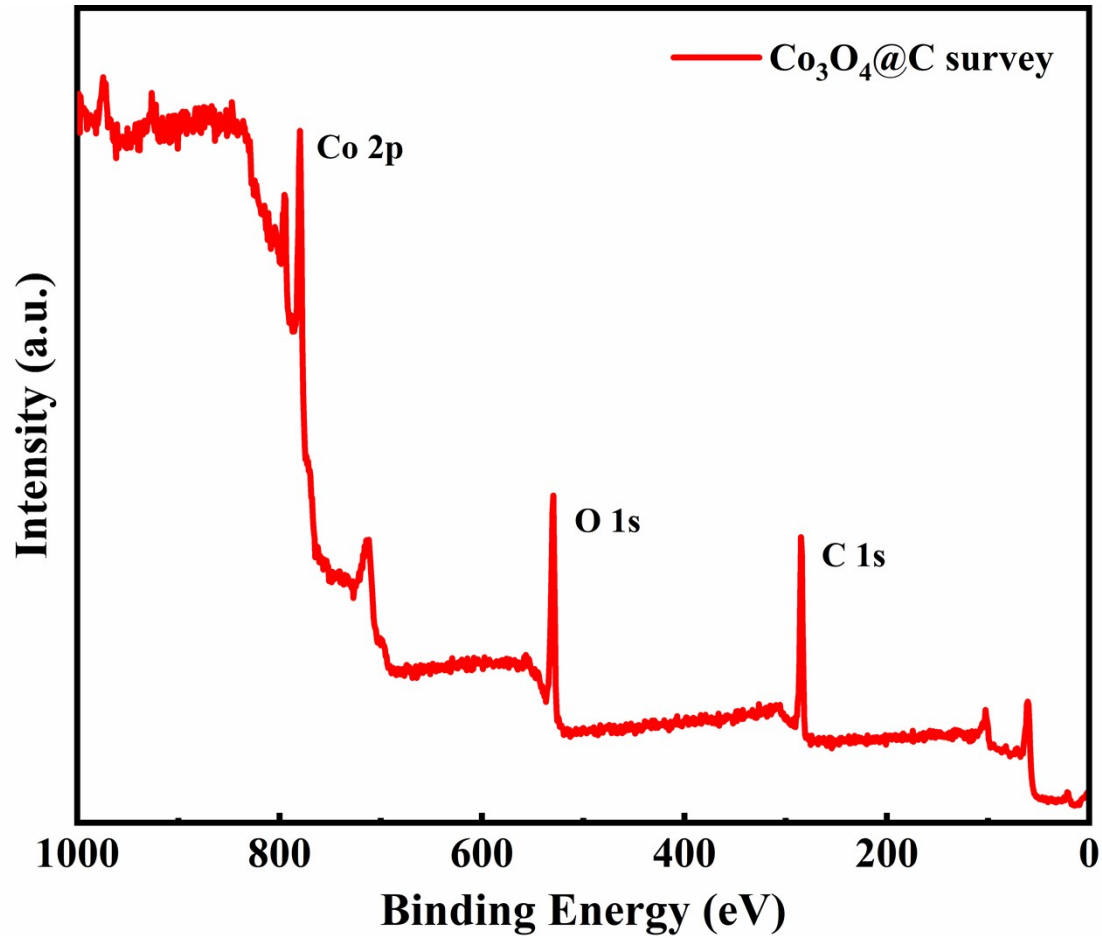

Fig. S1 The full XPS spectrum.

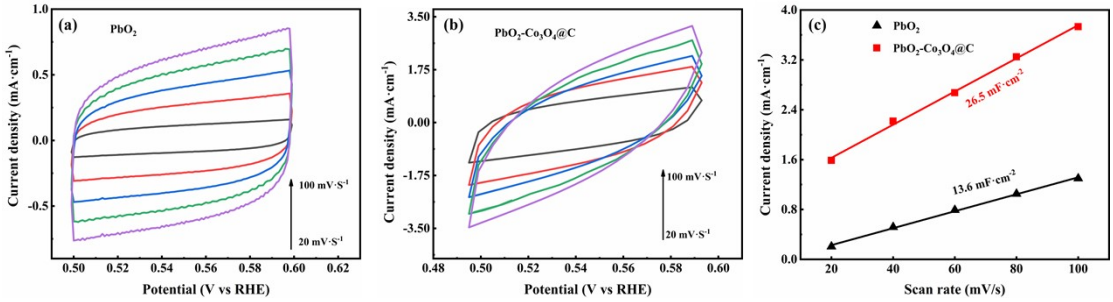

Fig. S2 CV curves of (a) PbO_2 and (b) PbO_2-Co_3O_4@C deposit at different scan rates; and (c) Double-layer capacitance measurements for determining electrochemically active surface area of PbO_2 and PbO_2-Co_3O_4@C deposit.

