Supporting Information

Controlled Phase Evolution from $Cu_{0.33}Co_{0.67}S_2$ to $Cu_3Co_6S_8$ Hexagonal Nanosheet as Oxygen Evolution Reaction Catalysts

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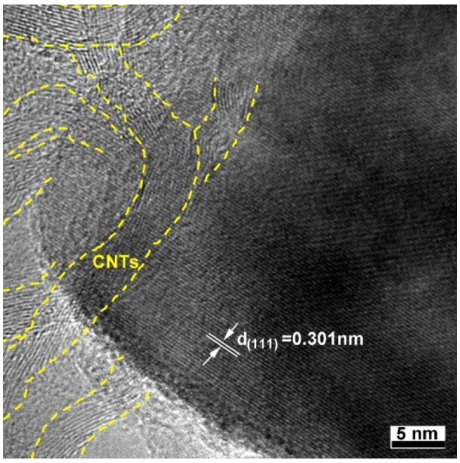


Fig. S1. high-resolution TEM image of $Cu_{0.33}Co_{0.67}S_2$/CNT.

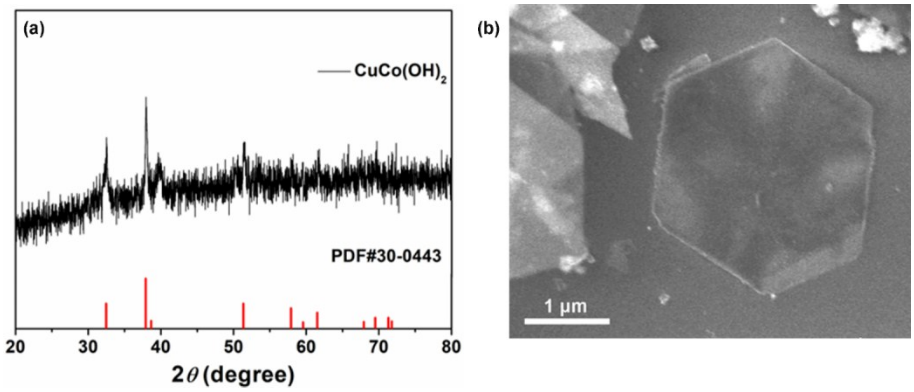


Fig. S2. (a) XRD pattern and SEM image of $CuCo(OH)_2$.

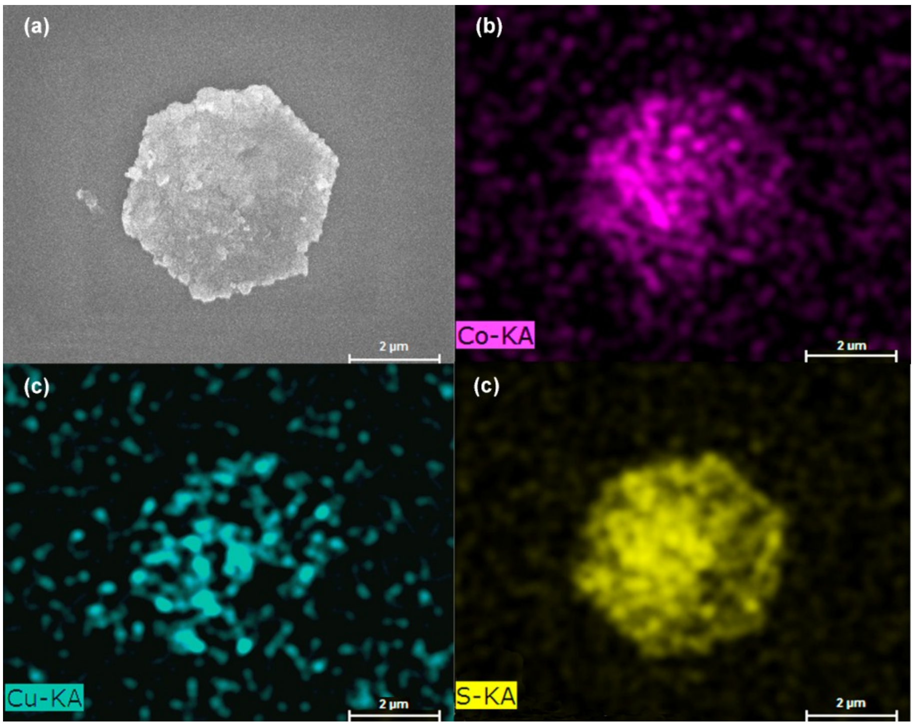


Fig.S3. (a)HAADF-SEM image and (b–d) elemental mapping images of $Cu_{0.33}Co_{0.67}S_2$.

