

Supporting Information

Atomically Dispersed Tin in Cuprous Oxide for Enhancing *CO Coverage to Selectively Electroreduce CO₂ toward C₂ Products

Shuai Wang ^a, Chang Liu ^a, Yue Qin ^a, Zepu Chen ^a and Qingfa Wang^{a,b,*}

^a Key Laboratory for Green Chemical Technology of the Ministry of Education, School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, China.

^b Collaborative Innovation Center of Chemical Science and Engineering (Tianjin), Tianjin University, Tianjin 300072, China.

*Corresponding author. Tel & Fax: +86-22-27892340, Email: qfwang@tju.edu.cn (Q. Wang)

* Corresponding Author. Tel & Fax: +86-22-27892340, Email: qfwang@tju.edu.cn(Q. Wang)

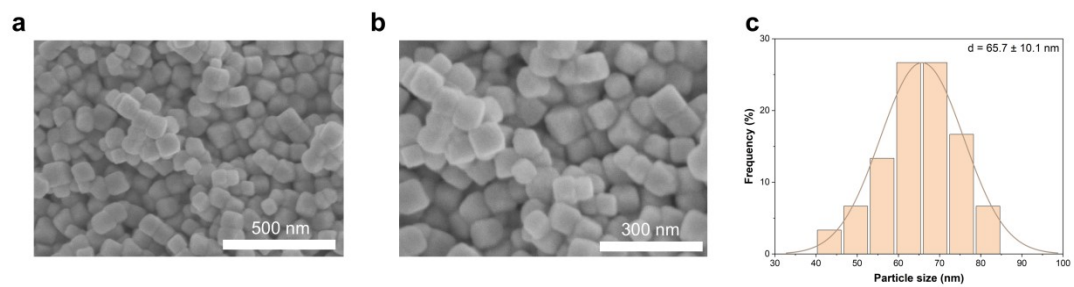


Figure S1. SEM image (a) and enlarged SEM image (b) of Cu₂O. (c) Particle size distribution histogram of Cu₂O determined from the SEM images.

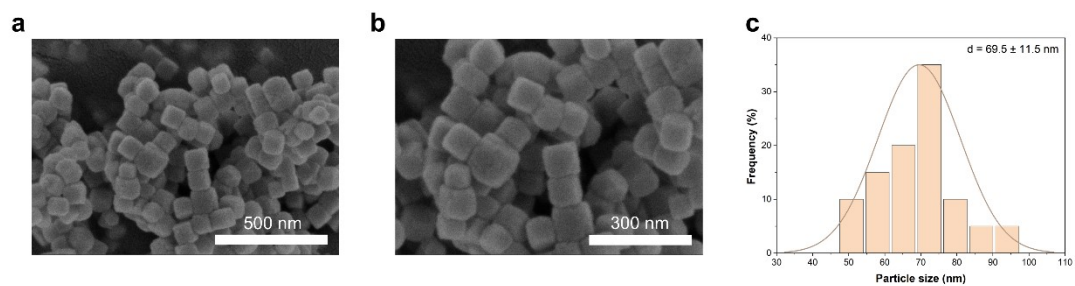


Figure S2. SEM image (a) and enlarged SEM image (b) of Sn-Cu₂O-0.0125. (c) Particle size distribution histogram of Sn-Cu₂O-0.0125 determined from the SEM images.

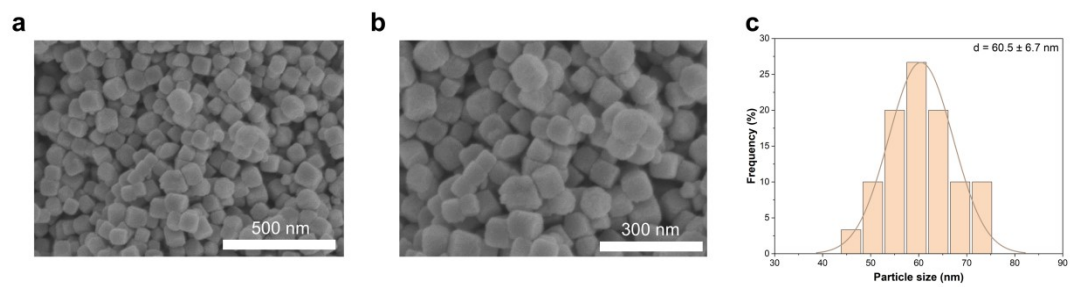


Figure S3. SEM image (a) and enlarged SEM image (b) of Sn-Cu₂O-0.025. (c) Particle size distribution histogram of Sn-Cu₂O-0.025 determined from the SEM images.

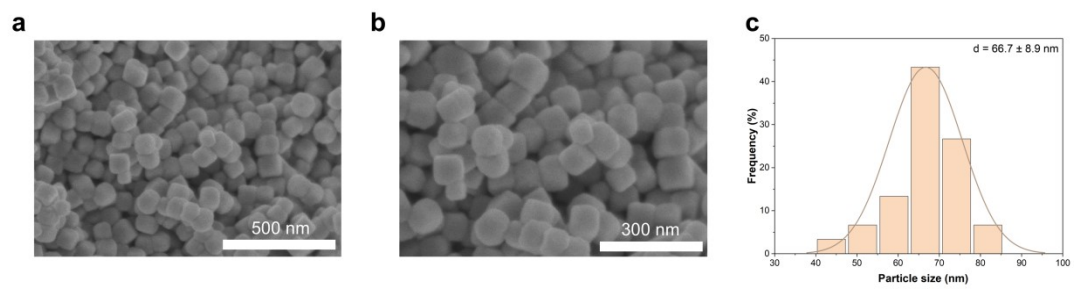


Figure S4. SEM image (a) and enlarged SEM image (b) of Sn-Cu₂O-0.05. (c) Particle size distribution histogram of Sn-Cu₂O-0.05 determined from the SEM images.

