Supplementary Information (SI) for RSC Advances.
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Electronic Supplementary Information

Selectively electrolyzing CO_2 to ethylene by Cu-Cu_2O/rGO catalyst derived from copper hydroxide nanostrands/graphene oxide

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The file includes:

1. **Figures S1-S13.**

2. **Tables S1-S3.**

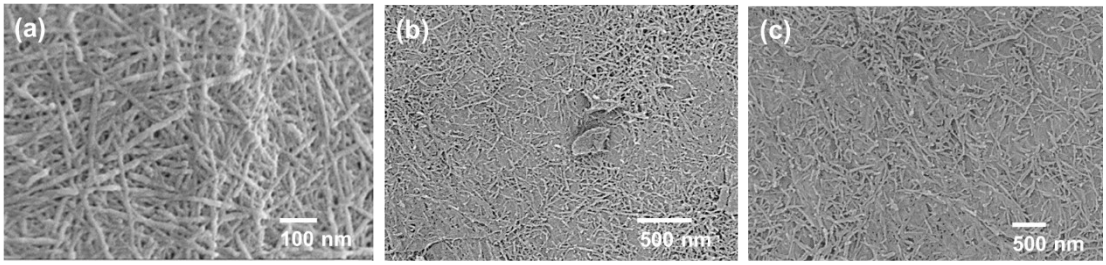

Fig. S1. SEM images of (a) Copper hydroxide nanostrands (CHNs); (b) S9 CNHS/GO before electrochemical reduction; (c) S11 CNHS/GO before electrochemical reduction.

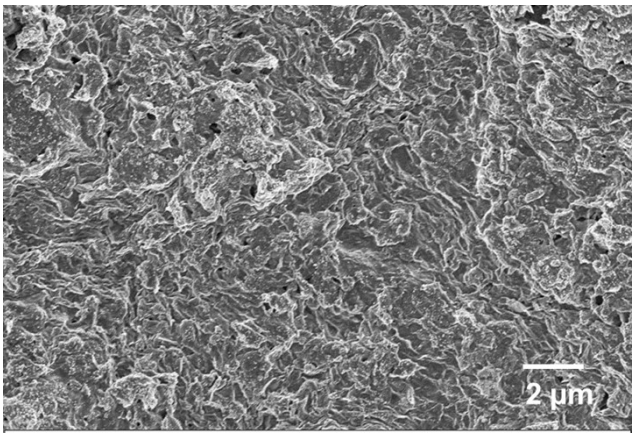

Fig. S2. SEM images of S10 Cu-Cu_2O/rGO in large scale.

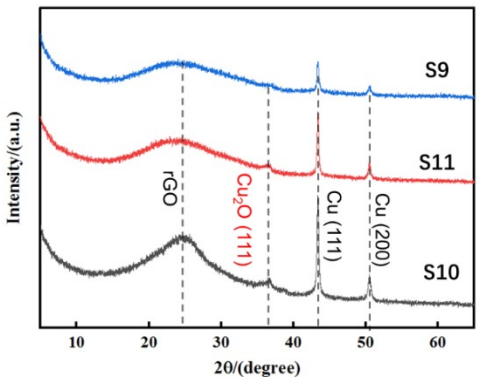

Fig. S3. XRD patterns of S9-S11 synthesized by in situ electrochemical reduction.

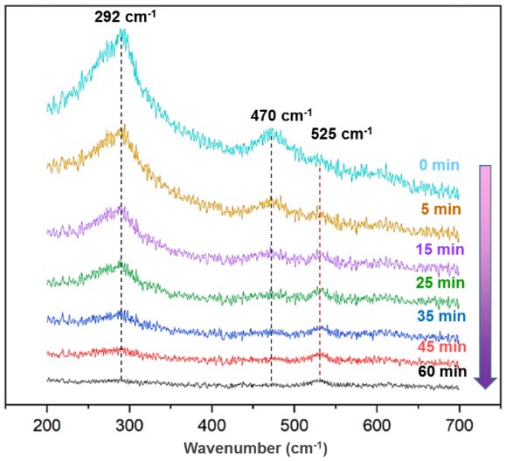

Fig. S4. The in-situ Raman spectra of the CHNs/GO electrochemical reduction process in the wavenumber range from 200 to 700 cm^{-1}.

