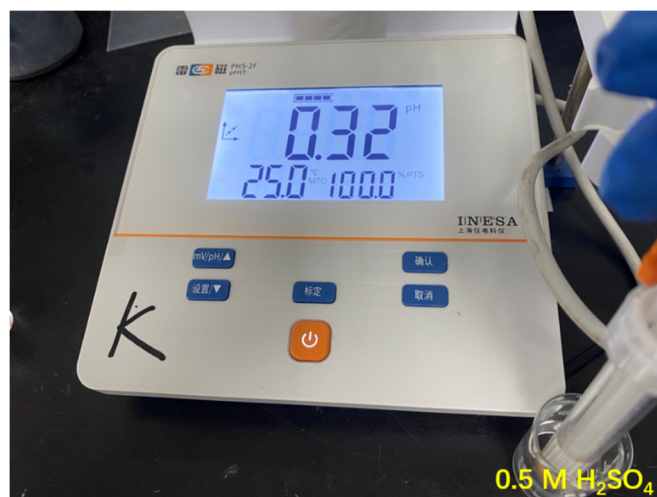


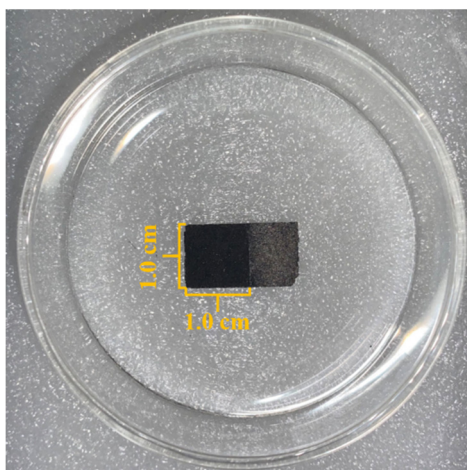
## Support Information

### Achieving High Activity and Long-Term Stability towards Oxygen

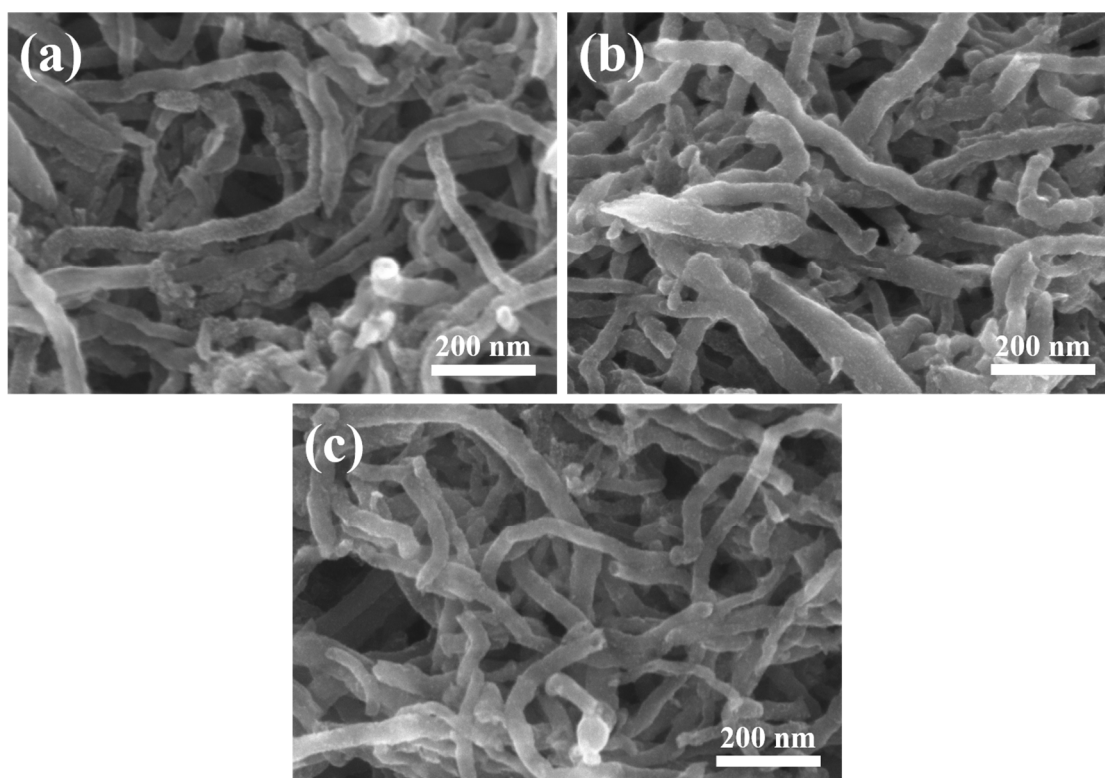
#### Evolution in Acid by Phases Coupling between CeO<sub>2</sub>-Ir