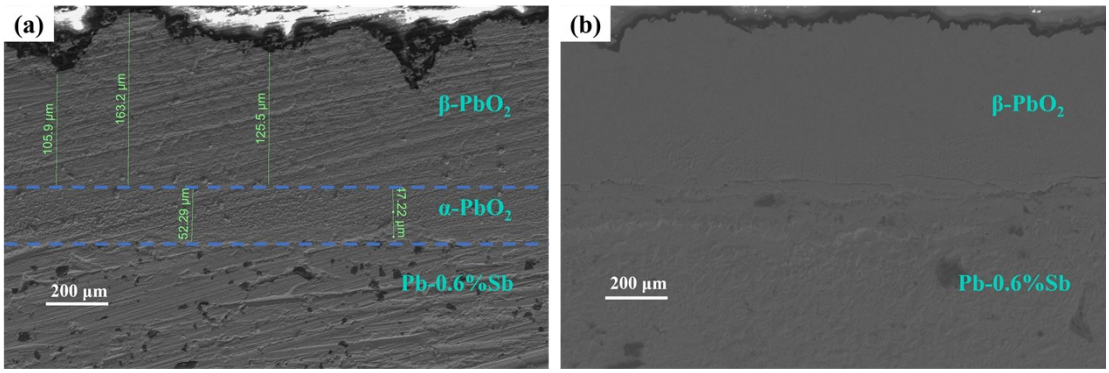

Fig. S3 Cross-section SEM images of (a) Pb-0.6%Sb/α-PbO_2/β-PbO_2 and (b) Pb-0.6%Sb/β-PbO_2.

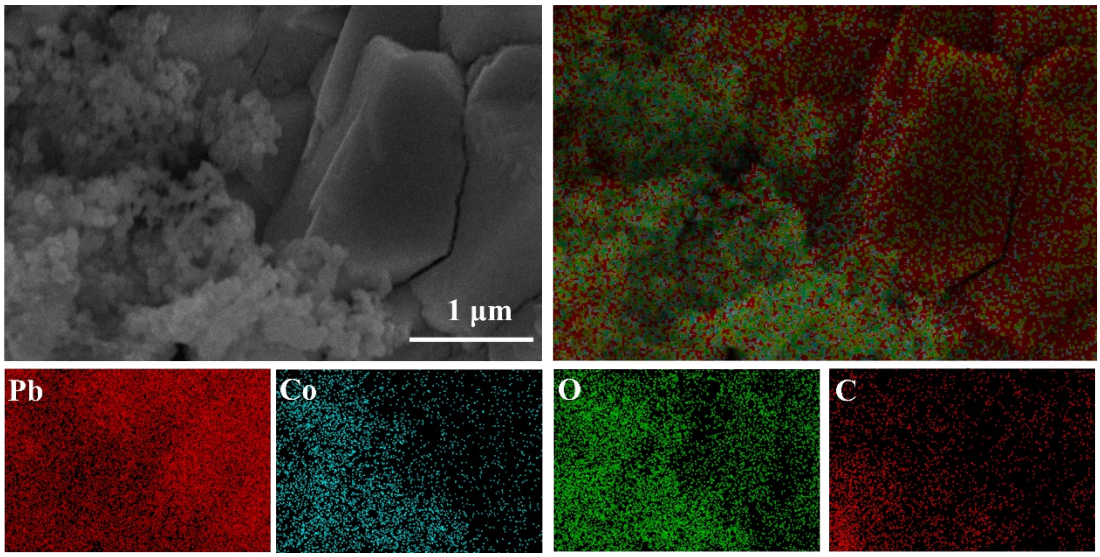

Fig. S4 The SEM image and element mapping of PbO_2-Co_3O_4@C deposit.

