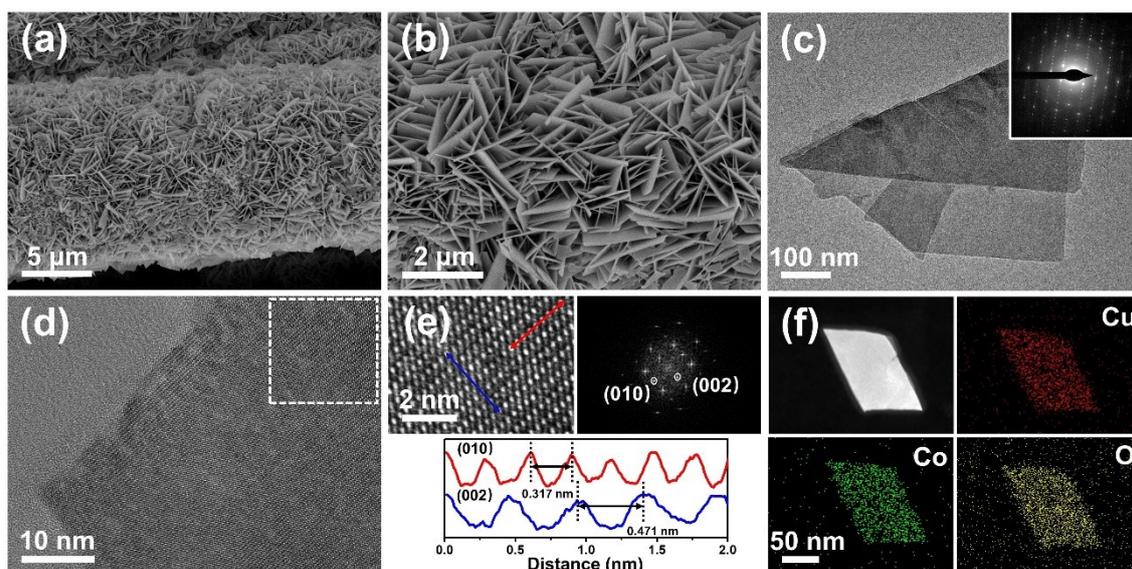
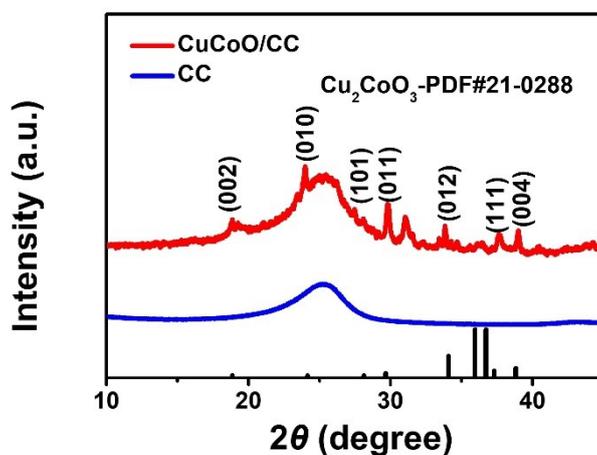


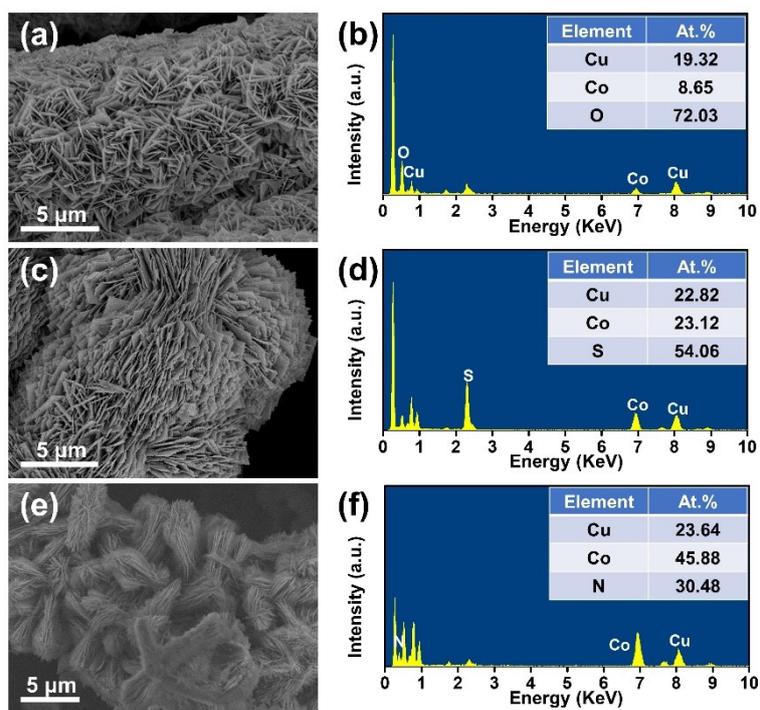
### Electronic Supplementary Information