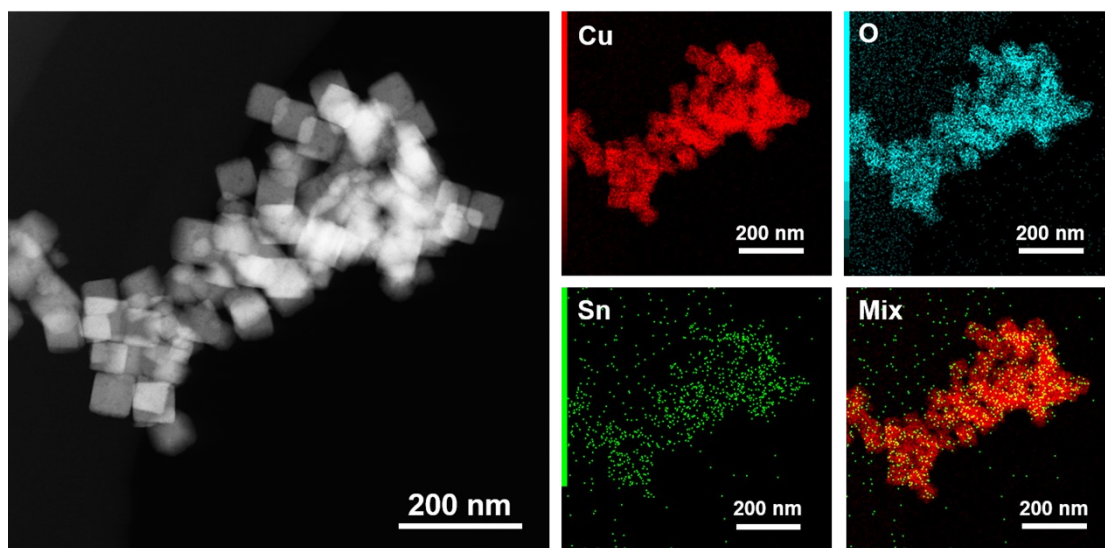


Figure S5. TEM image and Element mapping of Cu, O, Sn in Sn-Cu₂O-0.025.

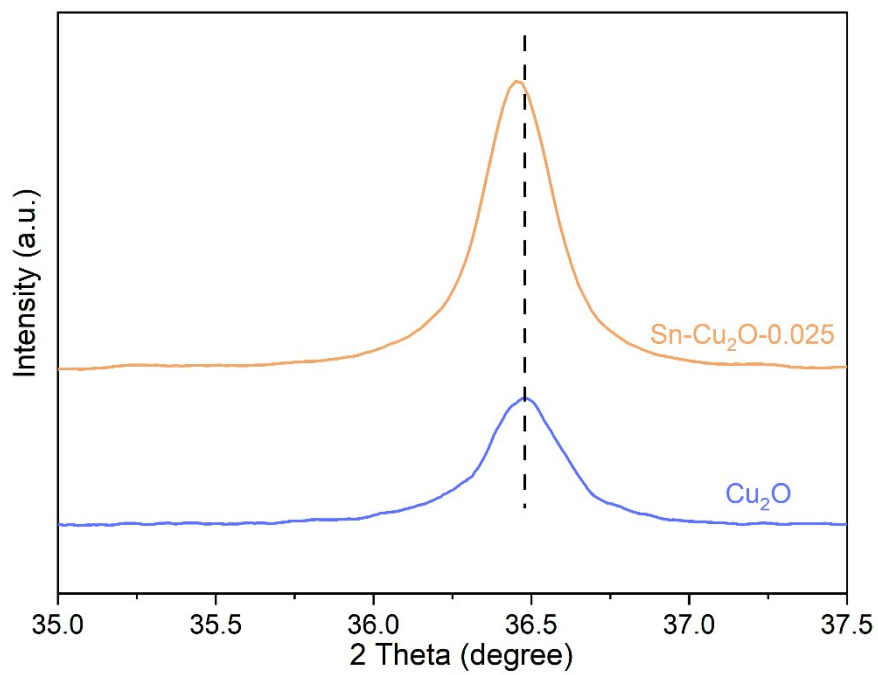


Figure S6. XRD magnified patterns of Cu₂O and Sn-Cu₂O-0.025.