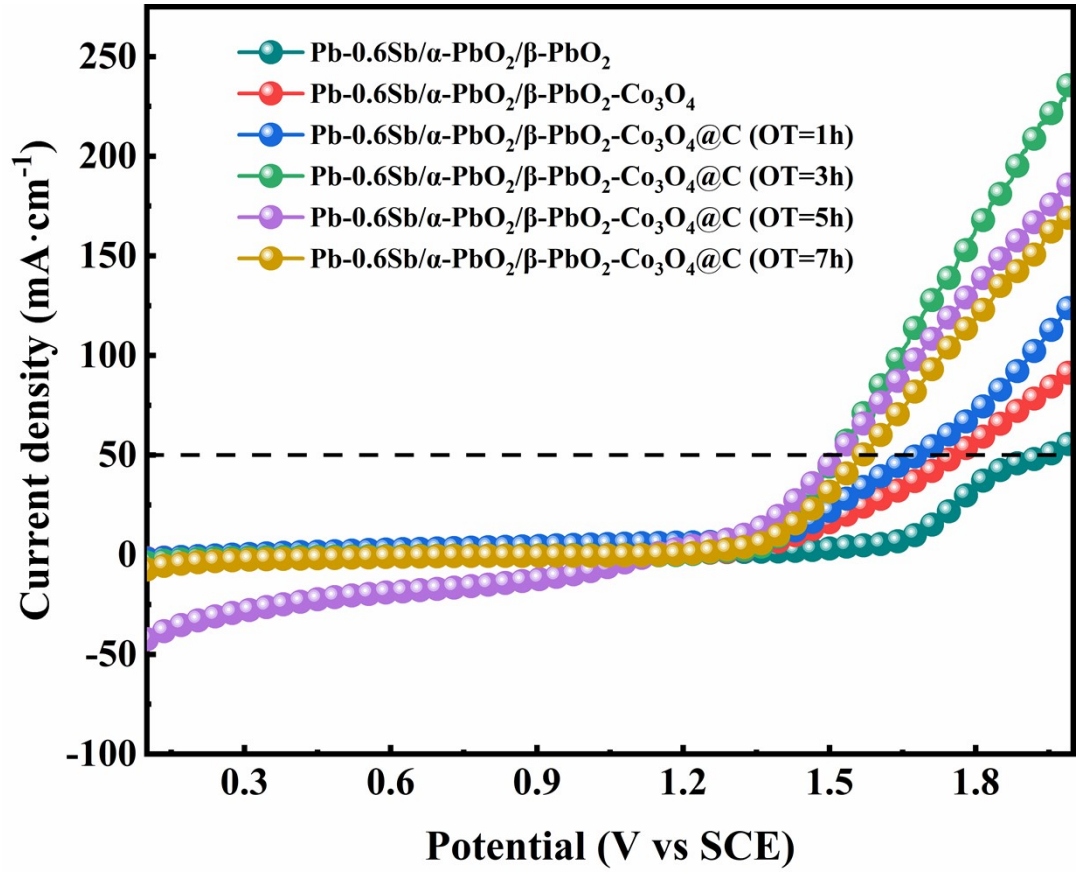

Fig. S5 The LSV curves of PbO_2 coated electrodes without and with reinforcement of different Co_3O_4@C composite.