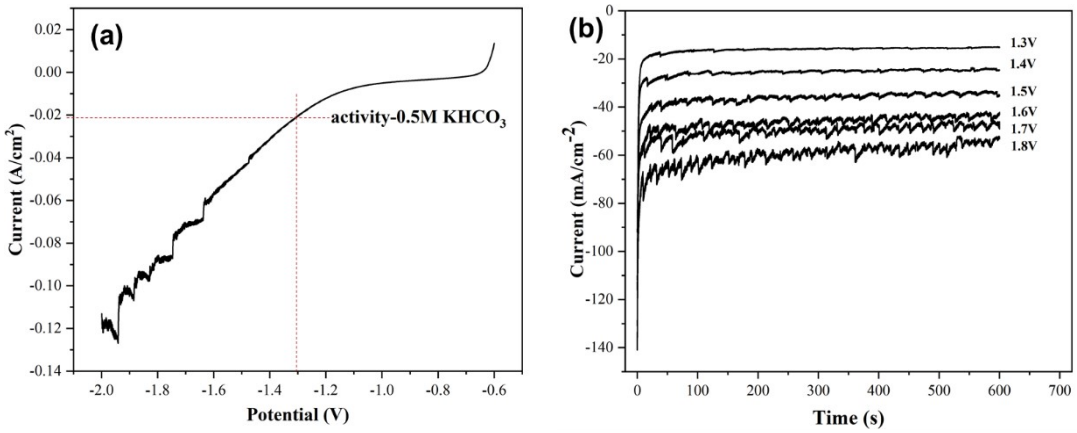

Fig. S5. (a) The activity measurement of S10 by potential scanning from -0.6 to -2.0 V vs. SHE; (b) the chronoamperometry curves of S10 at different potentials vs. SHE.

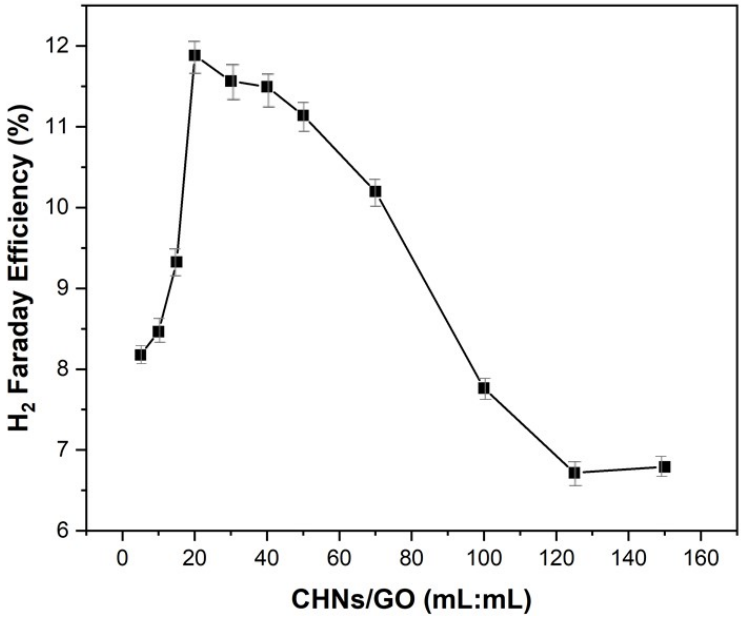

Fig. S6. FE of H_2 for CO_2 ERR from S1 to S11 samples at -1.3 V vs. SHE.