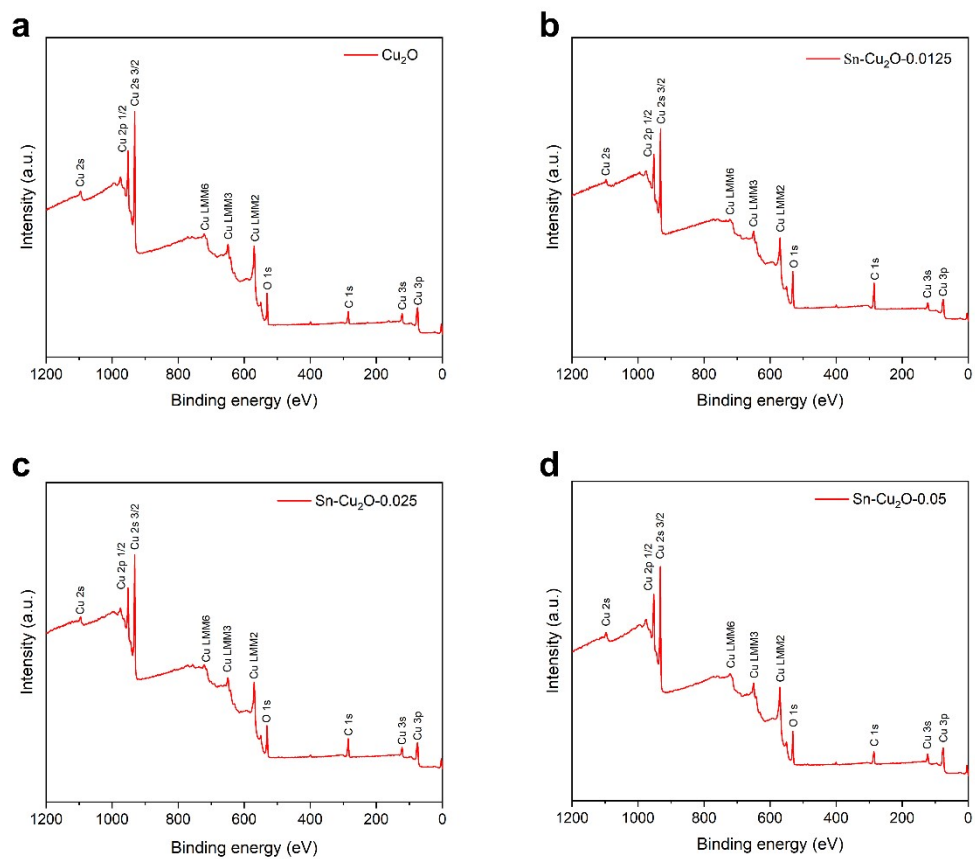


Figure S7. XPS survey spectra of Cu₂O and Sn-Cu₂O-X (X=0.0125, 0.025, 0.05).

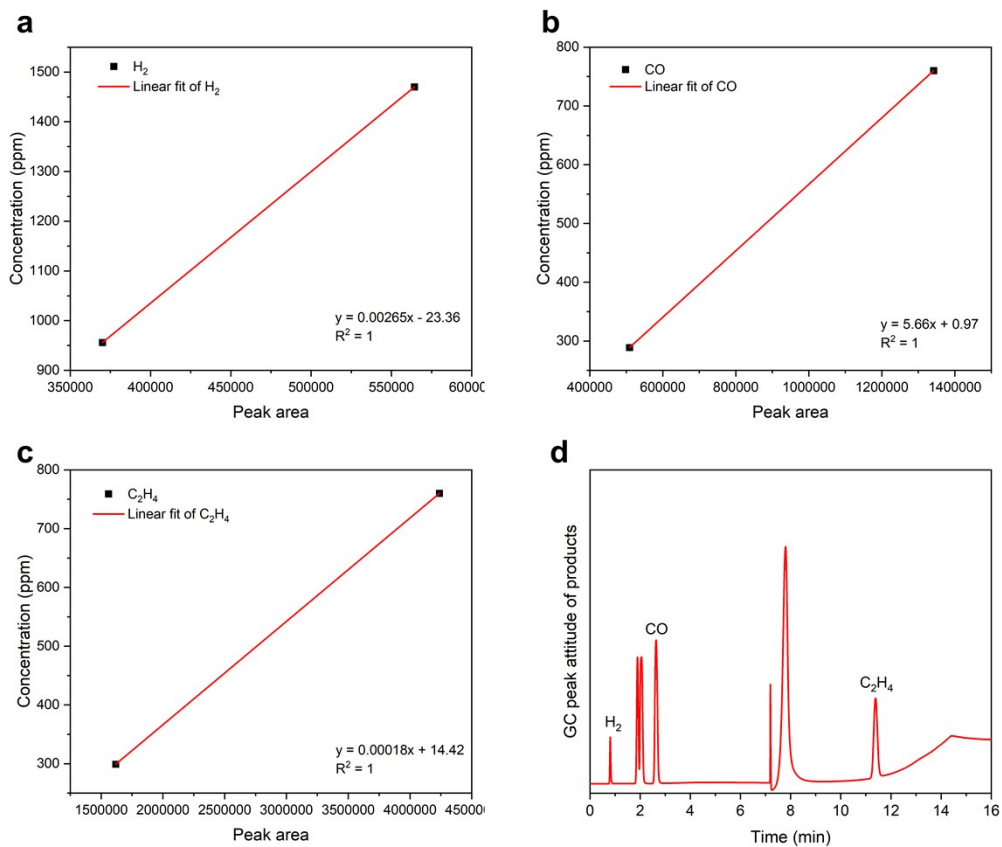


Figure S8. The standard curves of (a) H₂, (b) CO and (c) C₂H₄. Typical gas chromatography spectra (d) of the H₂, CO and C₂H₄ products of Sn-Cu₂O-0.025 catalysts.