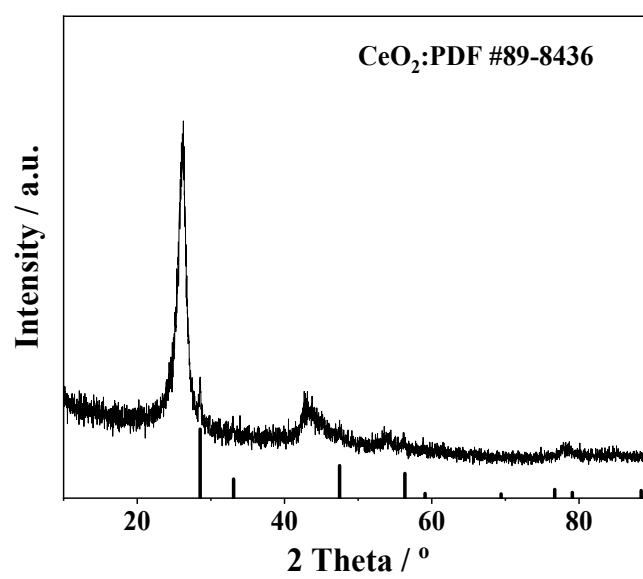
**Figure S1.** The pH of 0.5 M H<sub>2</sub>SO<sub>4</sub> at room temperature.



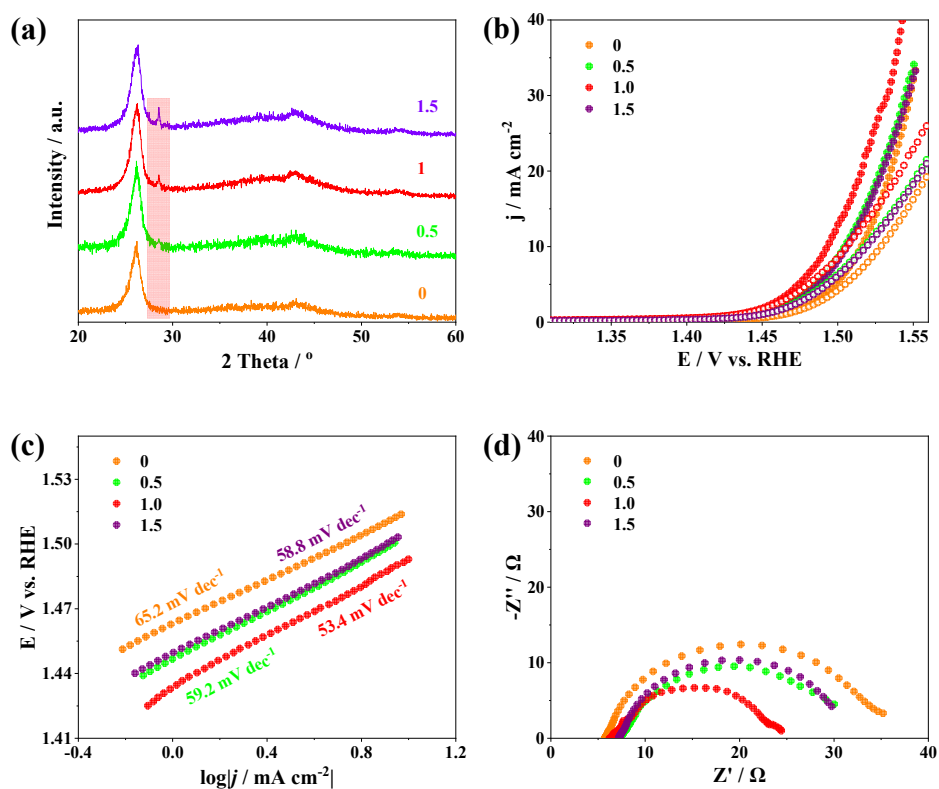
**Figure S2.** Photograph of catalyst-loaded carbon paper.



