Supporting Information

Cu_2O-reduced Graphene Oxide Composites as High-Performance Electrocatalysts for Oxygen Evolution Reaction in Alkaline Media

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Chemical reagents

Carbon cloth was purchased from Shanghai Hesen Electric Co, Ltd. Sodium hydroxide ($NaOH$, ≥96.0%), Copper(II)chloride dihydrate ($CuCl_2 \cdot H_2O$, ≥99.0%), Potassium hydroxide (KOH, ≥85.0%) and Ammonia solution ($NH_3 \cdot H_2O$, 25.0-28.0%) were purchased from Beijing Tongguang Fine Chemical Company. Ethylene glycol ($C_2H_6O_2$, ≥99 %) and hydroxylamine hydrochloride ($HONH_2HCl$, ≥ 98.5%) were purchased from Energy Chemical. Graphene oxide dispersion (Solid content) was purchased from The Sixth Element (Changzhou) Materials Technology co, 1td.

Electrochemical tests

Electrochemical tests were performed in the three-electrode system. Among them, a carbon cloth with area of 0.5 × 0.5 cm^2 sandwiched by platinum sheets was used as the working electrode, the saturated calomel electrode was the reference electrode, and the glassy carbon electrode was the counter electrode. All electrochemical tests were performed on the electrochemical workstation model CHI760. During the LSV test, the scanning range was 0-1 mV vs RHE, and the scanning speed was 5 mV s^{-1}.

Electrochemical Measurements

Electrochemical impedance spectroscopy (EIS) measurements were conducted at an overpotential in the frequency range of 0.05 to 10^5 Hz. EIS data were analysed using a Z-view software. The electrochemical surface areas (ECSA) was determined from the double-layer capacitance (C_{dl}) values via LSV with different scan rates in the 0-1 V potential range without any redox processes. The ECSA can be calculated according to following equation:

$$ECSA = C_{dl}/C_s \qquad (1)$$

where C_{dl} can be estimated as half of the slope, and C_s is normally between 0.02-0.06 mF cm^{-2}.

In addition, the long-term stability of overall water splitting was measured by recording the current-time (I-t) curves at 1.51 V vs. RHE Ar-saturated 1.0 M KOH for 24 h.

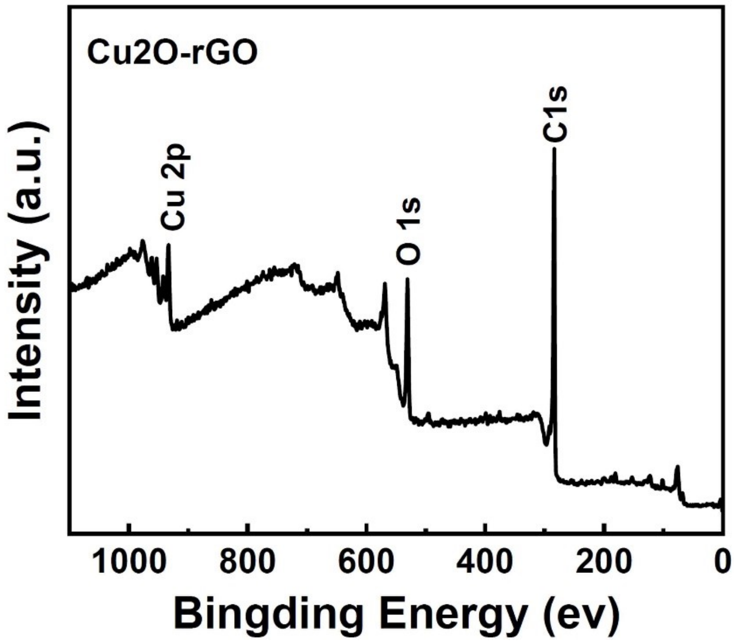

Fig. S1. XPS survey spectrum of Cu_2O-rGO.