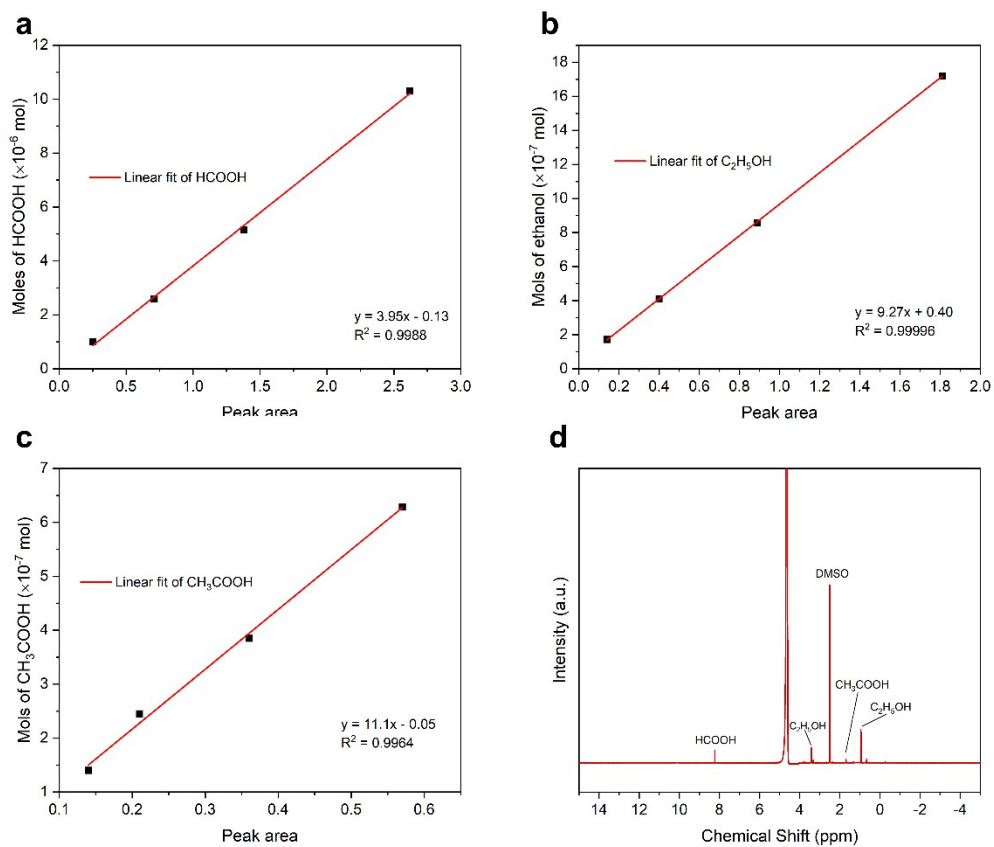


Figure S9. The standard curves of (a) HCOOH, (b) C_2H_5OH , and (c) CH_3COOH . The representative 1H NMR spectra (d) of CO_2RR liquid products of Sn-Cu₂O-0.05 at 400 mA cm⁻².

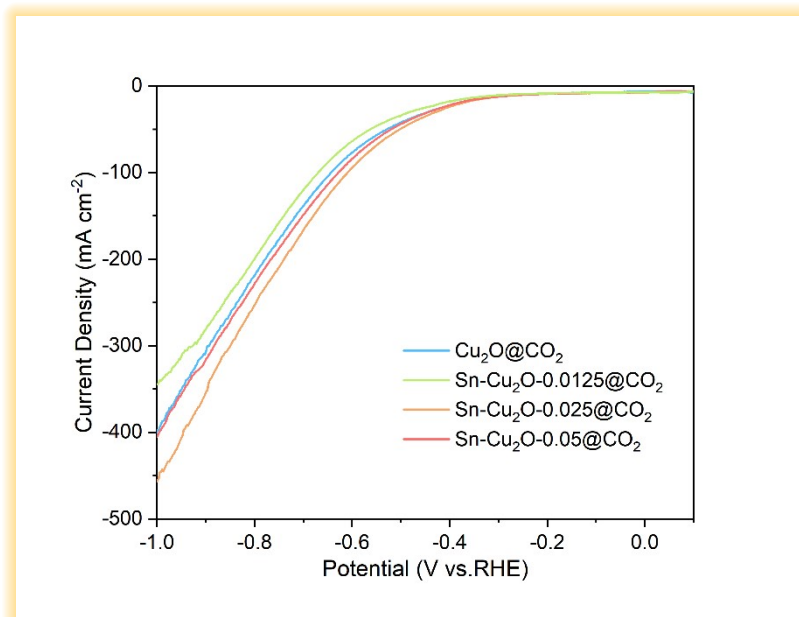


Figure S10. LSV curves of Cu₂O and Sn-Cu₂O-X measured in CO₂-saturated 1M KOH.