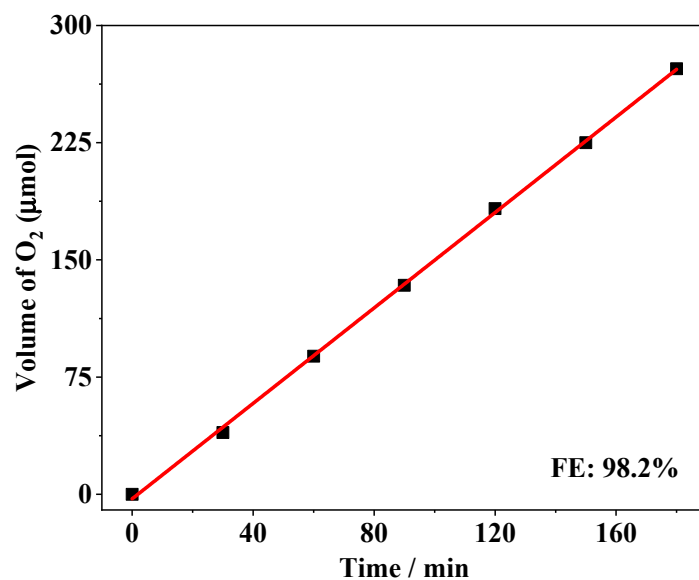
**Figure S3.** SEM images of (a) CeO<sub>2</sub>-Ir/CNTs, (b) Ir/CNTs and (c) CeO<sub>2</sub>/CNTs.



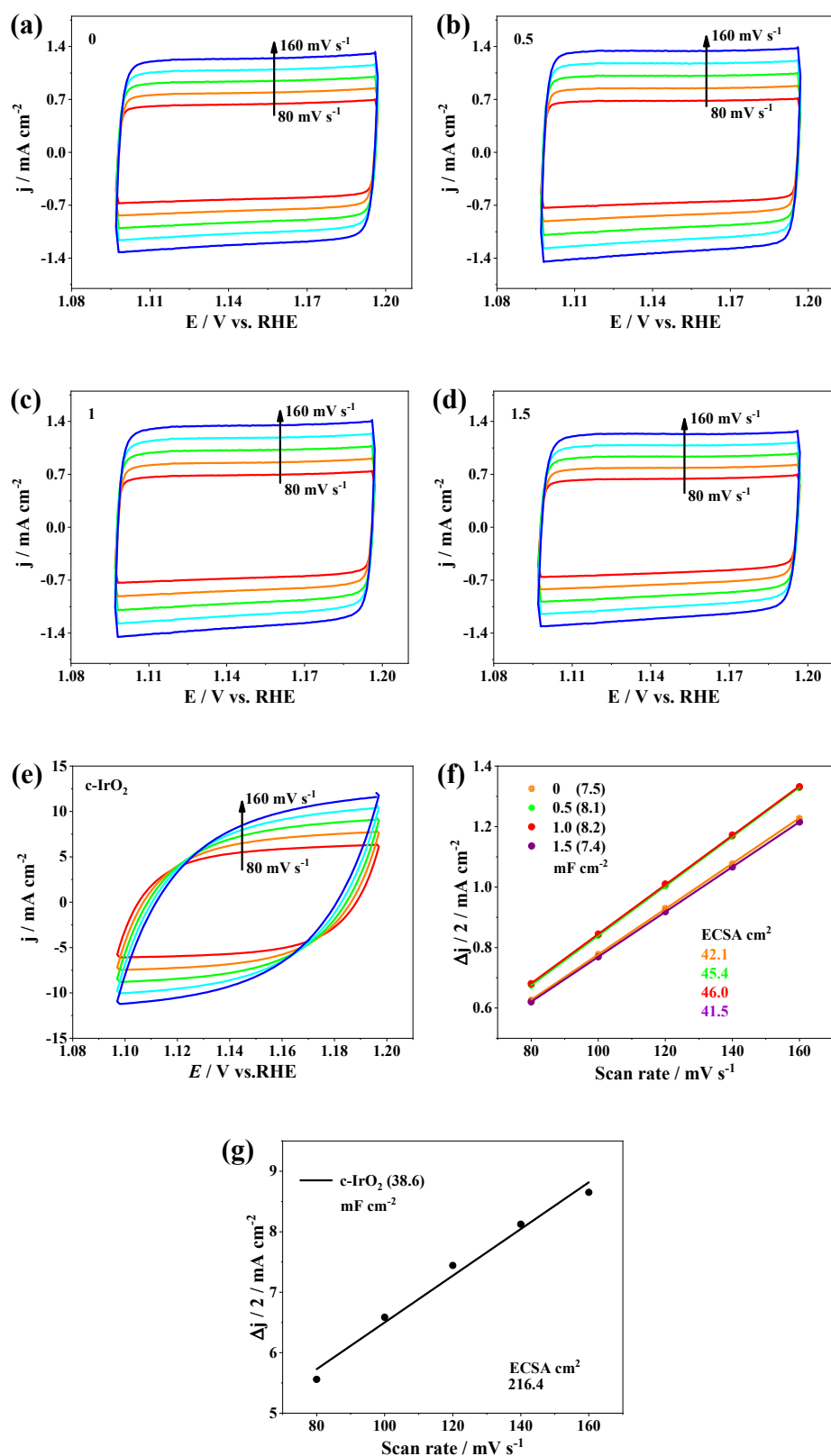
**Figure S4.** XRD pattern of CeO<sub>2</sub>/CNTs.