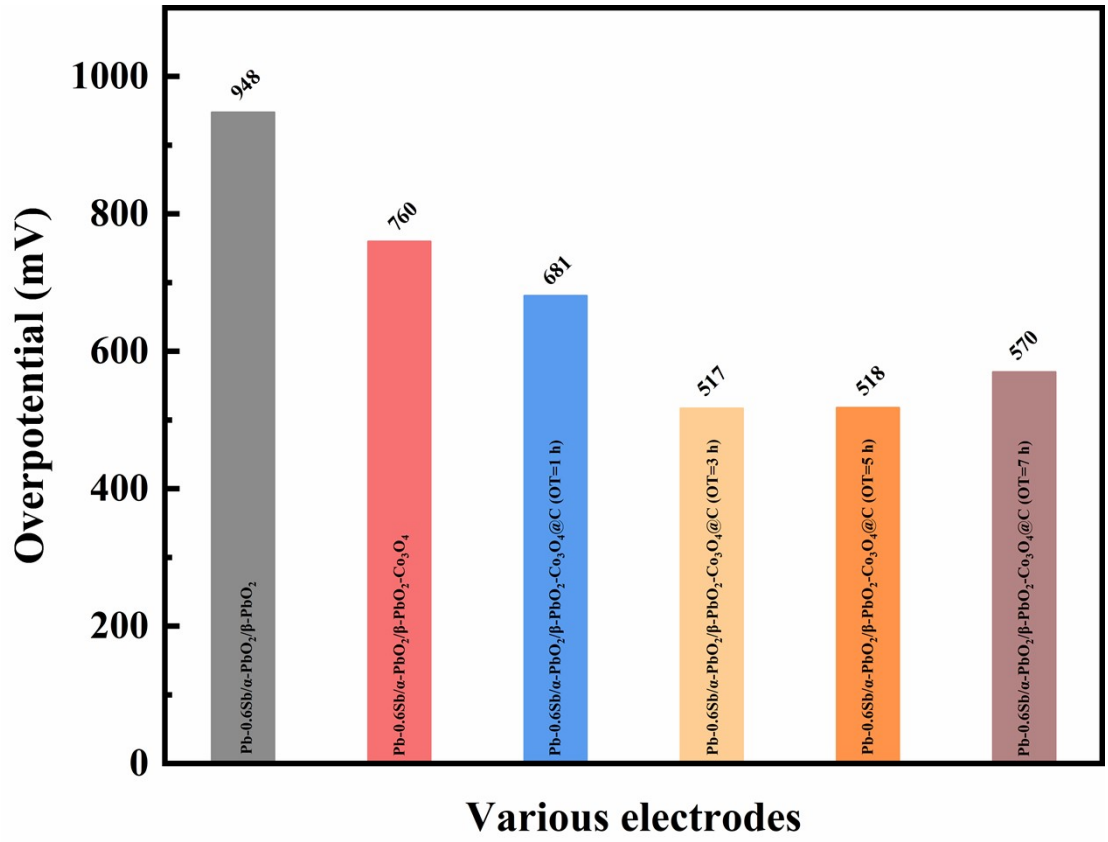

Fig. S6 The OER overpotential of different electrodes.

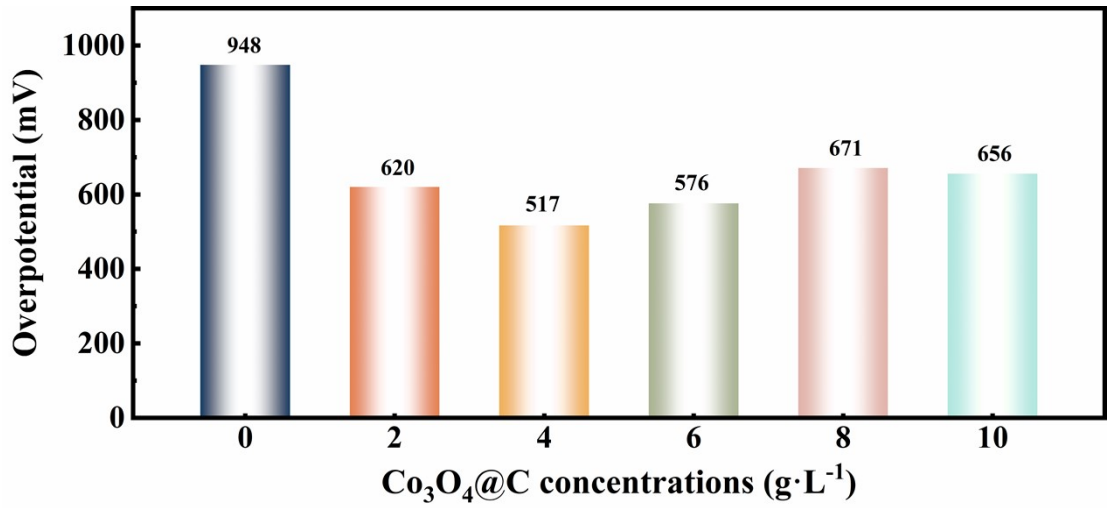

Fig. S7 The relationship between Co_3O_4@C concentration and overpotential at 500 $A \cdot m^{-2}$.