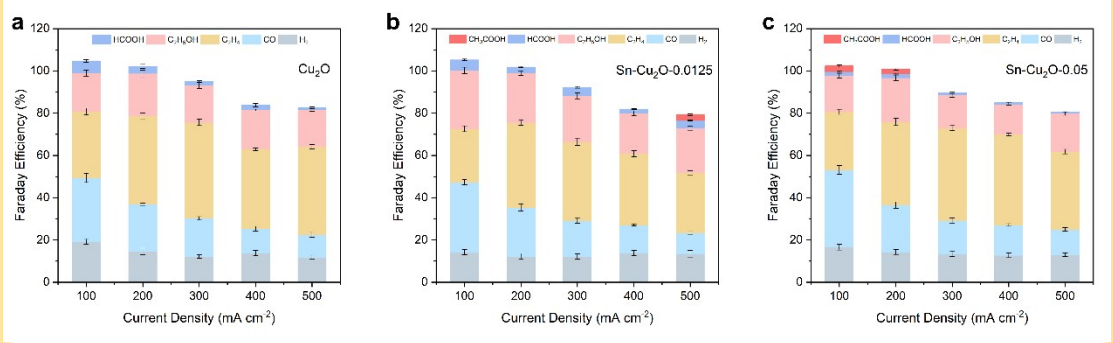


Figure S11. FE of Cu_2O , $\text{Sn-Cu}_2\text{O-0.0125}$ and $\text{Sn-Cu}_2\text{O-0.05}$ at applied current density ranging from 100-500 mA cm^{-2} in 1M KOH.

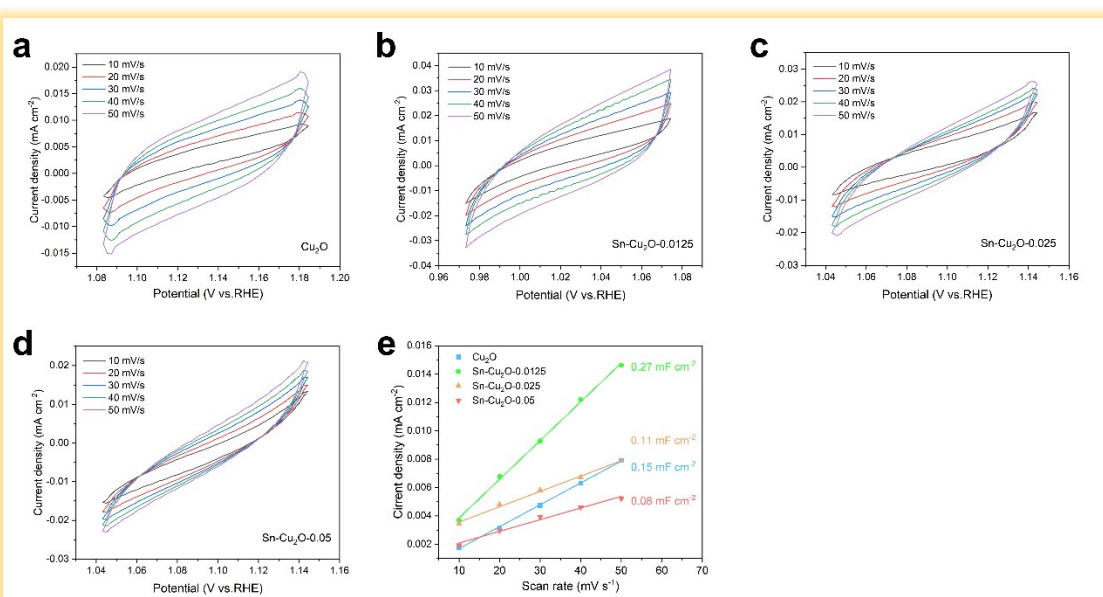


Figure S12. Cyclic voltammetry curves for (a) Cu₂O, (b) Sn-Cu₂O-0.0125, (c) Sn-Cu₂O-0.025 and (d) Sn-Cu₂O-0.05 performed at scan rates from 10 to 50 mV s⁻¹. (e) Linear fitting of double-layer capacitance of Cu₂O and Sn-Cu₂O-X to estimate ECSA.