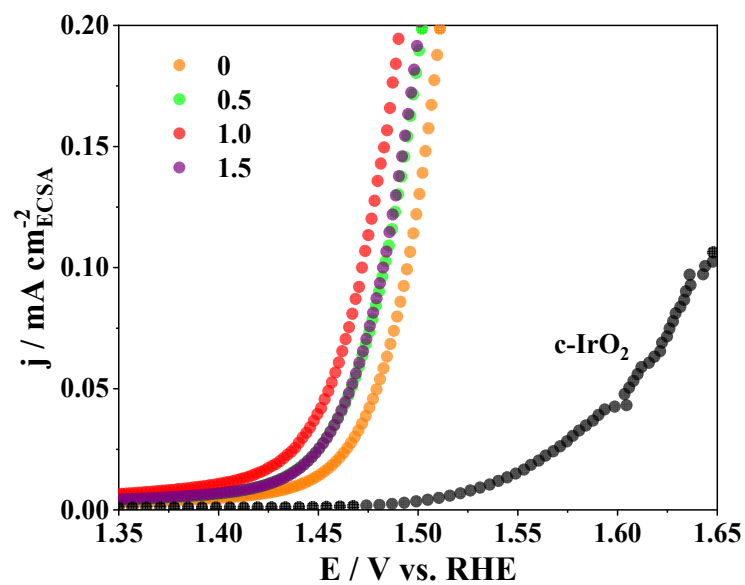
**Figure S5.** (a) XRD patterns, (b) LSVs (solid-dot line: with iR compensation), (c) Tafel plots and (d) EIS Nyquist plots of  $x\text{CeO}_2\text{-Ir/CNTs}$  with different  $\text{CeO}_2$  content.



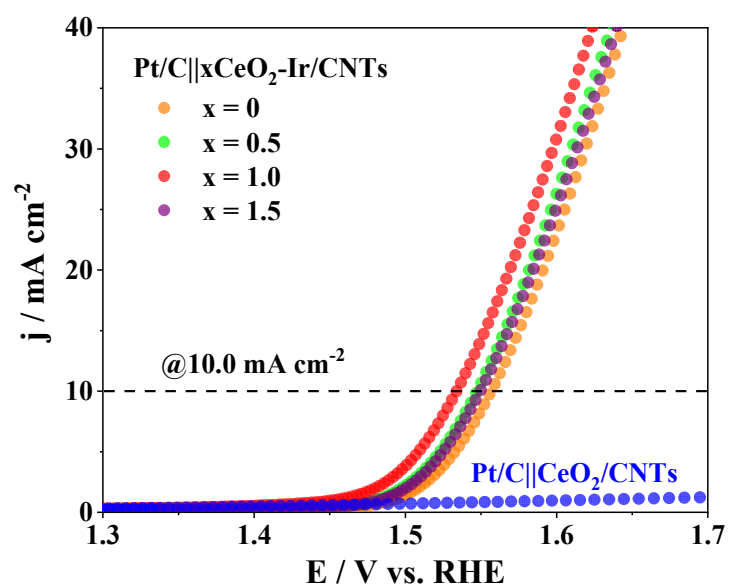
**Figure S6.** The time-dependent volume of  $\text{O}_2$  towards OER using  $\text{CeO}_2\text{-Ir/CNTs}$  as anode. The red line represents a fitted line, while square data points denote the volume of  $\text{O}_2$  generated at 30-minute intervals.



**Figure S7.** CVs recorded at different scan rates in the region of 1.1-1.2 V of (a-d)  $\text{xCeO}_2\text{-Ir/CNTs}$  with different  $\text{CeO}_2$  content and (e)  $\text{c-IrO}_2$ . (f) and (g)  $C_{dl}$  plots and ECSAs of the catalysts.