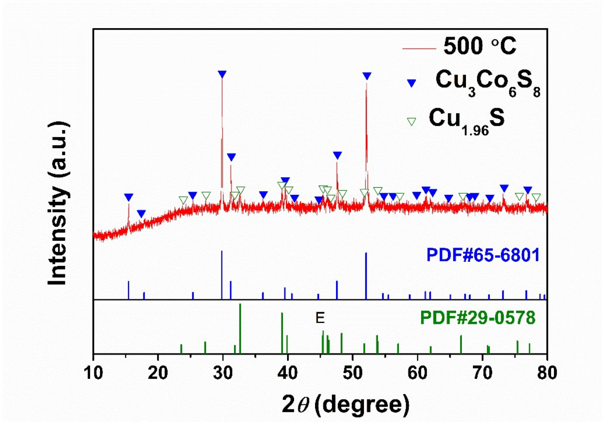
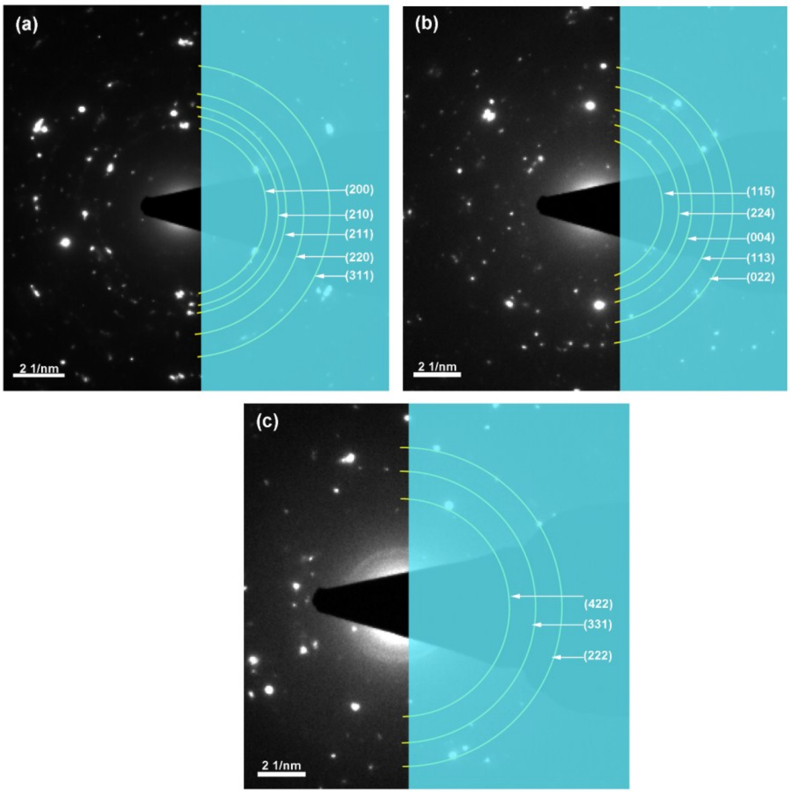


Fig. S4. XRD pattern of the Cu-Co-S product at 500 °C.



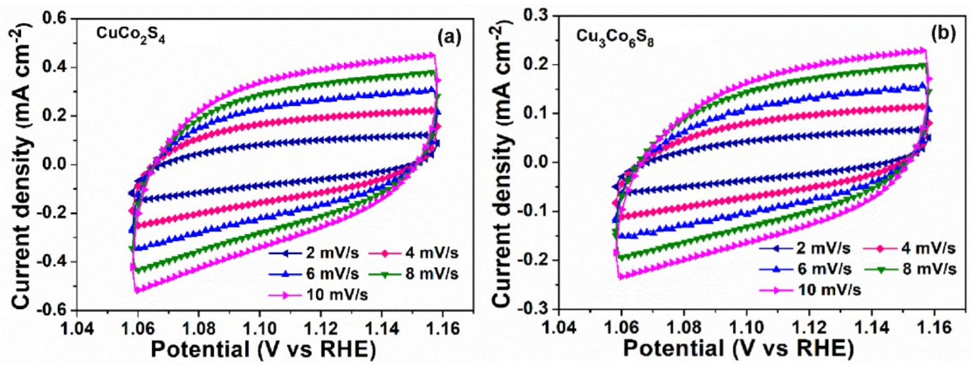


Fig. S5. the corresponding SAED pattern of (a) $Cu_{0.33}Co_{0.67}S_2$, (b) $CuCo_2S_4$ and (c) $Cu_3Co_6S_8$.