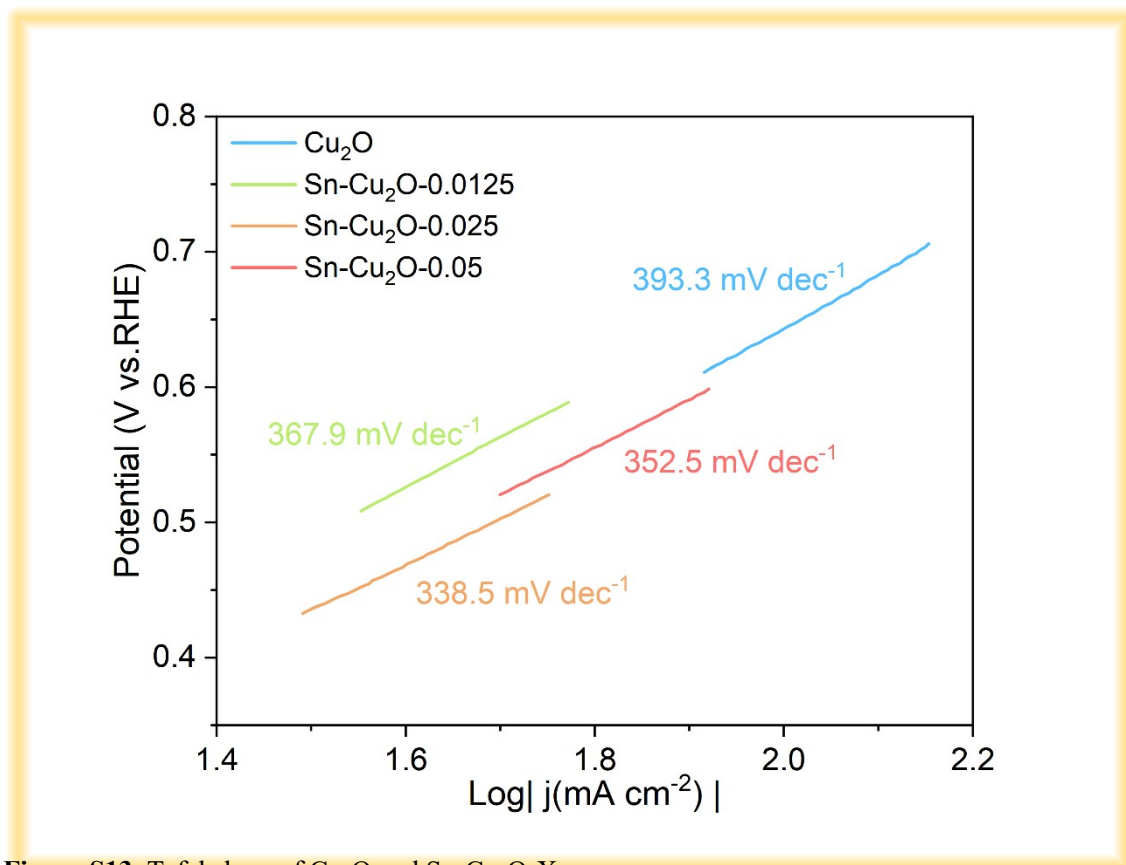


Figure S13. Tafel slope of Cu₂O and Sn-Cu₂O-X.

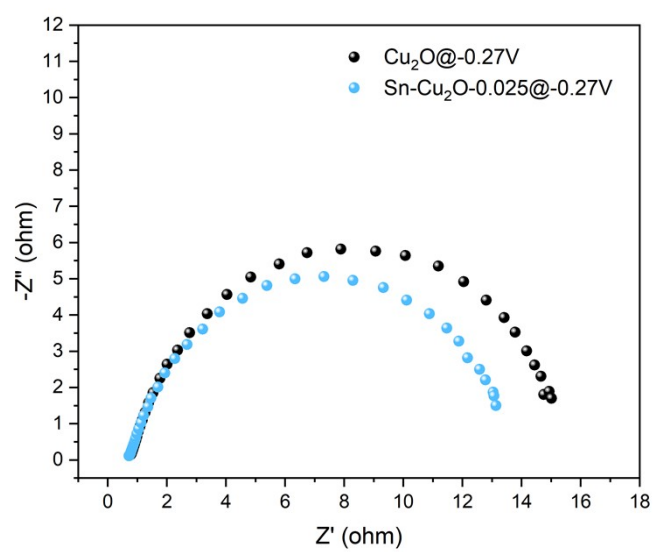


Figure S14. EIS curves of Cu_2O and $\text{Sn-Cu}_2\text{O-0.025}$ catalysts measured at -0.27 V vs RHE.

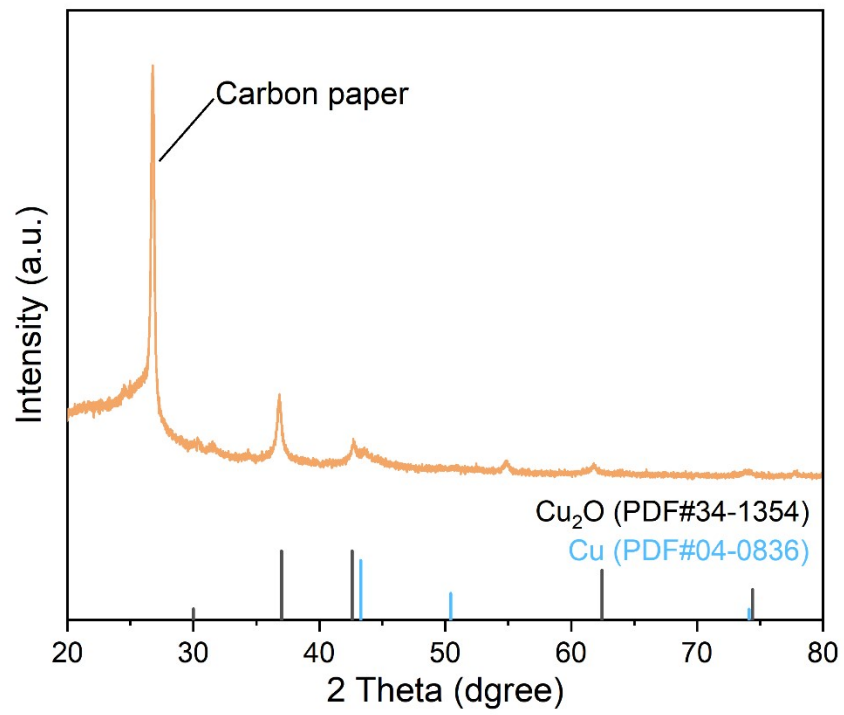


Figure S15. XRD image of Sn-Cu₂O-0.025 catalyst after CO₂RR test.

