

Electronic Supplementary Information (ESI) for Journal of Materials Chemistry C

Time-resolved XAS studies reveal sequential oxidative-reductive formation of Na-doped iridium oxide film with enhanced bio-stimulating performance

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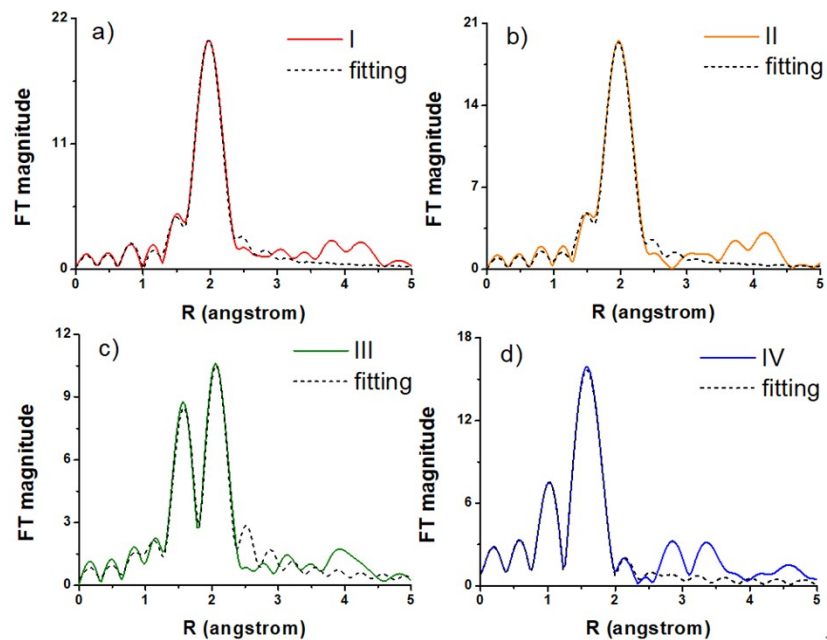


Fig. S1 The k^3 -weighted Fourier-transformed EXAFS profiles of Ir L₃-edge and their respective fitting curves for chemical baths in four distinct stages; a) I: K₃IrCl₆ aqueous solution, b) II: K₃IrCl₆ aqueous solution mixed with KNaC₄H₄O₆, c) III: K₃IrCl₆ aqueous solution mixed with KNaC₄H₄O₆ and NaOH, and d) IV: K₃IrCl₆ aqueous solution mixed with KNaC₄H₄O₆, NaOH, and NaClO.

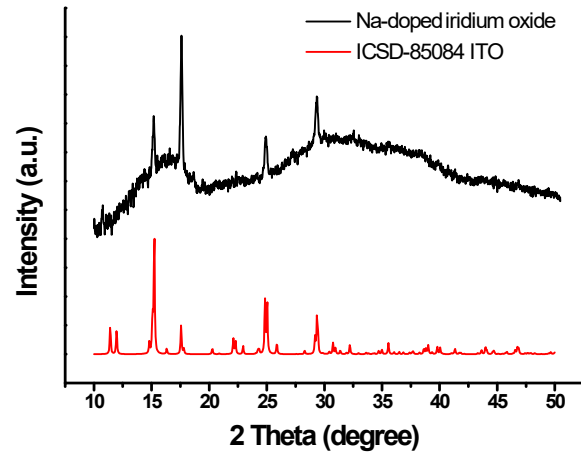


Fig. S2 The XRD pattern of Na-doped iridium oxide and ITO standard.

