Supplementary Information

Improvement of chlorine evolution activity of SnO_x@IrO_2-Ta_2O_5 electrode and its application in electrolysis of extremely dilute chlorine-containing solution

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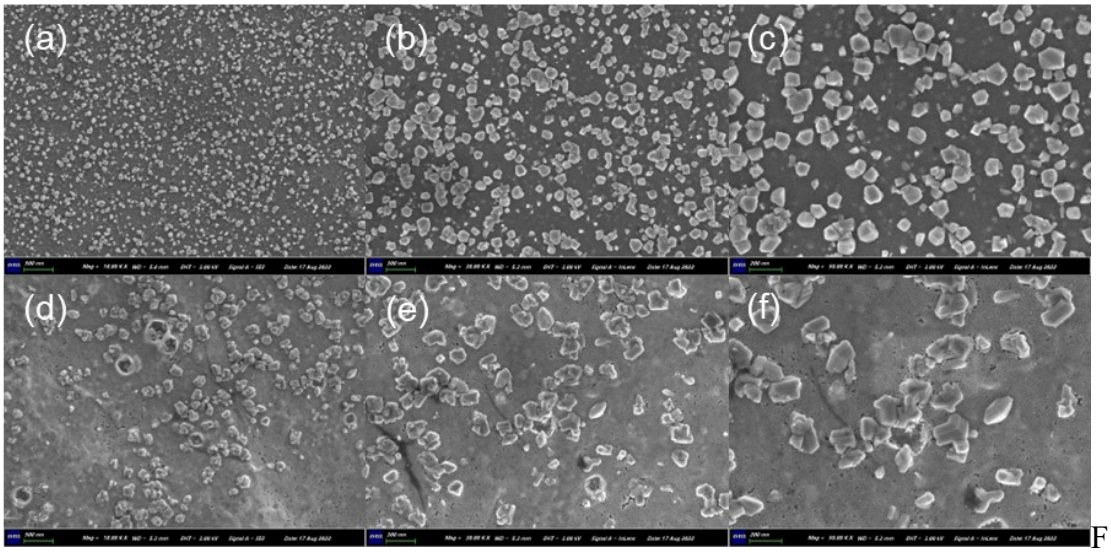

Figure S1 The SEM images of IrO_2-Ta_2O_5 (a-c) and SnO_x@IrO_2-Ta_2O_5-3 (d-f) electrodes.