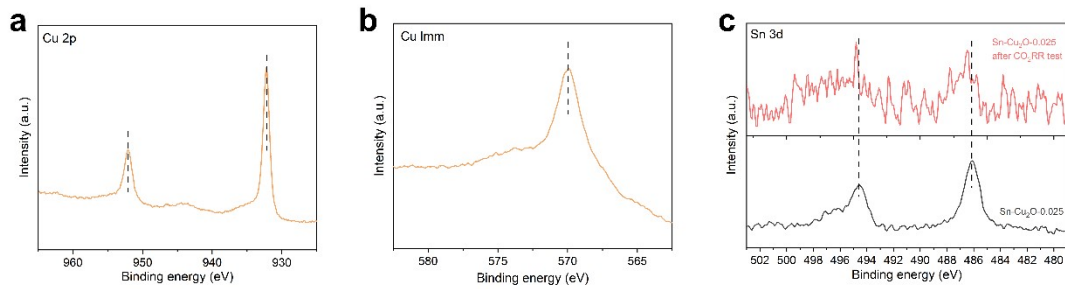


Figure S16. The XPS spectra of (a) Cu 2p, (b) Cu 1mm and (c) Sn 3d of Sn-Cu₂O-0.025 after CO₂RR test.

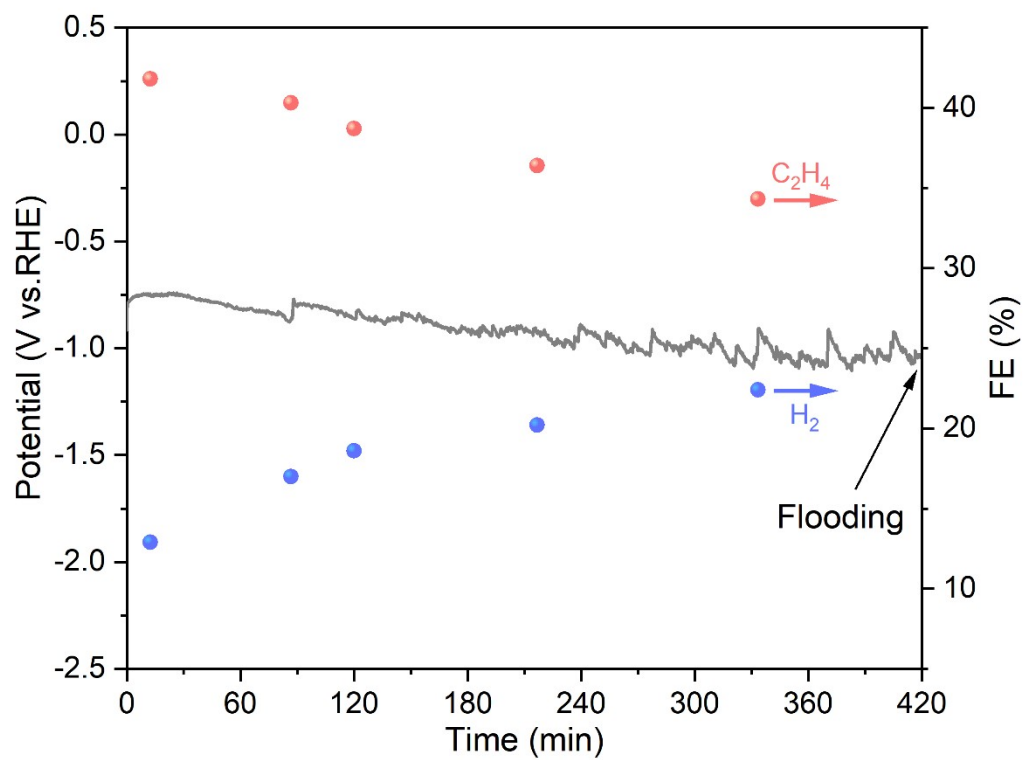


Figure S17. Stability of Sn-Cu₂O-0.025 at 200 mA cm⁻² over 420 min. Products were sampled by GC during the stability experiment.