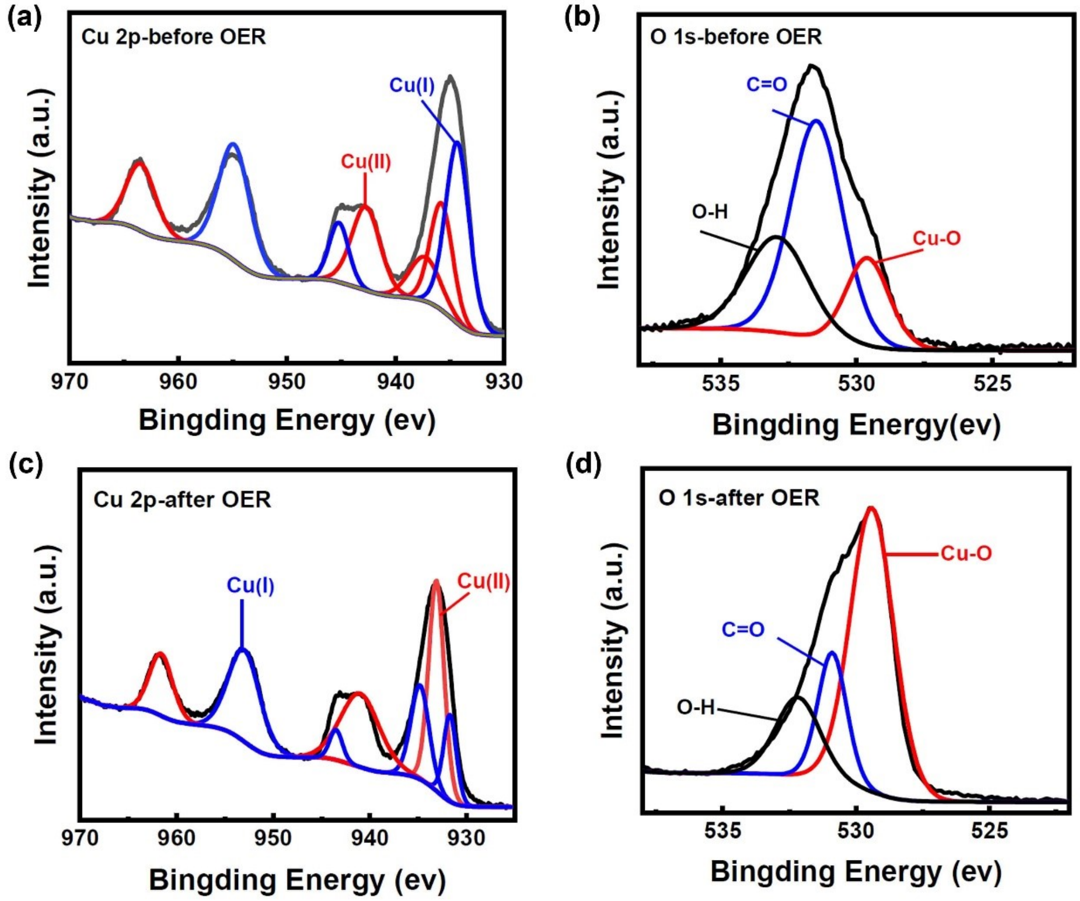

Fig. S2. XPS spectra of (a) Cu 2p and (b) O 1s before OER; XPS spectra of (c) Cu 2p and (d) O 1s after OER.