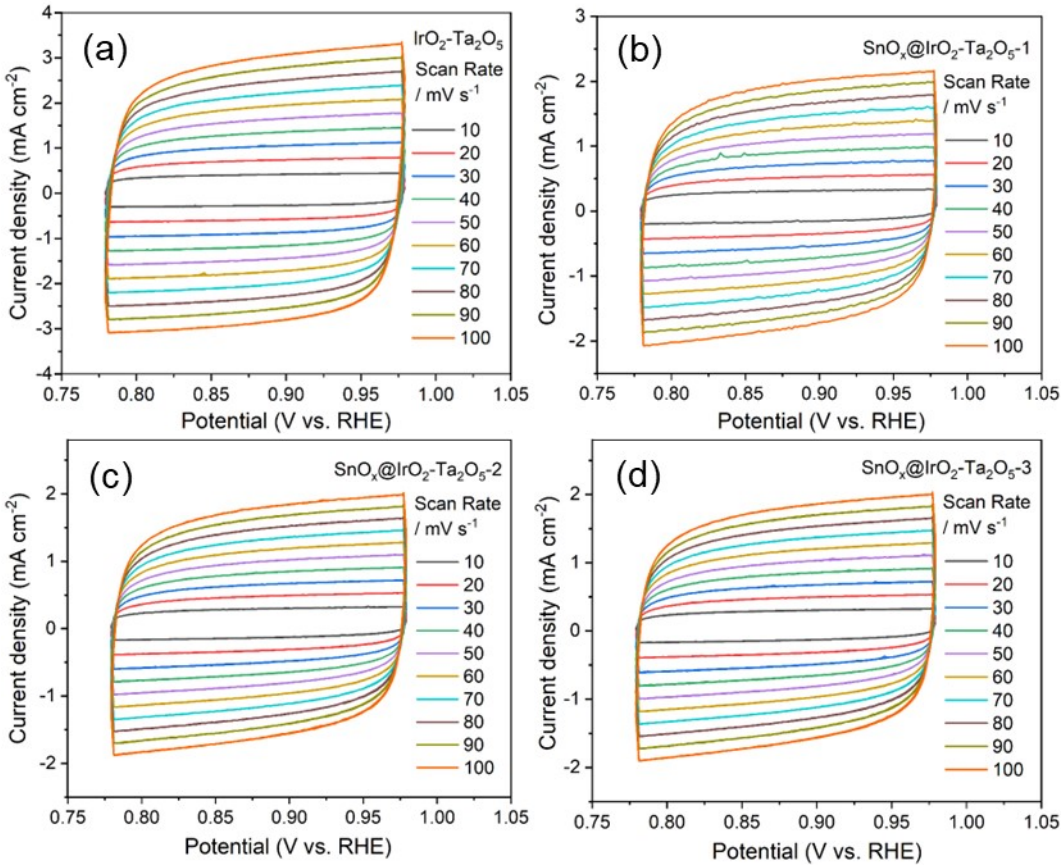

Figure S2 The cyclic voltammograms of IrO_2-Ta_2O_5 (a) and SnO_x@IrO_2-Ta_2O_5-1(2,3) (b-d) electrodes with different scan rate at potential of 0.78 ~ 0.98 V.