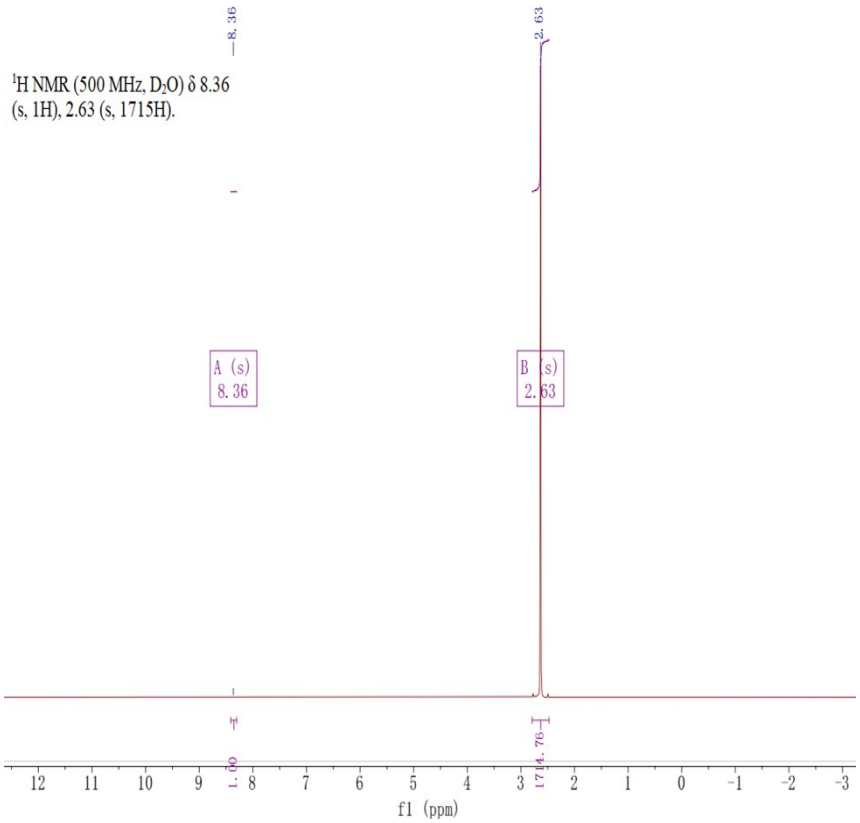

Fig. S7. NMR spectrum recorded from the liquid products after CO_2 ERR by using S10 catalyst at -1.3 V vs. SHE.

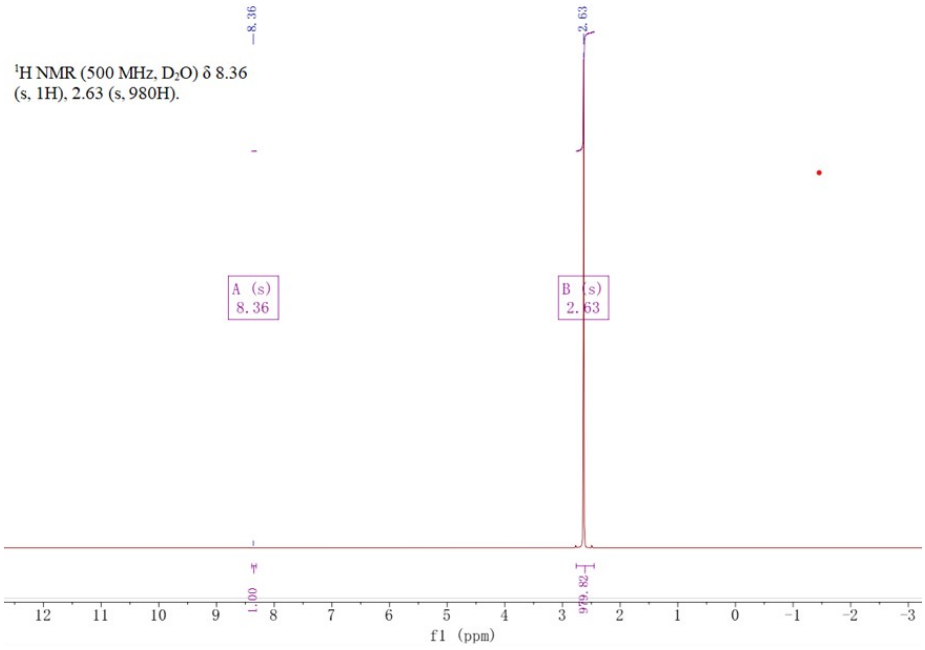

Fig. S8. NMR spectrum recorded from the liquid products after CO_2 ERR by using S10 catalyst at -1.4 V vs. SHE.