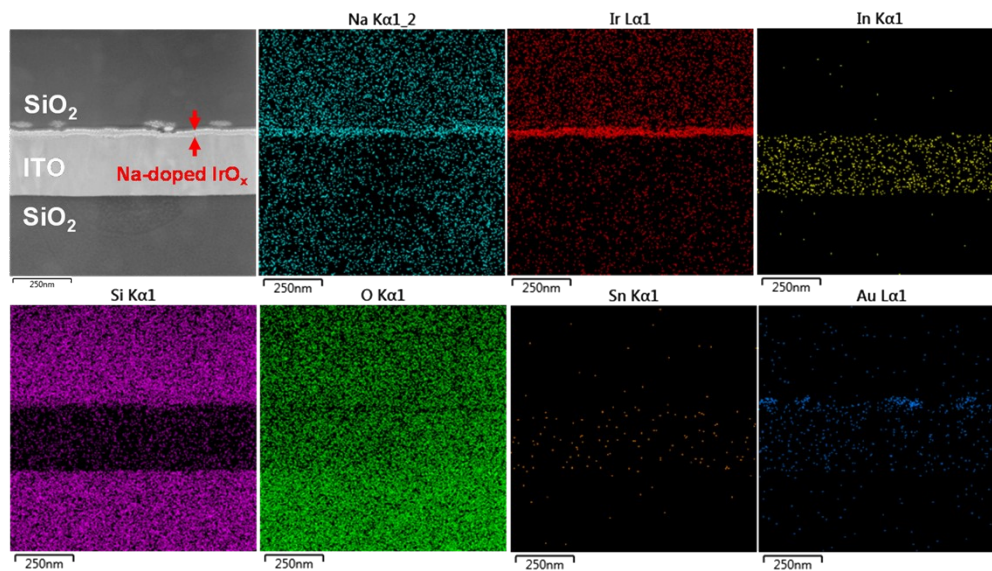


Fig. S3 The TEM image with EDS mapping profiles of Na-doped iridium oxide.

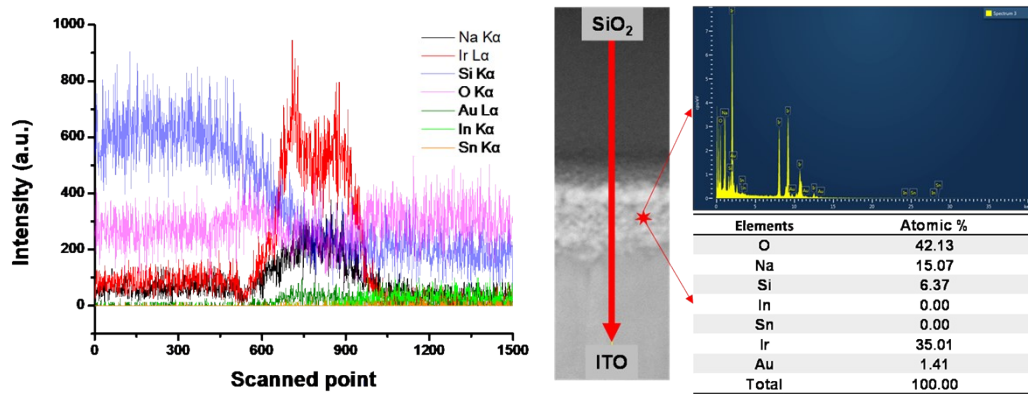


Fig. S4 The TEM/EDS line and point scans for Na-doped iridium oxide.

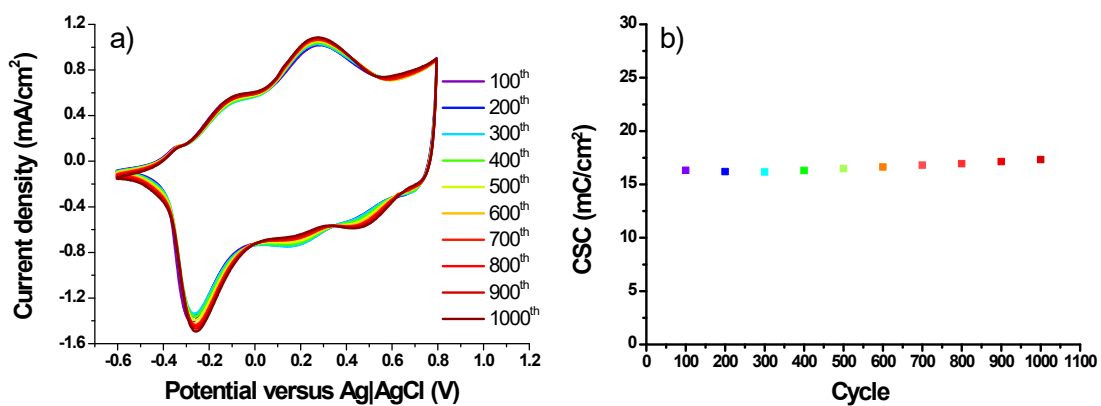


Fig. S5 a) The CV profiles of Na-doped iridium oxide for 1,000 cycles. b) The corresponding CSC as a function of CV cycles.