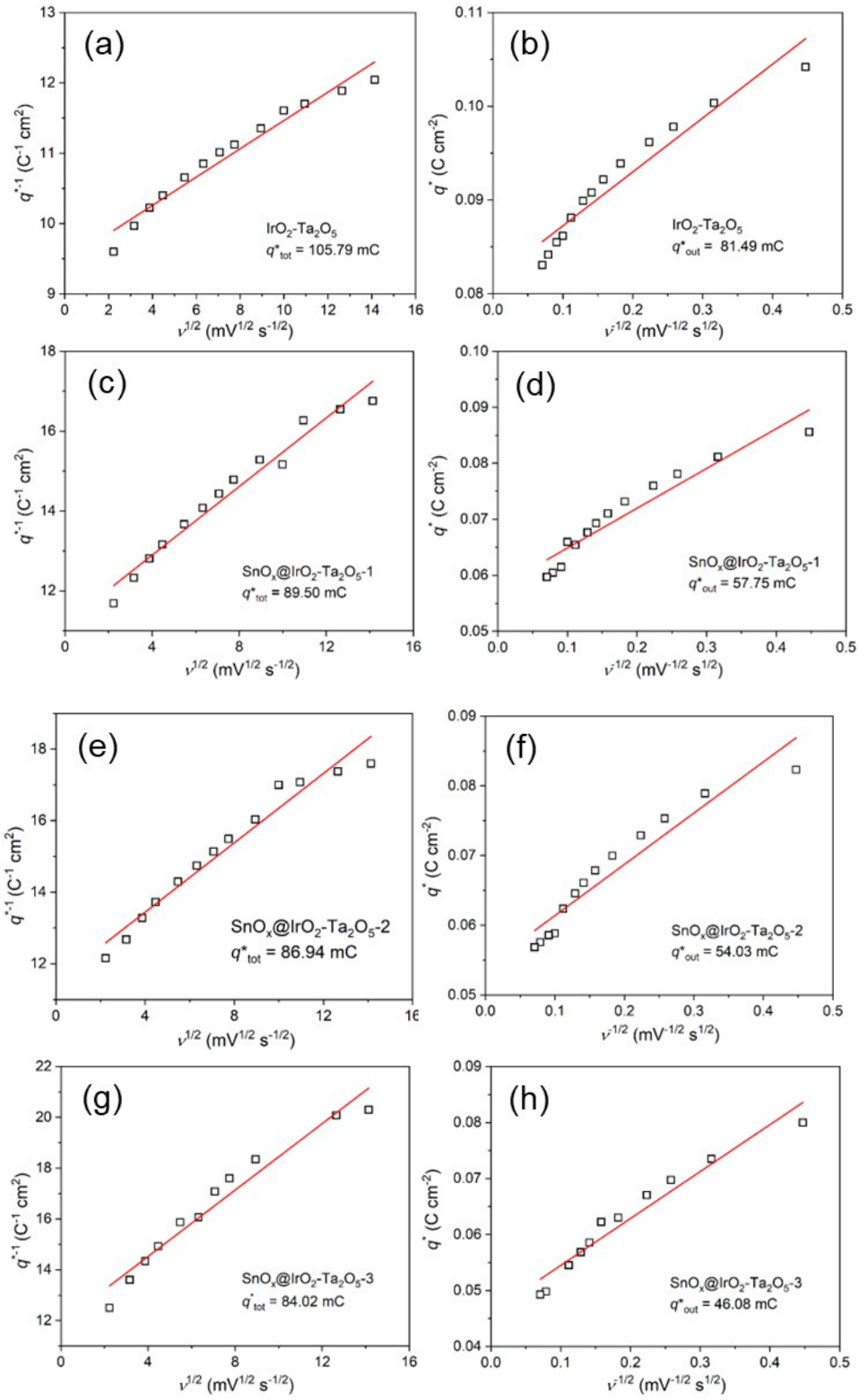

Figure S3 The total surface charge (q^*_{tot}) and outer surface charge (q^*_{out}) of IrO_2-Ta_2O_5 (a-b) and SnO_x@IrO_2-Ta_2O_5-1(2,3) (c-h) electrodes.

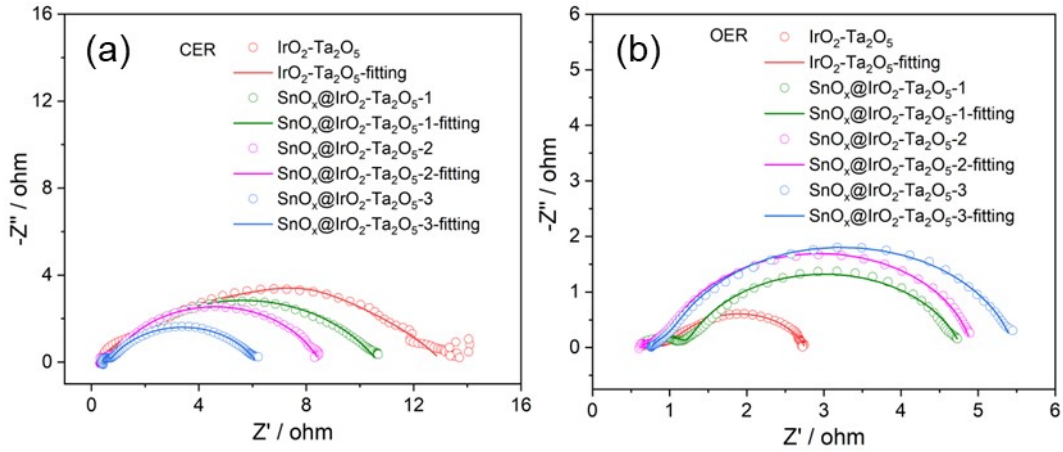

Figure S4 The electrochemical impedance spectroscopy (EIS) measurements of IrO_2-Ta_2O_5 and SnO_x@IrO_2-Ta_2O_5-1(2,3) electrodes at 1.48 V in the CER (a) and at 1.64 V OER (b).