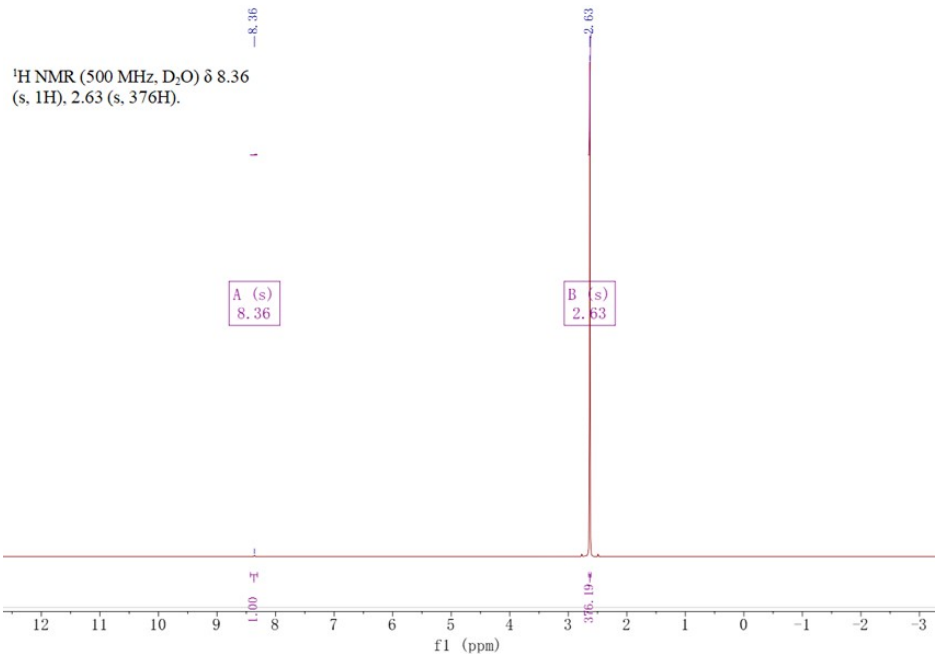

Fig. S9. NMR spectrum recorded from the liquid products after CO_2 ERR by using S10 catalyst at -1.5 V vs. SHE.

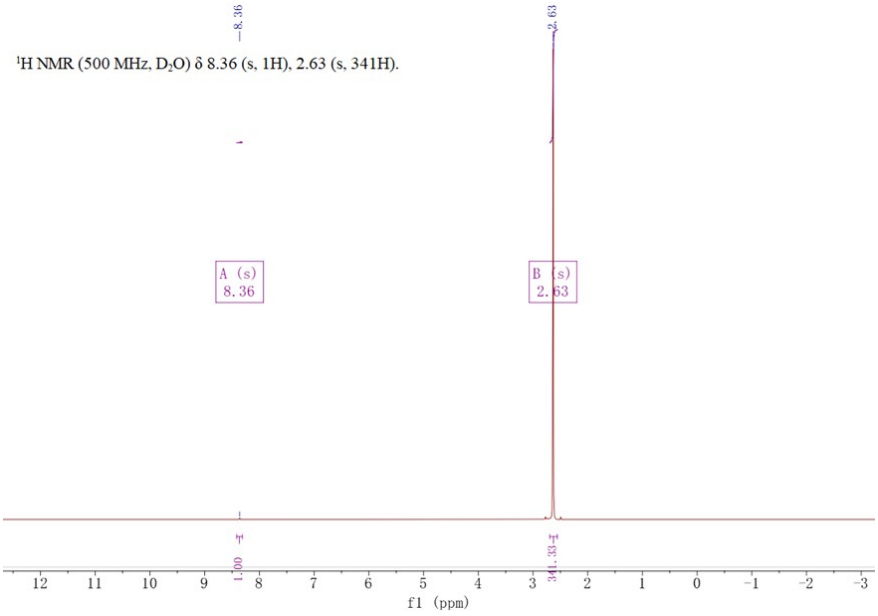

Fig. S10. NMR spectrum recorded from the liquid products after CO_2 ERR by using S10 catalyst at -1.6 V vs. SHE.