Fig. S6. CVs of (a) $CuCo_2S_4$ and (b) $Cu_3Co_6S_8$ at various scanning rates.

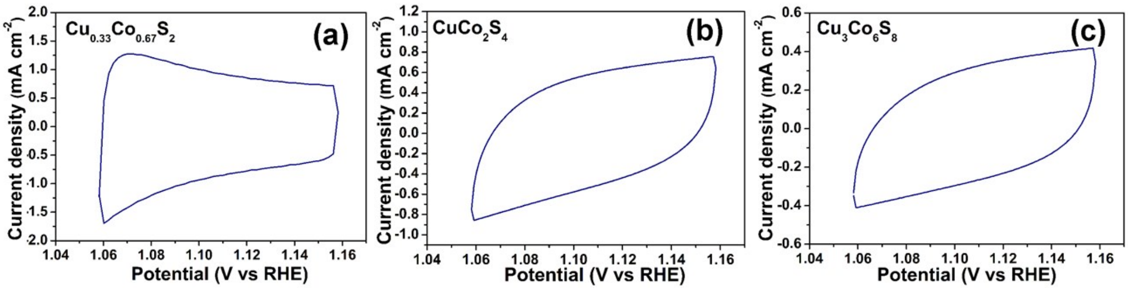


Fig.S7. Cyclic voltammograms of (a) $Cu_{0.33}Co_{0.67}S_2$, (b) $CuCo_2S_4$ and (c) $Cu_3Co_6S_8$ at 20 mV/s in 1 M KOH**.**

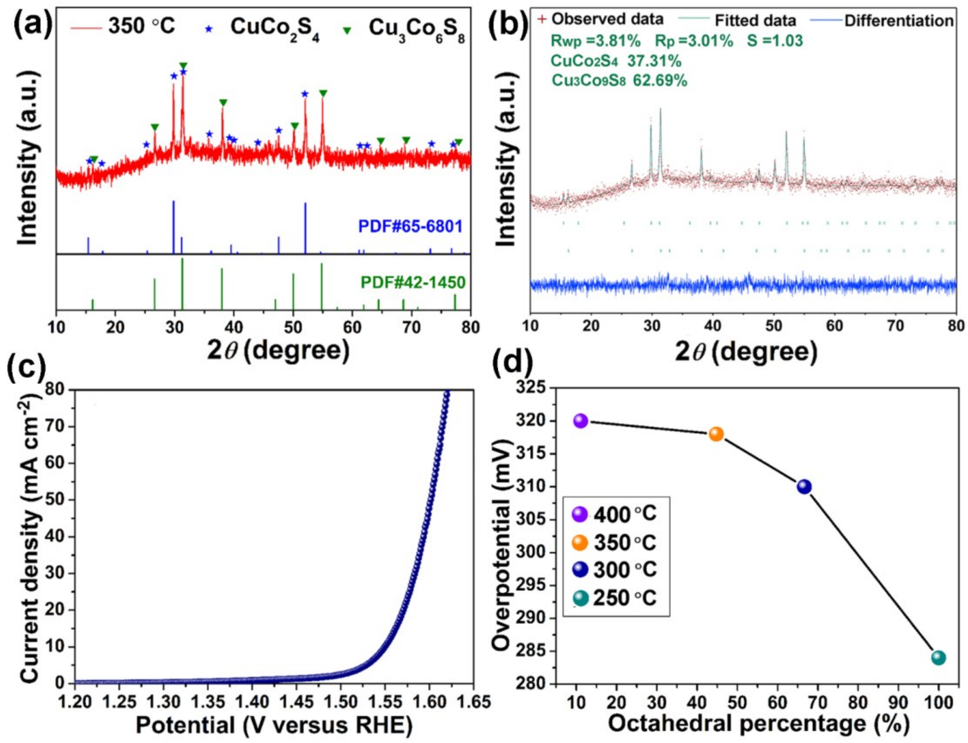


Fig.S8. (a) XRD pattern of the Cu-Co-S product at 350 °C. (b) Rietveld refinement of the XRD pattern of the Cu-Co-S product at 350℃. (c) LSV curve of the product at 350 ℃. (d) The Relationship of the content of octahedron in products at different temperatures with their overpotential performance.