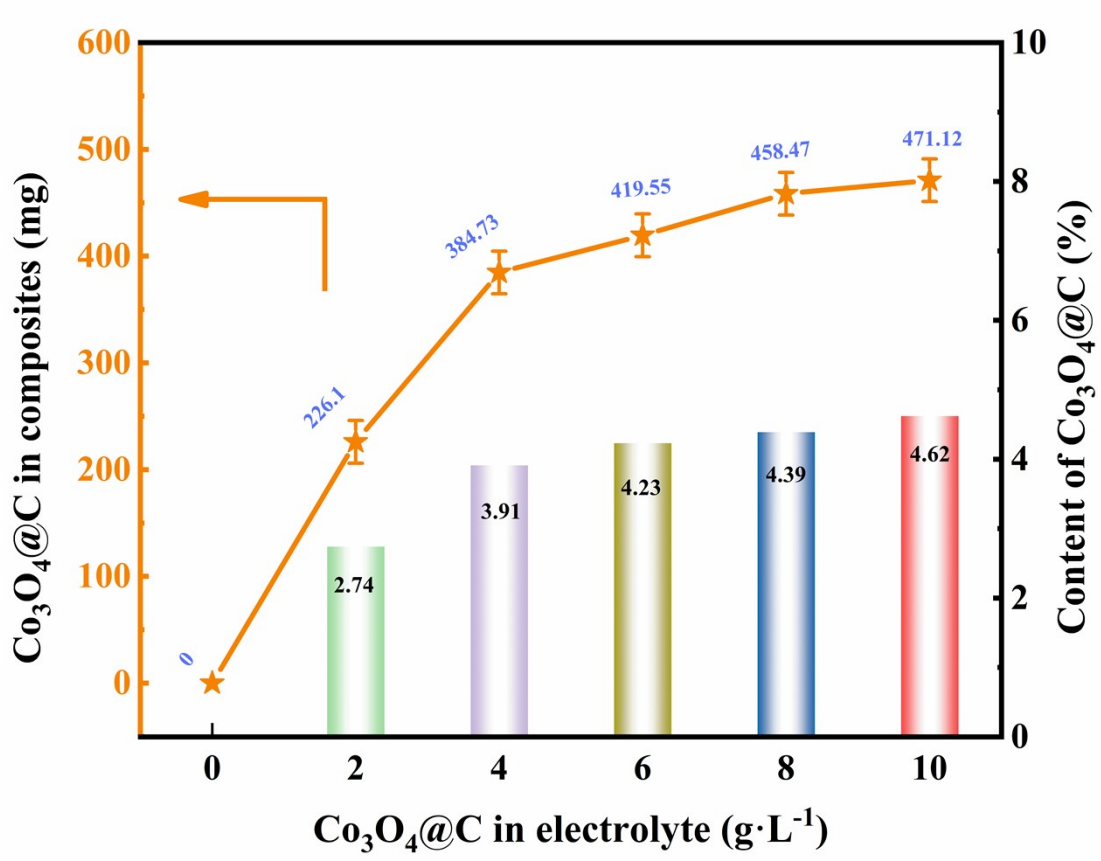

Fig. S8 The graph between Co_3O_4@C in electrolyte and in coated electrode.

Table. S1 Parameters involved in the Tafel fitting of the prepared coated electrodes.

Concentration (g L^{-1})	a	b	R^2
0	1.197	0.487	0.997
2	0.806	0.183	0.996
4	0.714	0.156	0.998
6	0.789	0.167	0.996
8	0.928	0.209	0.997
10	0.923	0.196	0.997

Table. S2 Related circuit parameters for PbO_2 electrodes with various Co_3O_4@C concentrations according to the EIS shown in Fig. 6(d).

concentrations	R_s Ω	R_f Ω	n_1	CPE1 Yo [S-sec^n]	R_{ct} Ω	n_2	CPE2 Yo [S-sec^n]
0	1.03	0.65	0.896	0.016	19.45	0.887	2.229×10-5
2	0.87	0.70	0.875	0.021	3.17	0.889	6.366×10-5
4	0.84	0.12	0.871	0.025	2.18	0.892	6.203×10-5
6	0.85	0.68	0.850	0.022	2.82	0.872	7.847×10-5
8	0.92	0.63	0.876	0.019	9.27	0.879	5.786×10-5
10	0.90	0.71	0.862	0.023	4.19	0.894	6.213×10-5