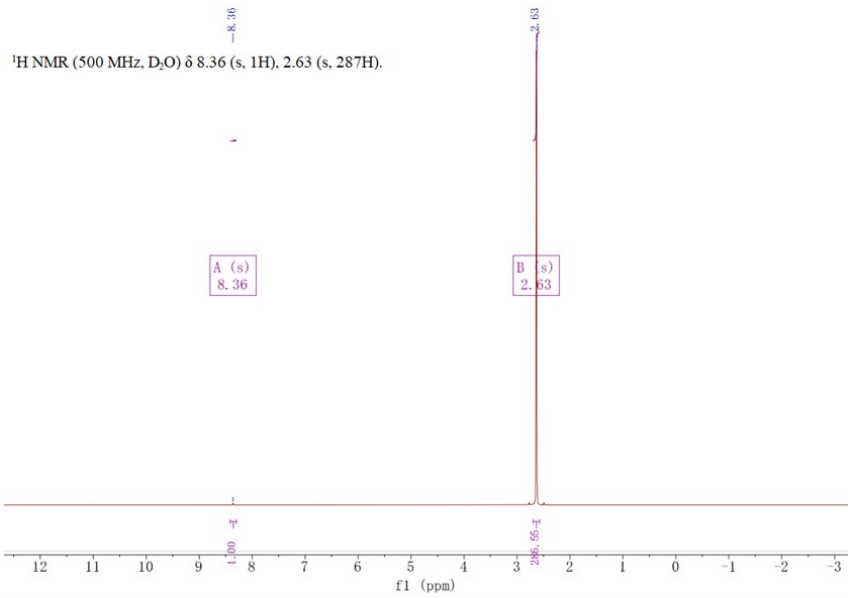

Fig. S11. NMR spectrum recorded from the liquid products after CO_2 ERR by using S10 catalyst at -1.7 V vs. SHE.

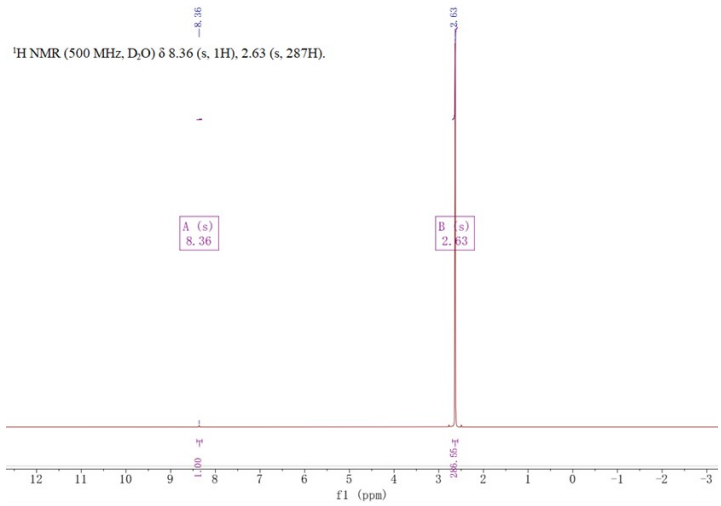

Fig. S12. NMR spectrum recorded from the liquid products after CO_2 ERR by using S10 catalyst at -1.8 V vs. SHE.