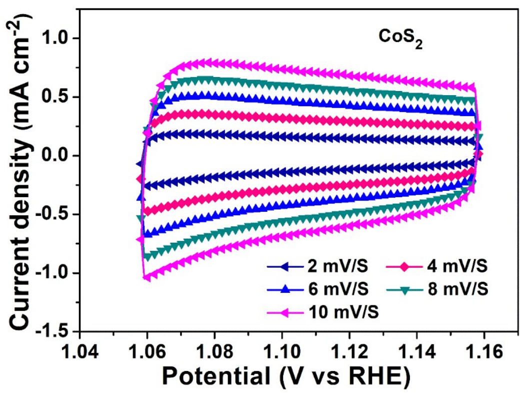


Fig. S9. CVs of CoS_2 at different scan rates.

Table. S1. Summary of the electrochemical activities of $Cu_{0.33}Co_{0.67}S_2$, $CuCo_2S_4$, $Cu_3Co_6S_8$ and CoS_2 for OER.

Catalyst	Overpotential@10 mA cm^{-2} (mV)	Tafel slope (mV dec^{-1})	C_{dl} (mF cm^{-2})	TOF (s^{-1})	R_{ct}
$Cu_{0.33}Co_{0.67}S_2$	284	86	76.32	13.512 s^{-1} @280 mV 19.814 s^{-1} @300 mV 32.045 s^{-1} @320 mV 49.940 s^{-1} @340 mV	47
$CuCo_2S_4$	310	90	31.26	6.701 s^{-1} @280 mV 9.799s^{-1} @300 mV 16.156s^{-1} @320 mV 27.518 s^{-1} @340 mV	54
$Cu_3Co_6S_8$	320	91	15.56	4.244 s^{-1} @280 mV 6.548 s^{-1} @300 mV 11.099 s^{-1} @320 mV 19.570 s^{-1} @340 mV	72
CoS_2	343	98	67.03	2.081 s^{-1} @280 mV 2.8112 s^{-1} @300 mV 4.905 s^{-1} @320 mV 9.638 s^{-1} @340 mV	48

Table. S2. Rietveld refinement results for the XRD patterns of the $Cu_{0.33}Co_{0.67}S_2$ and CoS_2.

Sample	Phase	Space group	Lattice parameters			Amount (wt%)	S
			***a*(Å)**	***b*(Å)**	***c*(Å)**		
CoS_2	CoS_2	*Pa-3*	5.524	5.524	5.524	100	1.10
$Cu_{0.33}Co_{0.67}S_2$	CoS_2	*Pa-3*	5.638	5.638	5.638	100	1.05

Table. S3. Comparison of OER performances of $Cu_{0.33}Co_{0.67}S_2$ with other reported similar non-noble metal OER electrocatalysts.

Material	Electrolyte (KOH)	Scan rate (mV s^{-1})	η_{10} (mv)	Ref.
$Co_2P@Co_3O_4$	1.0 M	5	335	1
Co_3S_4@NCNTs	0.1 M	5	430	2
CoS_2 NTA/CC	1.0 M	10	276	3
Co-doped Ni–Mn LDH	1.0M	10	310	4
CoS_2 HNSs	1.0 M	10	290	5
$Co_9S_8/Zn_{0.8}Co_{0.2}S@C$	0.1 M	5	292	6
Co9S8@NS-3DrGO	1.0 M	5	317	7
oxygenated-CoS_2–MoS_2	1.0 M	2	272	8
$Co_xS_y@C$	0.1 M	5	470	9
HPMS Co_3O_4/CoS_2	1.0 M	2	280	10
$Zn_xCo_{3-x}O_4$	1.0 M	10	435	11
Co3O4 Nanoflakes	1.0M	5	451	12
$CoSe_2@C$	1.0 M	10	330	13
$CoSe_2$@C-CNT	1.0 M	5	306	14
Zn-Doped $CoSe_2$	1.0 M	2	356	15
CoFeP NSs	1.0 M	5	305	16
octahedral Co_3O_4 particles	1.0 M	2	301	17
Co_3O_4@rGO	1.0 M	2	313	18
CoS_2@N,S-GO	0.1 M	10	390	19
$Cu_{0.33}Co_{0.67}S_2$	1 M	10	284	This work

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