Supporting Information for

Coupling SnS2 and rGO aerogel to CuS towards Enhanced Light-assisted OER Electrocatalysis

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Materials Preparation

Preparation of SnS_2 powder In a typical hydrothermal process, stannous chloride dihydrate ($SnCl_2 \cdot 2H_2O$), ethylenediamine tetraacetic acid disodium salt (EDTA-Na_2) and thiourea (CN_2H_4S) were successively dissolved into 60ml mixed solvent with water and ethylene glycol (1:1 volume ratio), and then were mixed successively under vigorous magnetic stirring for 1 h at room temperature. The reaction mixture was transferred into a 100 mL Teflon-lined stainless steel autoclave, filled up to 80% of the total volume with deionized water. After being sealed and heated in an electric oven at 180℃ for 24 h, the solution mixtures were cooled down naturally to room temperature. The resulting tan-coloured precipitate was collected by centrifugation, washed with distilled water and absolute ethanol for several times, and finally dried in a vacuum oven at 60℃ overnight.

Preparation of CSr composites 10 mg of GOA was ultrasonically dispersed in a mixture of 40 mL water and ethylene glycol (1:1 volume ratio) for 1h. The obtained SnS_2 powder was added to the above solution with ultrasonic and fully stirred. $CuCl_2 \cdot 2H_2O$ and thiourea dissolved in 20 mL deionized water, respectively, and then added into the above solution under vigorous stirring for 1 h. After the suspension went through the same hydrothermal process, the as-prepared product was thoroughly washed with deionized water and ethanol and then freeze-dried. The detail synthetic process is shown in Scheme 1. Through changing the amounts of SnS_2 powder, CSr composites with different mass percentage of SnS_2 in the composite were synthesized, and denoted as CSr-36.9%, CSr-60.8% and CSr-90%, respectively.

Light-assisted Electrochemical Measurements

In a typical working electrode preparation procedure, the as-synthesized catalysts (10 mg) was dispersed in 1 mL ethonal and 50 mL Nafion solution (5%) solution via ultrasonic dispersion for 20-30

min to obtain homogenous slurry. The obtained slurry was then coated onto Ni foam (NF, 1×1 cm^2) and then dried at room temperature which was used as the working electrode.

All current densities presented were corrected against ohmic potential drop. Linear sweep voltammetry (LSV) was performed at a scan rate of 5 mV/s. The 1000th cyclic voltammetry (CV) measurement was conducted between 0.8 and 1.4 V *vs*. the reversible hydrogen electrode (RHE) in 1.0 M KOH solution for OER to investigate the stability. The electrochemical double-layer capacitance (C_{dl}) of the catalysts was determined at various cyclic voltammetry scan rates. Electrochemical impedance spectroscopy (EIS) was measured with a frequency range from 0.1 Hz to 100 kHz and Nyquist plots were collected at 1.54 V. All the measured potentials were corrected to the reversible hydrogen electrode (RHE) by the following equation :

$$E\ (vs.\ RHE) = E\ (vs.\ Hg/HgO) + 0.098 + 0.0591 \times pH.$$

Results and discussion

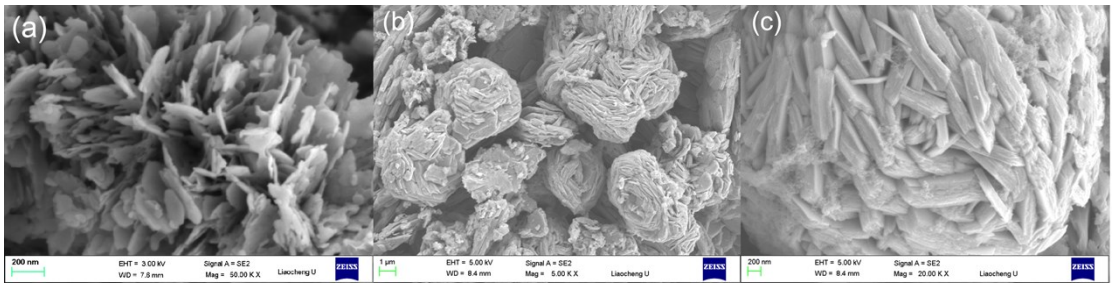

Fig. S1 FESEM image of as-synthesized CSr heterostructure at high magnification (a) and SnS_2 at low and high magnification (b and c).