**Figure S8.** ECSA-normalized LSVs of  $x\text{CeO}_2\text{-Ir/CNTs}$  and  $\text{c-IrO}_2$ .



**Figure S9.** LSVs of  $\text{Pt/C}||x\text{CeO}_2\text{-Ir/CNTs}$  and  $\text{Pt/C}||\text{CeO}_2/\text{CNTs}$ .

**Table S1.** Composition analysis of xCeO<sub>2</sub>-Ir/CNTs.

xCeO <sub>2</sub> -Ir/CNTs	Mass Concentration / mg L <sup>-1</sup>		Atomic Concentration / mmol L <sup>-1</sup>		Atomic ratio
	Ce	Ir	Ce	Ir	Ce:Ir
x = 0	0	56.161	0	0.292	0
x = 0.5	20.635	56.772	0.147	0.295	0.498
x = 1	41.327	56.568	0.295	0.294	1.003
x = 1.5	62.006	56.572	0.443	0.294	1.507

**Table S2.** Analysis of EDS spectrum.

Element	Atomic Fraction (%)	Mass Fraction (%)
C	94.70	84.94
O	4.52	5.41
Ce	0.39	4.07
Ir	0.39	5.58

**Table S3.** OER performance comparison of the CeO<sub>2</sub>-Ir/CNTs with the catalysts reported in acid media.

Catalyst	Electrolyte	Mass loading	$\eta_{10}$ (mV)	Stability (h @ $\eta_{10}$ )	Mass activity (A g <sub>Ir</sub> <sup>-1</sup> @V)	Ref.
CeO <sub>2</sub> -Ir/CNTs	0.5 M H <sub>2</sub> SO <sub>4</sub>	~0.20 mg cm <sup>-2</sup>	262.9	60	2542.3 @1.53	This work
Li-IrO <sub>x</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	0.125 mg cm <sup>-2</sup>	290	10	100 @1.52	[1]
IrO <sub>2</sub> @Ir/TiN	0.5 M H <sub>2</sub> SO <sub>4</sub>	0.379 mg·cm <sup>-2</sup>	265	6	480.4 @1.6	[2]
Ir@N-G-750	0.5 M H <sub>2</sub> SO <sub>4</sub>	23 μg·cm <sup>-2</sup>	303	20*	2420 @1.6	[3]
IrGa/N-rGO	0.5 M H <sub>2</sub> SO <sub>4</sub>	-	275	-	-	[4]
Sr <sub>2</sub> IrO <sub>4</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	0.404 mg cm <sup>-2</sup>	263			[5]
IrO <sub>2</sub> /V <sub>2</sub> O <sub>5</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	0.1 mg <sub>Ir</sub> cm <sup>-2</sup>	266	20	287 @1.53	[6]
IrCo NRAs	0.5 M H <sub>2</sub> SO <sub>4</sub>	-	296.9	15	315.5 @1.51	[7]
Ru@IrO <sub>x</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	~0.051 mg <sub>oxide</sub> cm <sup>-2</sup>	282	24	644.8 @1.56	[8]
Ir-CeO <sub>2</sub> -C	0.5 M H <sub>2</sub> SO <sub>4</sub>	1 mg cm <sup>-2</sup>	283	60	21.95 @1.53	[9]
IrO <sub>x</sub> /SrIrO <sub>3</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	-	~270	30	-	[10]
IrMoO <sub>x</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	0.816 mg <sub>oxide</sub> cm <sup>-2</sup>	267	30	-	[11]
IrNiO <sub>x</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	10.2 μg <sub>Ir</sub> cm <sup>-2</sup>	~309	-	170 @1.50	[12]
Ir <sub>6</sub> Ag <sub>9</sub> NTs/C	0.5 M H <sub>2</sub> SO <sub>4</sub>	13.3 ug <sub>Ir</sub> cm <sup>-2</sup>	285	6	-	[13]
La <sub>2</sub> LiIrO <sub>6</sub>	0.5 M H <sub>2</sub> SO <sub>4</sub>	0.255 mg <sub>oxide</sub> cm <sup>-2</sup>	278	-	-	[14]

\*denotes the OER durability tested in 0.1 M HClO<sub>4</sub>.

**Table S4.** Component analysis of CeO<sub>2</sub>-Ir/CNTs before and after OER.

CeO <sub>2</sub> -Ir/CNTs				
	Before OER		Post OER	
Element	Ce	Ir	Ce	Ir
Mass concentration / mg L <sup>-1</sup>	41.327	56.568	29.479	54.742
Atomic Concentration / mmol L <sup>-1</sup>	0.295	0.294	0.210	0.285
Atomic ratio	Ce:Ir = 1.003		Ce:Ir = 0.737	

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