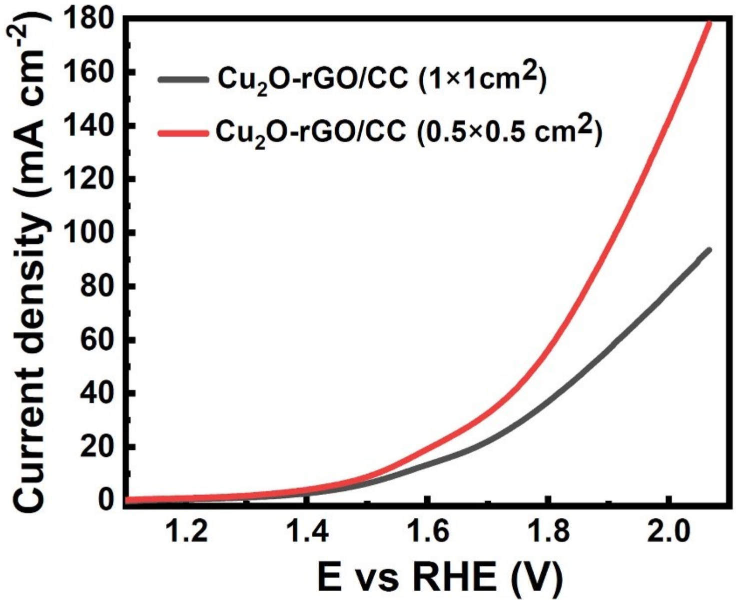

Fig. S3. LSV polarization curves of Cu_2O-rGO/CC at different working area.

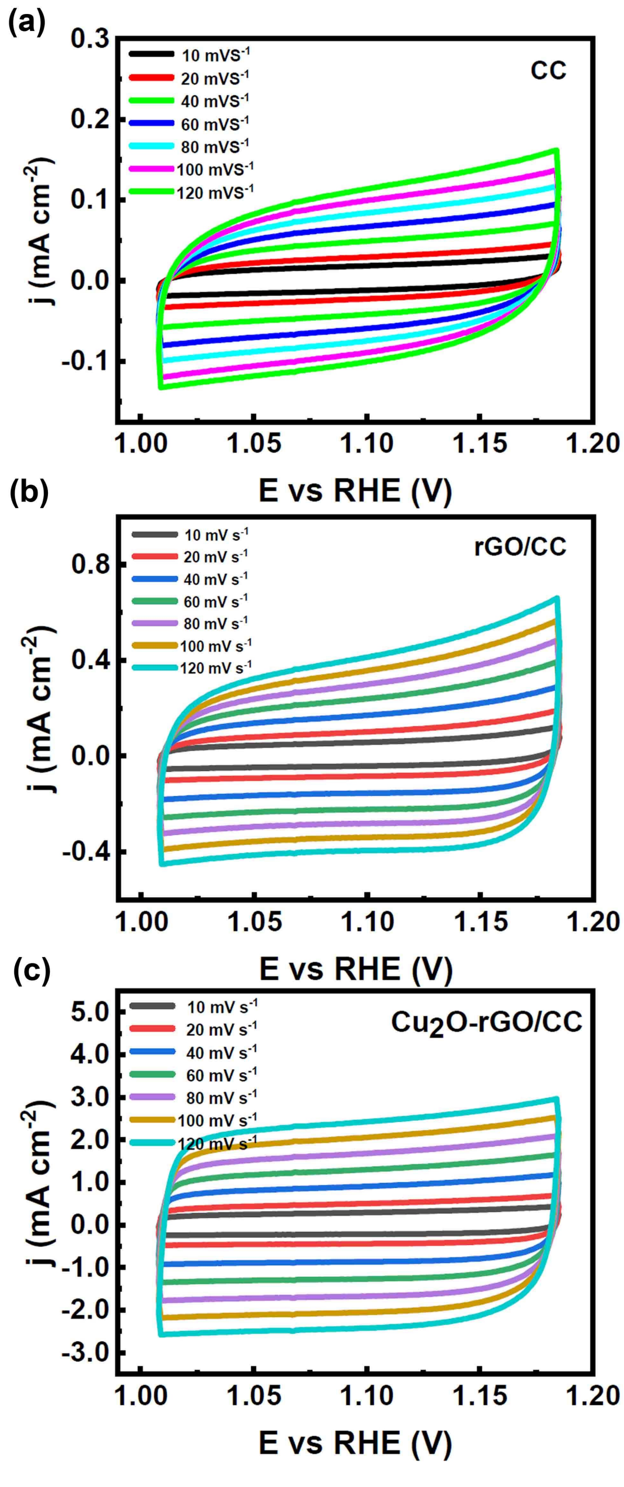

Fig. S4. CV curves of (a) CC, (b) rGO/CC and (c) Cu_2O-rGO/CC in the potential range of 1.01-1.19 V vs RHE at various scan rates (10-120 mV s^{-1}).