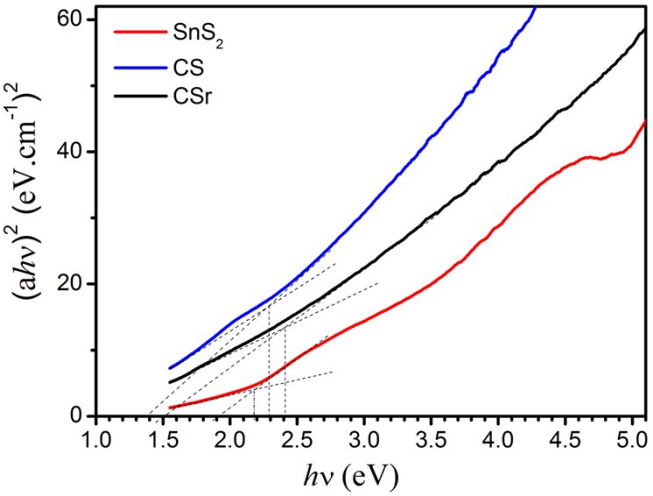

Fig. S2 UV-Vis DRS corresponding Tauc plots of all samples.

Table S1 BET data of all samples.

Sample	BET surface area (m^2/g)	Average pore size (nm)	Total pore volume (cm^3/g)
SnS_2	2.05	17.13	0.015
CS	7.76	8.71	0.032
CSr	14.65	18.46	0.089

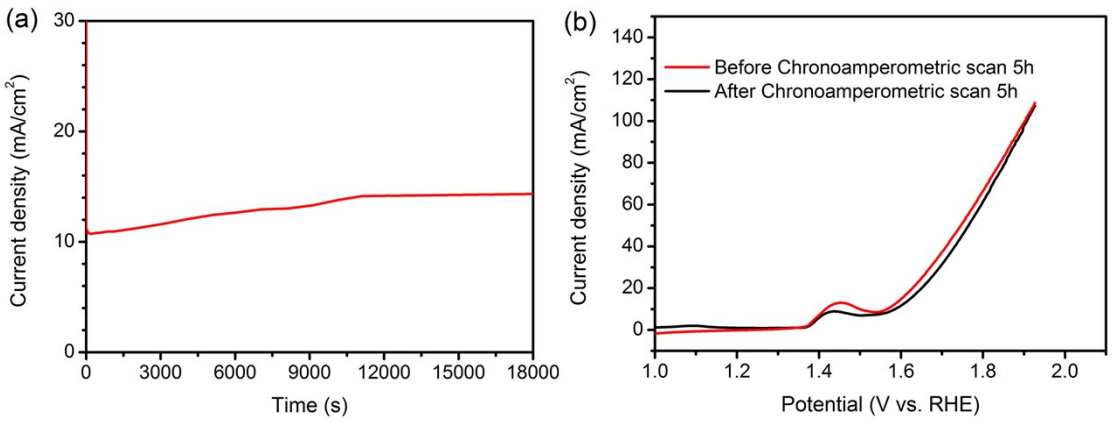

Fig. S3 (a) Chronoamperometric curve of CSr/NF electrode at 1.56 V (vs. RHE) under light-assisted condition, (b) LSV polarization curves of before and after Chronoamperometric scan 5h.