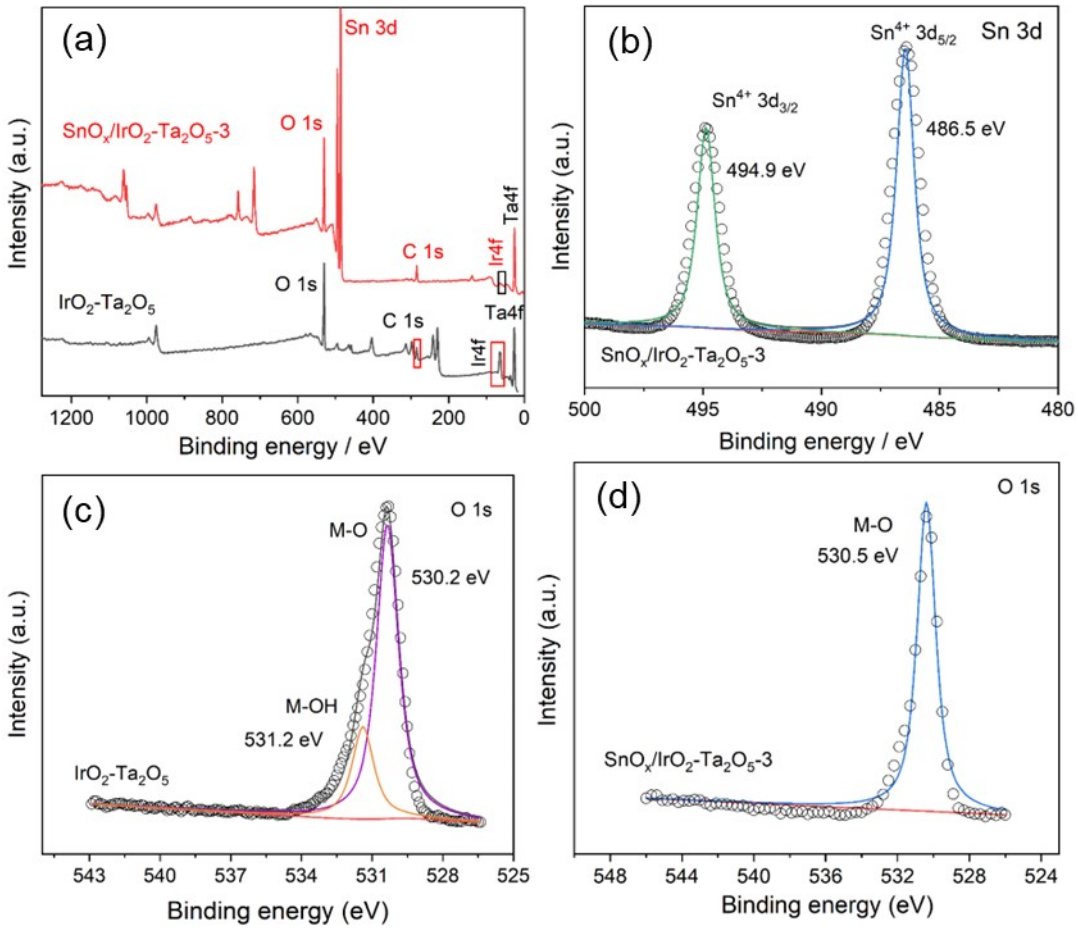

Figure S5 The XPS whole spectra of IrO_2-Ta_2O_5 (c) and SnO_x@IrO_2-Ta_2O_5-3 (a). The XPS core-level spectra of Sn 3d obtained from SnO_x@IrO_2-Ta_2O_5-3 (b). The XPS core-level spectra of O 1s obtained from IrO_2-Ta_2O_5 (c) and SnO_x@IrO_2-Ta_2O_5-3 (d).

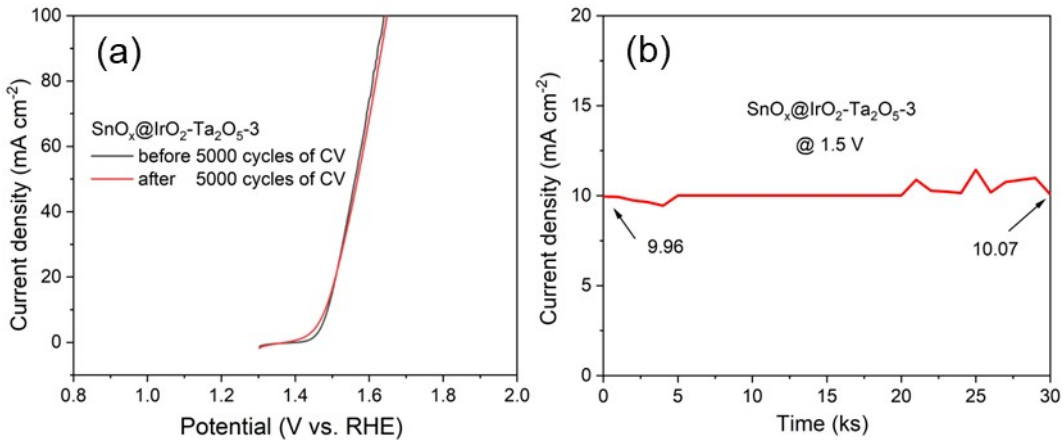

Figure S6 The accelerated lifetime tests of SnO_x@IrO_2-Ta_2O_5-3 electrode after 5000 cycles of CVs (a) and the 30 ks of chronoamperometry testing (b).