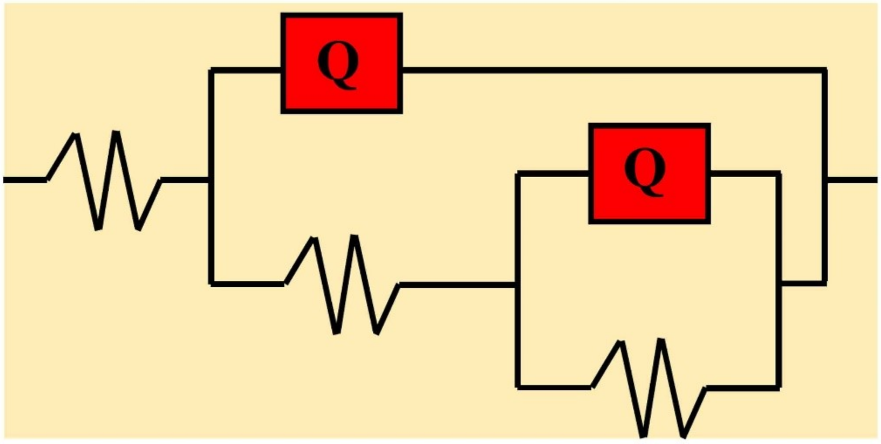

Fig. S5. The circuit equivalent model used for the data fitting for EIS Nyquist plots.

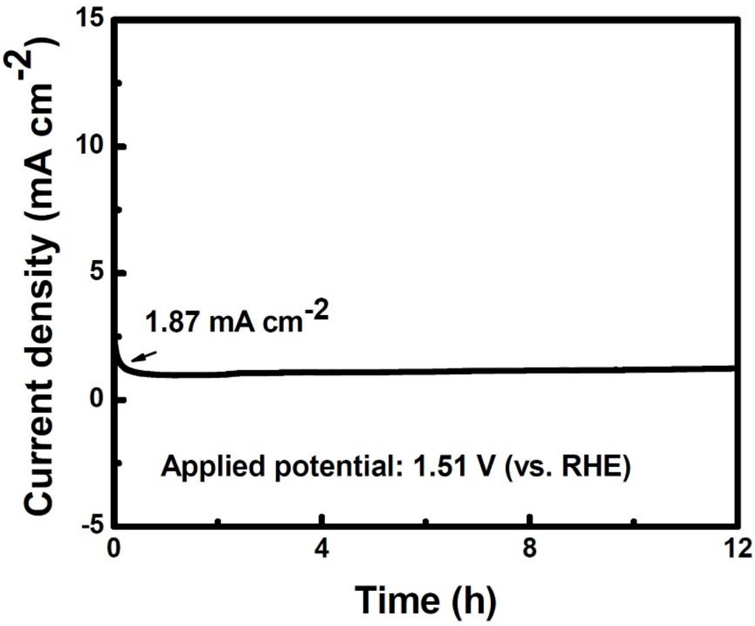

Fig. S6. The stability test results of Cu_2O /CC at 1.51 V (vs. RHE)

Table S1. Fitting parameters obtained from the EIS data for the OER in 1 M KOH.

	CC	**rGO/CC**	**Cu_2O-rGO/CC**
R_{ct} (Ω)	5.364	4.28	5.064
R_s (Ω)	165	43.37	8.93