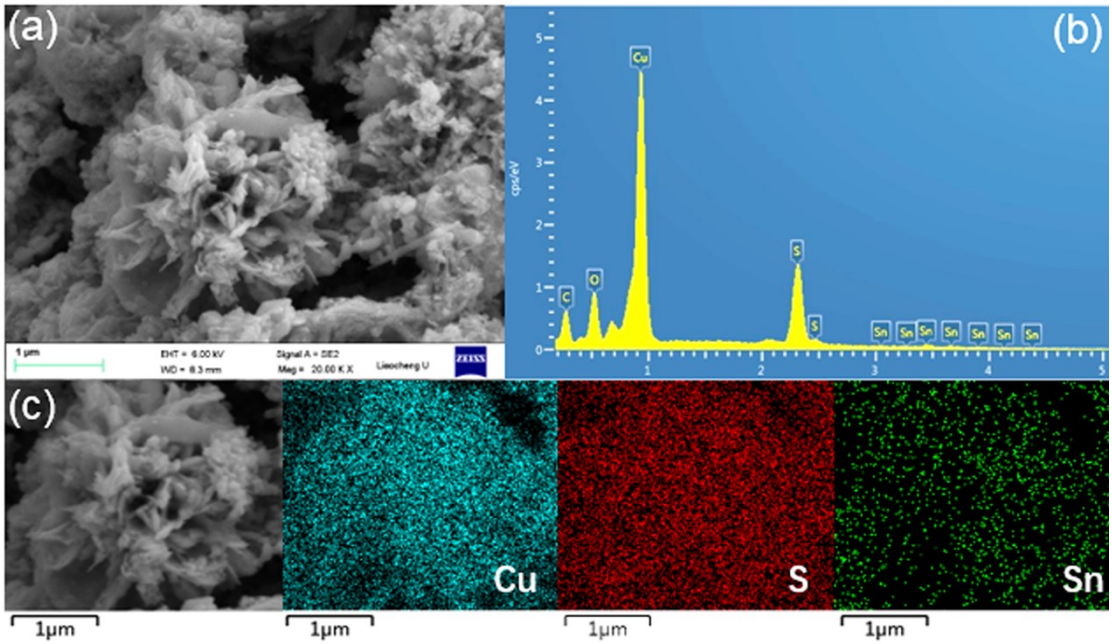

Fig. S4 (a) FESEM image, (b) EDS spectra and (c) Elemental mapping of CSr sample.

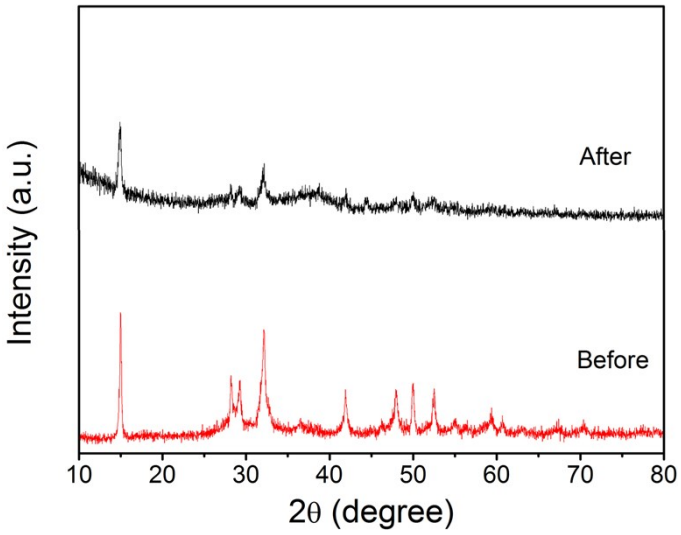

Fig. S5 XRD patterns of CSr sample before and after OER.