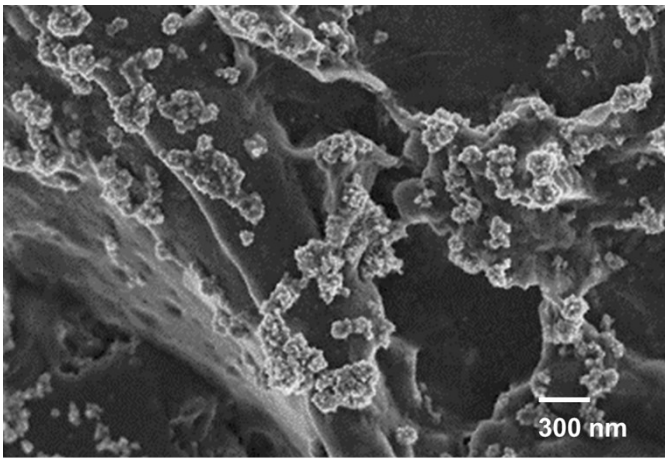

Fig. S13. SEM image of S10 after catalytic CO_2 ERR for 50 hours at -1.3 V vs. SHE.

Table S1. The CHNs and GO volume ratio for different samples.

Sample	CHNs溶液 (ml)	GO (2mg/ml)
S1	5	1
S2	10	1
S3	15	1
S4	20	1
S5	30	1
S6	40	1
S7	50	1
S8	70	1
S9	100	1
S10	125	1
S11	150	1

Table S2. The FE of the gas products from CO_2 ERR at different potential by suing S10 as catalyst.

vs. SHE	C_2H_4	C_2H_6	H_2	CO
-1.3 V	55.4%	37.6%	6.7%	0.3%
-1.4 V	68.2%	10.2%	20.5%	1.1%
-1.5 V	43.2%	2.9%	51.2%	2.7%
-1.6 V	17.8%	1.2%	77.5%	3.7%
-1.7 V	4.6%	0.7%	91%	3.7%
-1.8 V	1.8%	0	95.9%	2.3%

Table S3. The Faraday efficiency of C_2H_4 and total C_2 through the CO_2 ERR catalyzed by Cu^0-Cu^+ based catalyst reported recently and this work.

Electrolyzer	Catalyst	Electrolyte	Potential (V)	Current density (mA/cm^2)	Stability (h)	C_2H_4 (FE %)	C_2 total (FE %)	Ref.
Flow cell	OH^{-1} modified 25 nm Cu NPs/graphite/carbon black/PTFE	7 M KOH	-0.55 vs RHE	275	150	70	83%	2
H cell	Tens nm Cu-CuO_x/carbon black	0.1 M $KHCO_3$	-1.3 vs RHE	20	9	53	74	4
Flow cell	CuO-Cu_2O/carbon black	1 M $KHCO_3$	-1.6 vs RHE	160	12	46	-	7
H cell	250-300 nm Cu-CuOx-I/copper foil	0.1 M $KHCO_3$	-0.9 vs RHE	31.2	22	47	80	9
H cell	Cu_x@Cu_2O nano covex/carbon paper	0.1 M $KHCO_3$	-1.2 vs RHE	14.8	12	59.3	90.5	11
Flow cell	Cu-Cu^+ on $CuSiO_3$/carbon black	0.1 M $KHCO_3$	-1.1 vs RHE	20.2	6	51.8	70	12
Flow cell	C_{60}-Cu-Cu^+ composite	1.0 M KOH	-1.4 vs RHE	366	12	~35	61	14
Flow cell	Cu/Cu_2O NPs/Carbon nanotubes	2 M KOH	-	800	3	45	79	17
Flow cell	OH^- modified Cu NPs/carbon black	0.1 M $KHCO_3$	-3.4 cell voltage	316	35	55.6	-	22
Flow cell	NH_3Cl modified Cu/Cu_2O/carbon black	0.1 M $KHCO_3$	-	200	50	~10	~75	24
Flow cell	Poly ionic liquid/Cu-Cu_2O hybrids	1 M KOH	-0.85 vs RHE	304	10	~44	76.1	35
Flow cell	Cu-Cu_2O/rGO	1 M $KHCO_3$	-1.3 vs SHE -1.4 vs SHE	16 26	50 50	55.4 68.2	93 78.4	This work