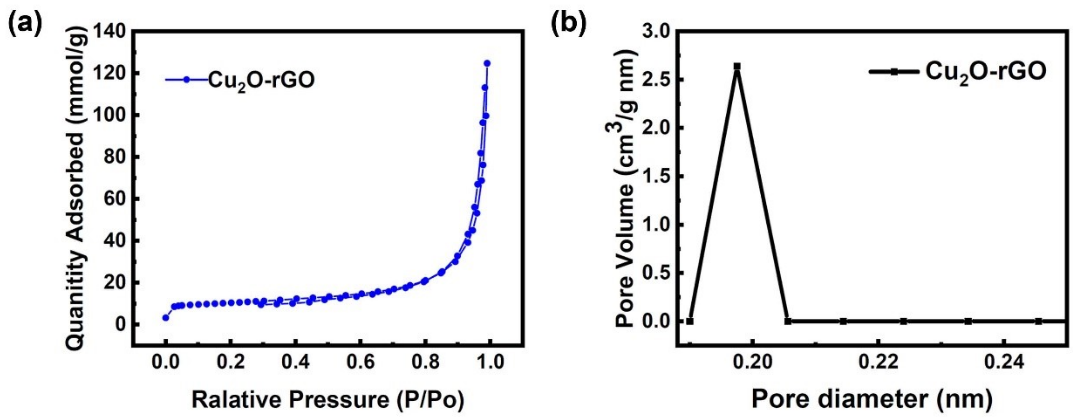

Fig. S7. (a) N_2 adsorption/desorption isotherms and (b) corresponding pore-size distribution of Cu_2O-rGO.

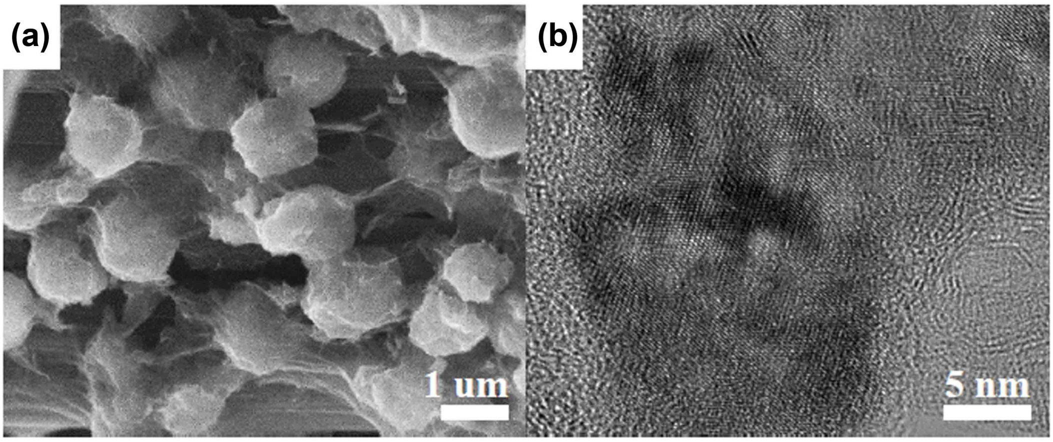

Fig. S8. SEM (a) and TEM (b) of Cu_2O-rGO after OER.

Table S2. Literature survey on potential and Tafel slope of the Cu-based nanostructures for OER.

Electrocatalysts	**Electrolyte**	***j* *[mA cm^{-2}]***	**potential (V *vs* RHE)**	**Tafel slop (mV dec^{-1})**	**References**
Cu_2O-rGO/CC	1.0 M KOH	10 50 100	1.51 1.70 1.76	178.1	*this work*
RuO_2	1.0 M KOH	10	1.54	82.6	*this work*
Cu_2O	1.0 M KOH	10	1.75	-	*1*
Cu_2O-Cu foam	1.0 M KOH	10	1.57	70.2	*2*
$CuCoO_x$-FeOOH	1.0 M KOH	10	1.52	93.97	*3*
CuOx-C	1.0 M KOH	10	1.56	181	*4*
Cu_2O@C	1.0 M KOH	10	1.56	63	*5*
Cu_2O/NWAS	1.0 M KOH	10	1.55	-	*6*
Cu_2O	1.0 M KOH	10	1.76	128	*7*
IrO_2	1.0 M KOH	10	1.51	69	*8*
RuO_2	1.0 M KOH	10	1.51	81	*9*

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