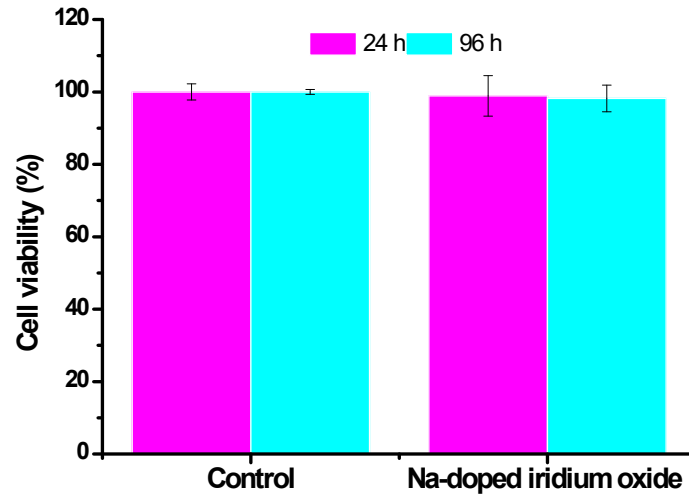


Fig. S6 The cell viability of Na-doped iridium oxide and control group (glass substrate) for 24 and 96 h, respectively.

Table S1 The edge energy shift of Ir L₃-edge XANES profiles from chemical baths in different stages.

Stage	Edge energy shift (subtracted by the absorption energy of standard IrO ₂)
I	-1.93 eV
II	-1.70 eV
III	-1.54 eV
IV	0.84 eV

Table S2 The fitting parameters of Ir L₃-edge EXAFS profiles from chemical baths in different stages.

Stage	Path	N ^a	R (Å) ^b	$\Delta\sigma_j^2 (\times 10^{-3} \text{ \AA}^2)^c$	R-factor ^d
I	Ir-O ^e	1	2.04	3.1	0.013
	Ir-Cl	5	2.35	3.1	
II	Ir-O ^e	1	2.04	11.4	0.005
	Ir-O ^f	1	2.06	11.4	
	Ir-Cl	4	2.35	2.3	
III	Ir-O ^f	1	2.06	4.2	0.006
	Ir-O ^g	3	2.03	4.2	
	Ir-Cl	2	2.37	0.9	
IV	Ir ^V -O ^h	1	1.67	2.8	0.002
	Ir-O ^g	5	1.96	2.0	

a: coordination number, b: bonding distance, c: Debye-Waller factor, d: difference between data and fitting, e: Ir-O^eH₂, f: Ir-O^fOC(OH)C₂H₂(OH)COO⁻, g: Ir-O^gH, h: Ir=O^h.

Table S3 The fitting parameters of XPS profiles and their fitting results for Na-doped iridium oxide.

	Peak	FWHM (eV)	Binding energy (eV)	Area
Ir ⁵⁺	4f _{5/2}	2.10	66.80	3,273.05
	4f _{7/2}	2.10	63.80	4,364.06
Ir ⁴⁺	4f _{5/2}	1.00	65.45	2,102.39
	4f _{7/2}	1.00	62.45	2,803.19
	4f satellite	2.20	65.90	2,851.25
	4f satellite	2.20	62.90	3,801.66
	4f satellite	3.88	67.80	1,366.88
Na ⁺	2s	2.00	65.80	6,46.24
O ²⁻	1s	2.00	530.50	7,006.80
OH ⁻	1s	2.00	531.60	7,741.20
H ₂ O	1s	2.00	532.90	1,439.10

Table S4 The fitting parameters of Ir L₃-edge EXAFS profile for Na-doped iridium oxide.

Sample	Path	N ^a	R (Å) ^b	$\Delta\sigma_j^2 (\times 10^{-3} \text{ \AA}^2)^c$	R-factor ^d
Na-doped IrO _x	Ir-O ₁	1.73	1.93	3.7	0.009
	Ir-O ₂	3.45	1.97	3.7	
	Ir-Ir	1.73	3.09	15.6	
	Ir-Na	1.73	3.22	1.2	
hydrous ^e	Ir-O ₁	1.49	1.98	4.8	0.001
	Ir-O ₂	2.98	2.01	4.8	
pristine ^f	Ir-O ₁	1.60	1.96	2.3	0.009
	Ir-O ₂	3.20	1.99	2.3	

a: coordination number, b: bonding distance, c: Debye-Waller factor, d: difference between data and fitting, e: standard hydrous IrO₂, f: standard pristine IrO₂, Ir-O₁: apical bond, Ir-O₂: planar bond.

Table S5 The impedance fitting results for Na-doped iridium oxide and sputtered iridium

	R_s^a (Ω)	R_{ct}^b (Ω)
Na-doped iridium oxide	139.1	12.35
Sputtered iridium oxide	138.3	120.2

oxide.

a: electrolyte resistance; b: charge transfer resistance