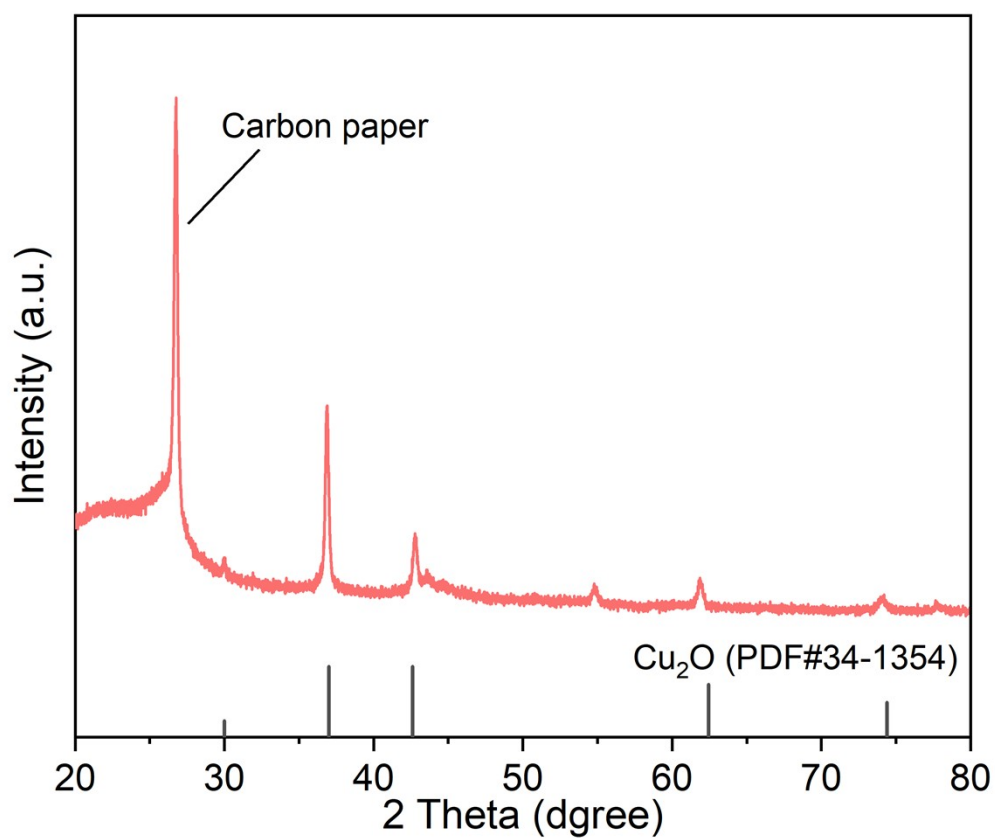


Figure S18. The XRD pattern of Sn- Cu_2O -0.025 after stability test.

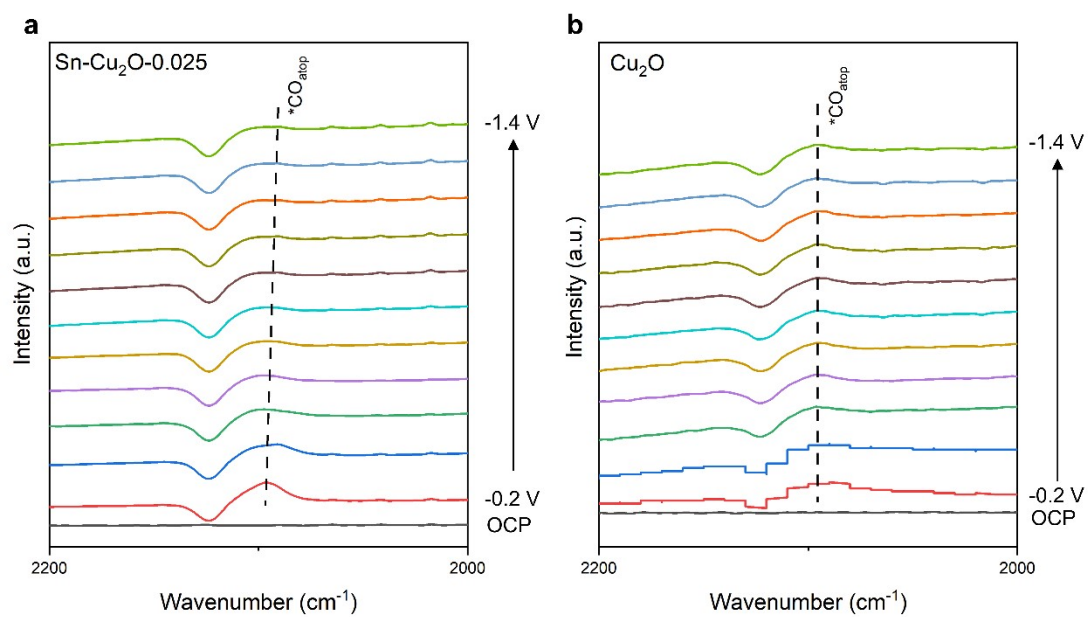


Figure S19. In situ IF-TR spectra at different potentials of a) Sn-Cu₂O-0.025 and b) Cu₂O.

TableS1. The content of metal for Sn-Cu₂O-0.025, Sn-Cu₂O-0.05 and Sn-Cu₂O-0.1 by ICP-OES.

Sample	Metal	Content (wt%)
Sn-Cu ₂ O-0.0125	Sn	0.047
Sn-Cu ₂ O-0.025	Sn	0.058
Sn-Cu ₂ O-0.05	Sn	0.129

TableS2. The average size and standard deviation of Cu₂O, Sn-Cu₂O-0.025, Sn-Cu₂O-0.05, and Sn-

Cu₂O-0.1 by SEM images.

Sample	Average (nm)	Standard deviation (nm)
Cu ₂ O	65.7	10.1
Sn-Cu ₂ O-0.0125	64.8	10.2
Sn-Cu ₂ O-0.025	60.5	6.7
Sn-Cu ₂ O-0.05	66.7	8.9

TableS3. Performances and comparison of Sn-Cu₂O-0.025 and reported Cu-based SAA catalysts

for CO₂RR.

Catalyst	Cell	Electrolyte	FE _{C2+} (%)	Current Density (mA cm ⁻²)	Ref
Sn-Cu ₂ O-0.025	Flow cell	1M KOH	73.2	200	This work
Sn1Cu-SAA	Flow cell	1M KOH	79.3	800	(¹)
Mo1Cu-SAA	Flow cell	1M KOH	86.4	800	(²)
Pd-Cu	Flow cell	1M KOH	80.8	800	(³)
Cu3Al-LDHs	Flow cell	1M KOH	84.5	300	(⁴)
Sc _{0.09} -Cu ₂ O	Flow cell	1M KOH	71.9	600	(⁵)
BiCu-SAA	Flow cell	1M KOH	73.4	400	(⁶)
CoCu-SAA	Flow cell	1M KHCO ₃	61.87	≈520	(⁷)
AgCu SAA	Flow cell	1M KOH	94	720	(⁸)
CuPd SAA	H-cell	0.1M KHCO ₃	85.7	No	(⁹)
De-Au ₁ Cu SAA	Flow cell	1M KOH	52	252	(¹⁰)

References

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