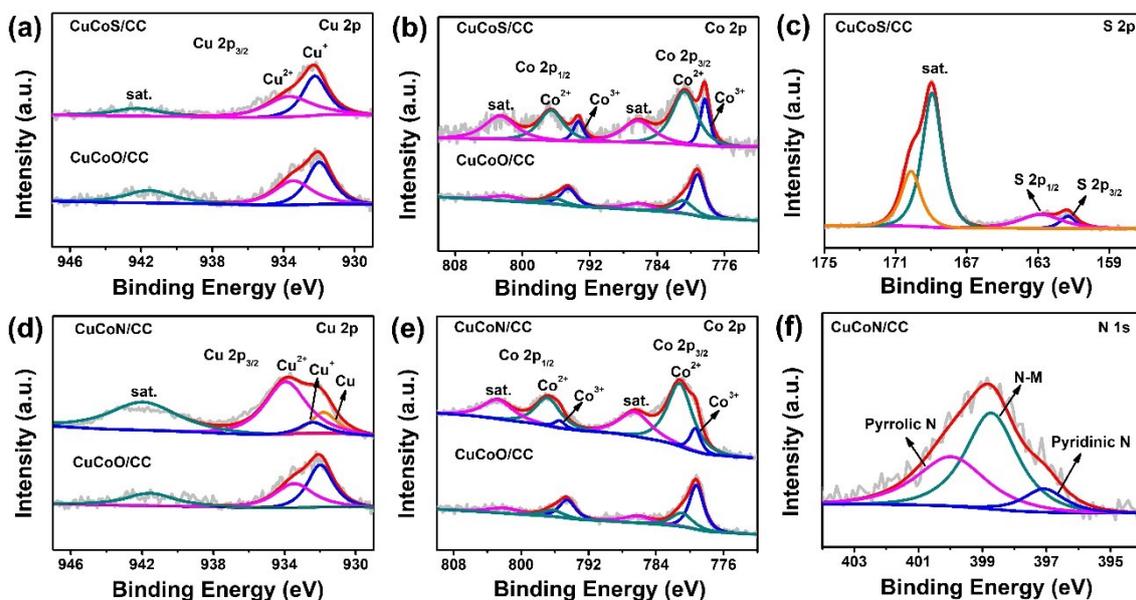
**Fig. S1** (a and b) SEM images, (c) TEM image, (d) HRTEM image, (e) the corresponding patterns of crystal detail, FFT pattern, and interplanar spacing of CuCoO/CC in the selected areas in (d). (f) HAADF-STEM image and the corresponding EDX elemental mapping images of CuCoO/CC. The inset of (c) shows the SAED pattern of CuCoO/CC.



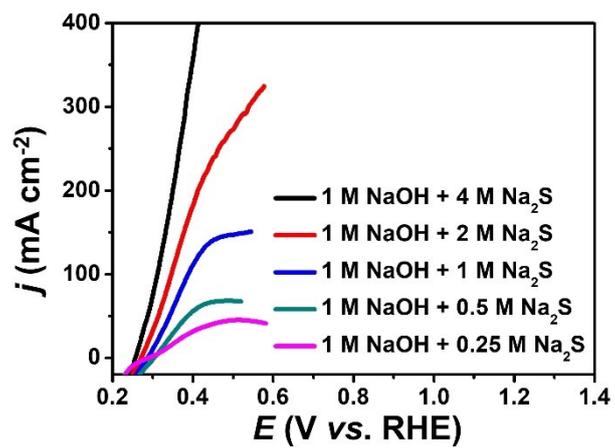
**Fig. S2** XRD pattern of CuCoO/CC.