Table. S3 Comparison of the overpotential of various electrodes at 500 $A \cdot m^{-2}$

Electrodes	Concentration of H_2SO_4	η (mV)	Reference
Bi-PbO_2	0.5M	1046	[1]
Pb-0.76%Ag	1.53M	1038	-
Al/Pb-PANI-WC	1.53M	941	[2]
Pure Pb	1.8M	936	[3]
CF/PbO_2	1.53M	931	[4]
PANI/CeO_2/WC	1.53M	856	[5]
PbO_2-CeO_2	1.63M	826	[6]
Ti/Cu-PbO_2	0.5M	751	[7]
Pb-0.3Ag/PbO_2-Co_3O_4	1.53M	747	[8]
Ti/TiO_2-NTs/PbO_2	1.53M	630	[9]
Pb-0.6Sb/α-PbO_2/β-PbO_2-Co_3O_4@C	1.53M	517	This work

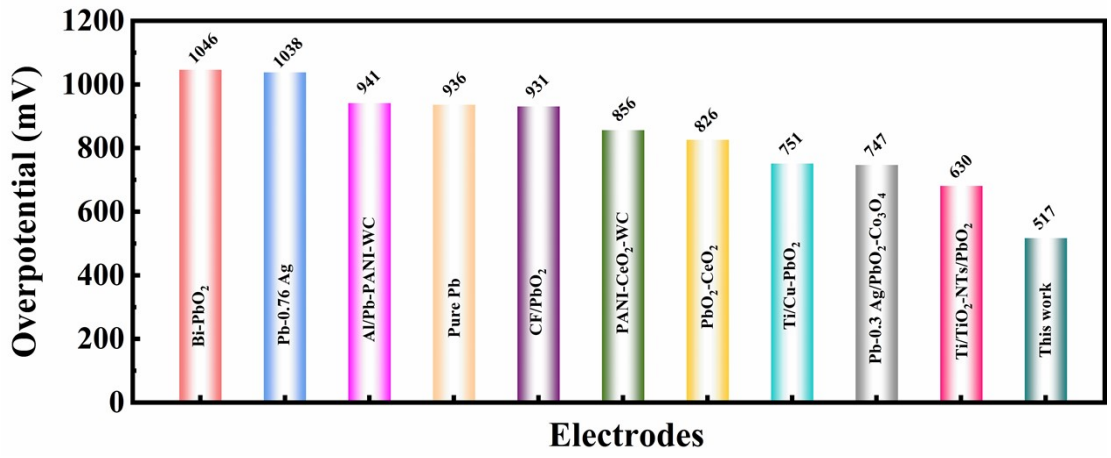

Fig. S9 The comparison chart of the overpotential of various works at 500 A m^{-2}.