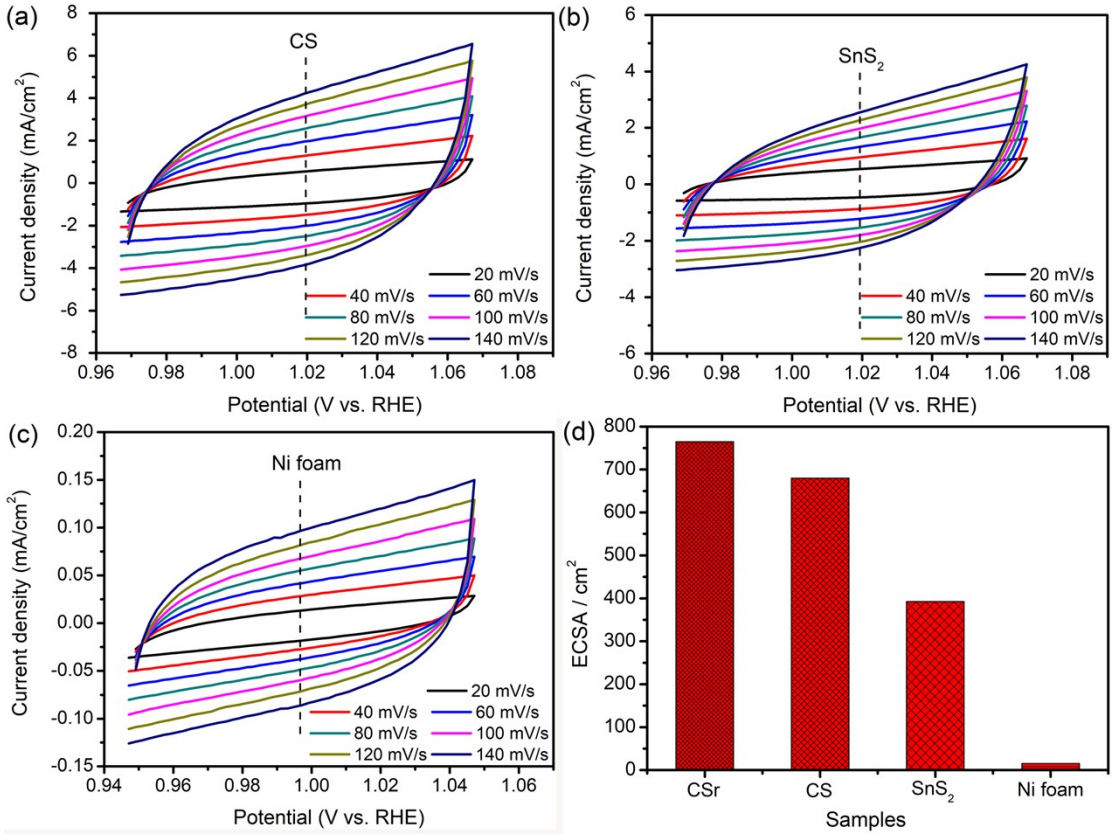

Fig. S6 Cyclic voltammetry curves for (a) CS/NF, (b) SnS_2/NF, (c) Ni foam, and (d) ECSA data of all samples.

Table S2 EIS analysis (R_s and R_{ct}) of Ni foam, SnS_2, CS, and CSr electrodes.

Parameter	Electrode			
	Ni foam	SnS_2	CS	CSr
R_s (Ω)	1.610	1.598	2.630	1.782
R_{ct} (Ω)	60.90	29.71	25.90	8.715

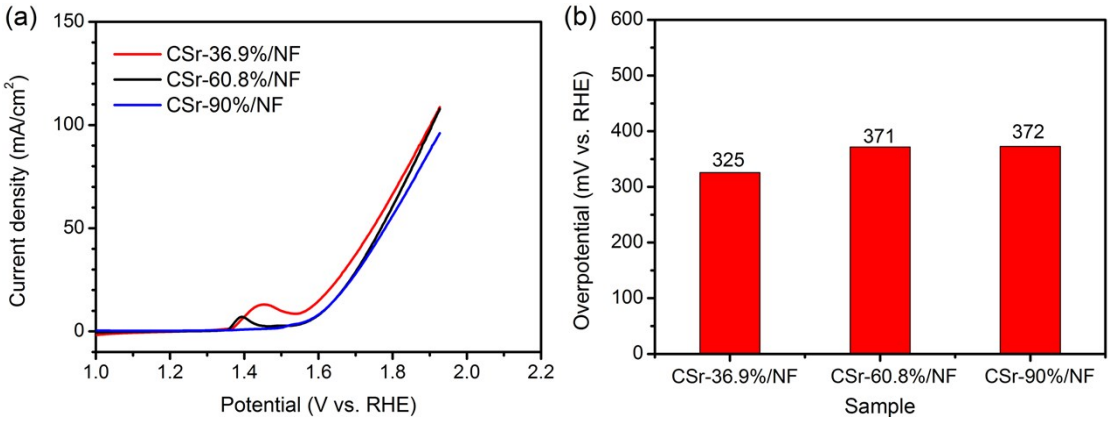

Fig. S7. (a) The OER catalytic performance without light irradiation of different mass percentage of SnS_2 in CSr composite and (b) Corresponding overpotential at current density of 10 mA/cm^2.