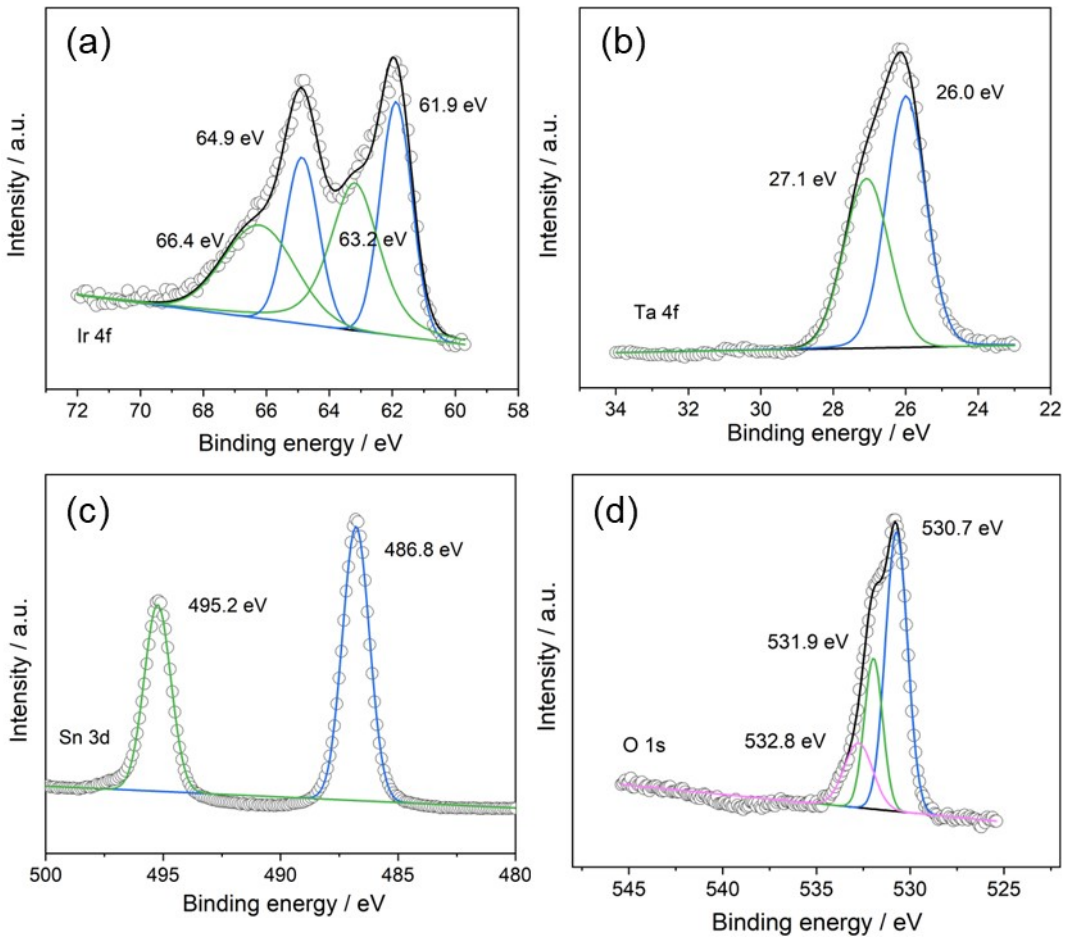

Figure S7 The XPS core-level spectra of Ir 4f (a), Ta 4f (b), Sn 3d (c) and O1s (d) obtained from SnO_x@IrO_2-Ta_2O_5-3 electrode after accelerated service life test.

Table S1 The loading of Ir, Ta and Sn of the IrO_2-Ta_2O_5 and SnO_x@IrO_2-Ta_2O_5 electrodes by XRF

Electrode	Ir:Ta:Sn (molar ratio)	The loading / μg cm^{-2}		
		Ir	Ta	Sn
IrO_2-Ta_2O_5		169.40	138.52	
SnO_x@IrO_2-Ta_2O_5-1	4.2:5.0:0.8	109.40	138.36	24.01
SnO_x@IrO_2-Ta_2O_5-2	3.7:5.0:1.3	123.16	146.12	41.22
SnO_x@IrO_2-Ta_2O_5-3	3.3:5.0:1.7	127.31	152.31	54.17

Table S2 Fitting parameters of equivalent circuit of IrO_2-Ta_2O_5 and SnO_x@IrO_2-Ta_2O_5-1(2,3) electrodes

Reaction	Electrodes	R_s/Ω cm^2	R_{ct}/Ω cm^2
CER	IrO_2-Ta_2O_5	0.370	11.0
	SnO_x@IrO_2-Ta_2O_5-1	0.413	10.1
	SnO_x@IrO_2-Ta_2O_5-2	0.367	7.81
	SnO_x@IrO_2-Ta_2O_5-3	0.425	5.54
OER	IrO_2-Ta_2O_5	0.697	1.99
	SnO_x@IrO_2-Ta_2O_5-1	0.630	3.56
	SnO_x@IrO_2-Ta_2O_5-2	0.581	3.76
	SnO_x@IrO_2-Ta_2O_5-3	0.763	4.44