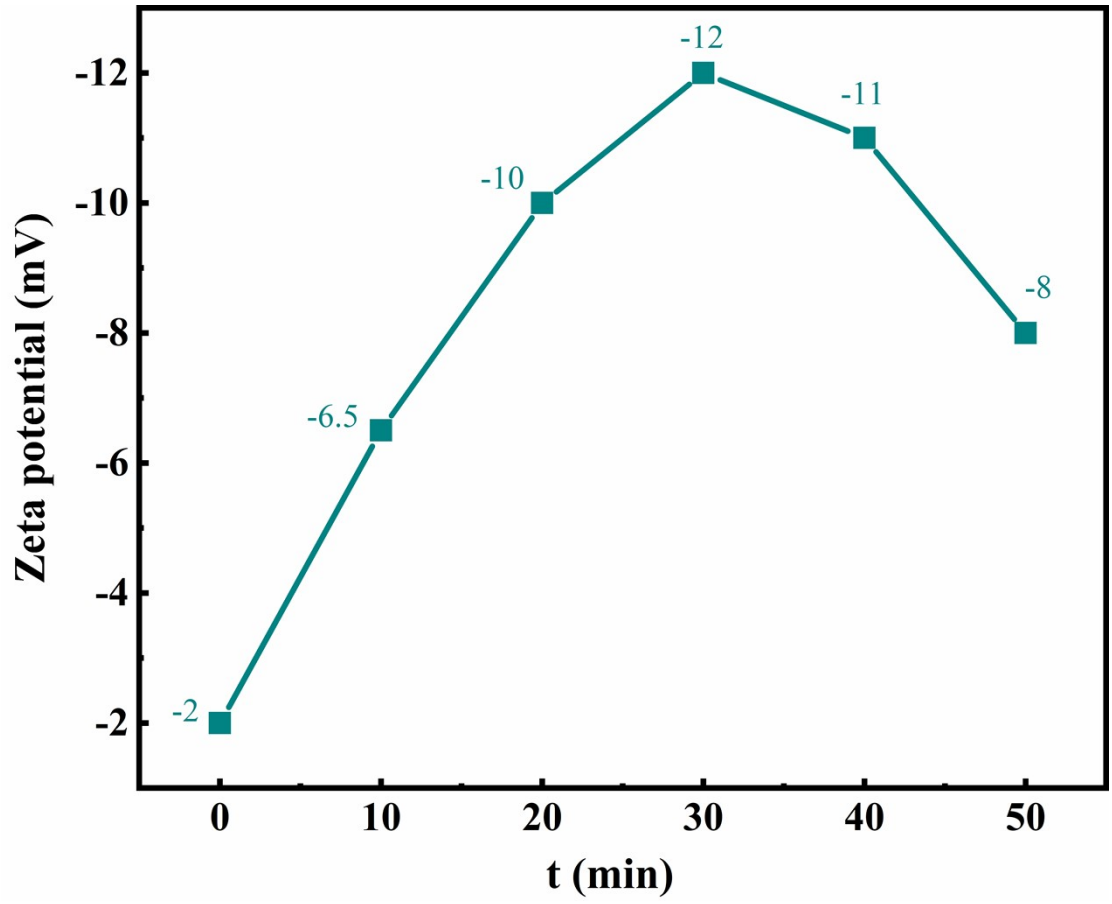

Fig. S10 The zeta potential of Co_3O_4@C particles in β-PbO_2 plating bath at different ultrasonic dispersion time.

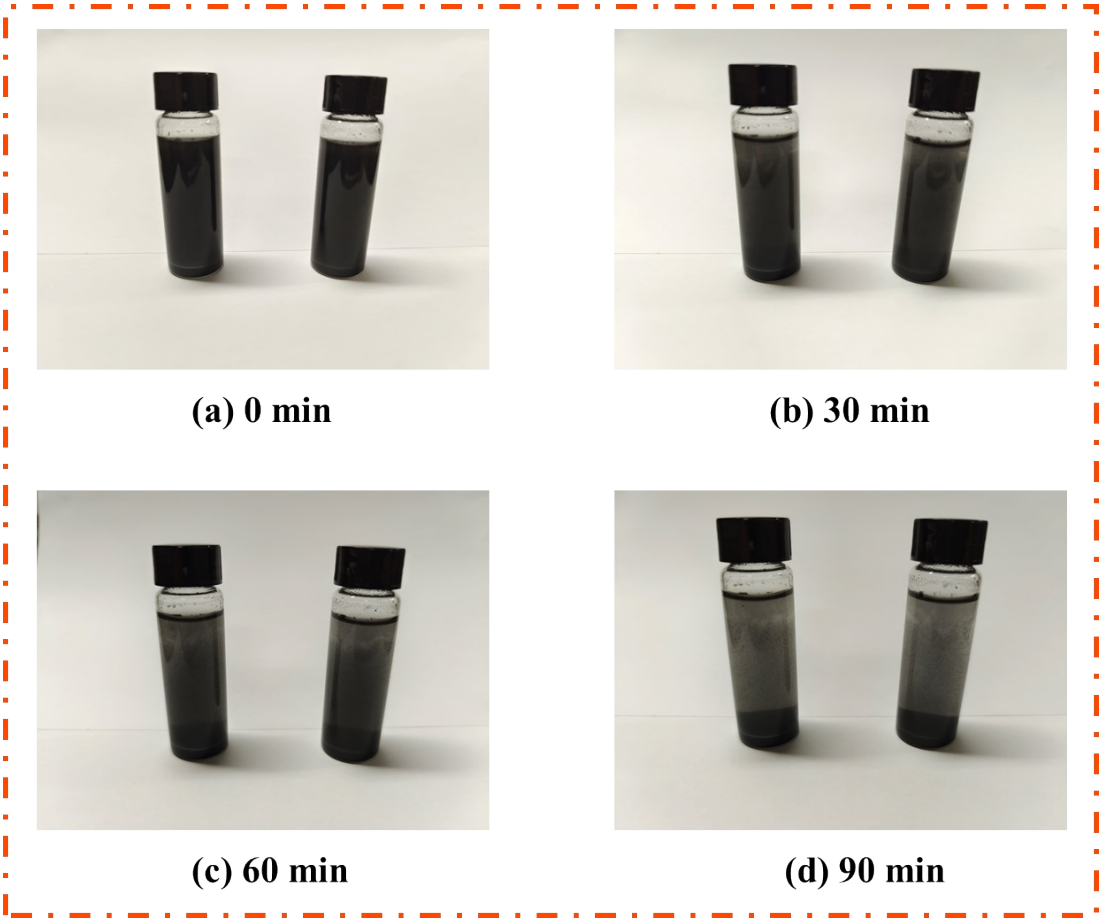

Fig. S11 Photographs of sedimentation of Co_3O_4@C particles in β-PbO_2 plating bath.

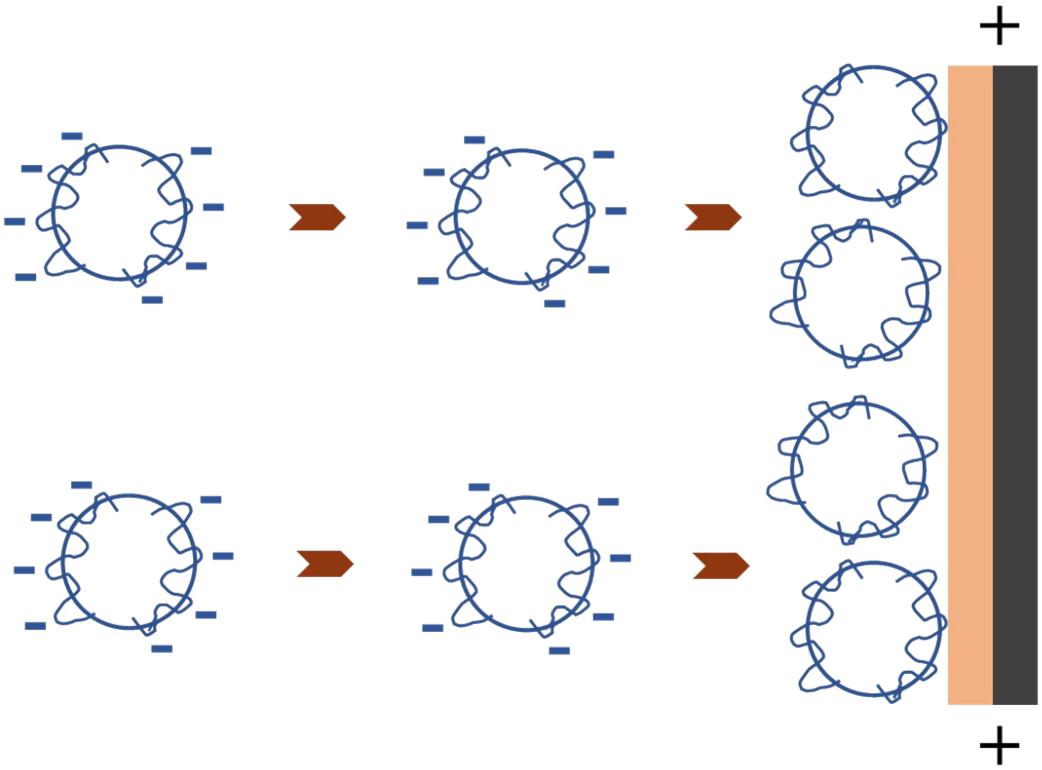

Fig. S12 Diagram of the migration of Co_3O_4@C particles on the electrode surface.

References

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