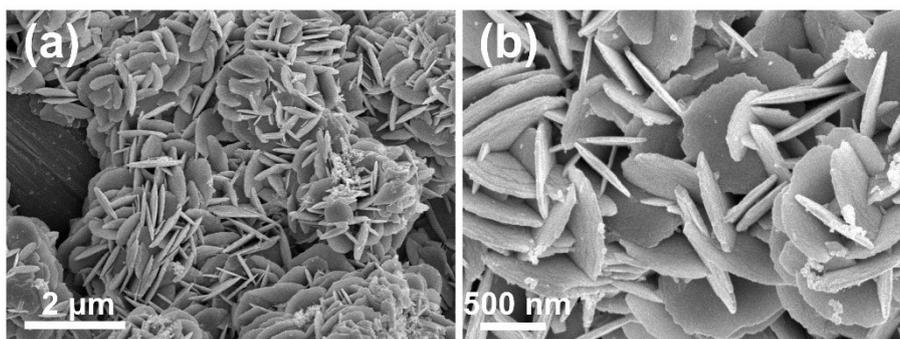
**Fig. S3** (a) SEM image and (b) corresponding EDX image of CuCoO/CC. (c) SEM image and (d) corresponding EDX image of CuCoS/CC. (e) SEM image and (f) corresponding EDX image of CuCoN/CC.



**Fig. S4** XPS spectra of (a) Cu 2p, (b) Co 2p, and (c) S 2p of CuCoS/CC. XPS spectra of (d) Cu 2p, (e) Co 2p, and (f) N 1s of CuCoN/CC.



**Fig. S5** LSV curves of CuCoS/CC in different concentrations of Na<sub>2</sub>S and NaOH hybrid solutions.



**Fig. S6** SEM images of CuS/CC.

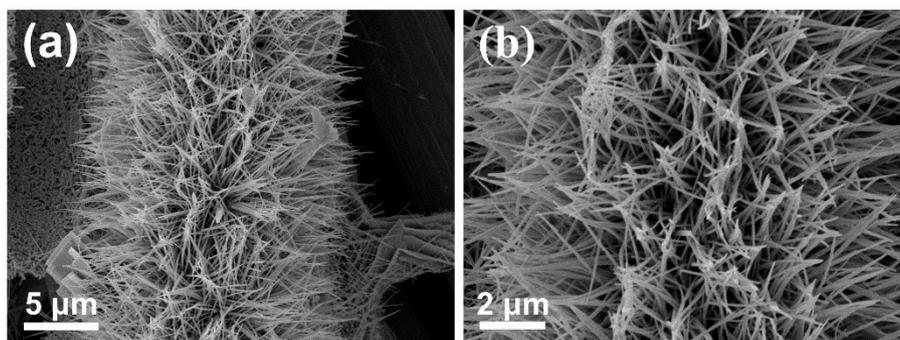


Fig. S7 SEM images of CoS/CC.

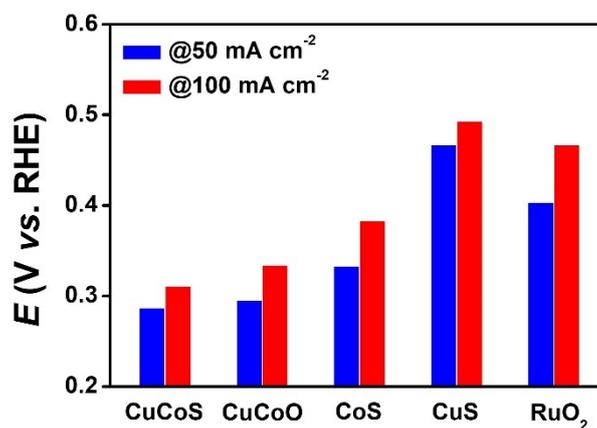
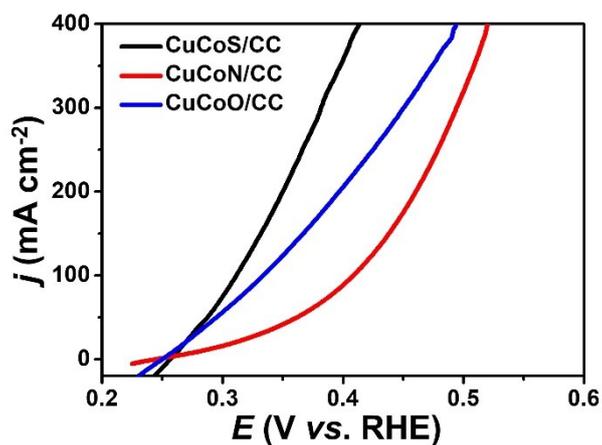
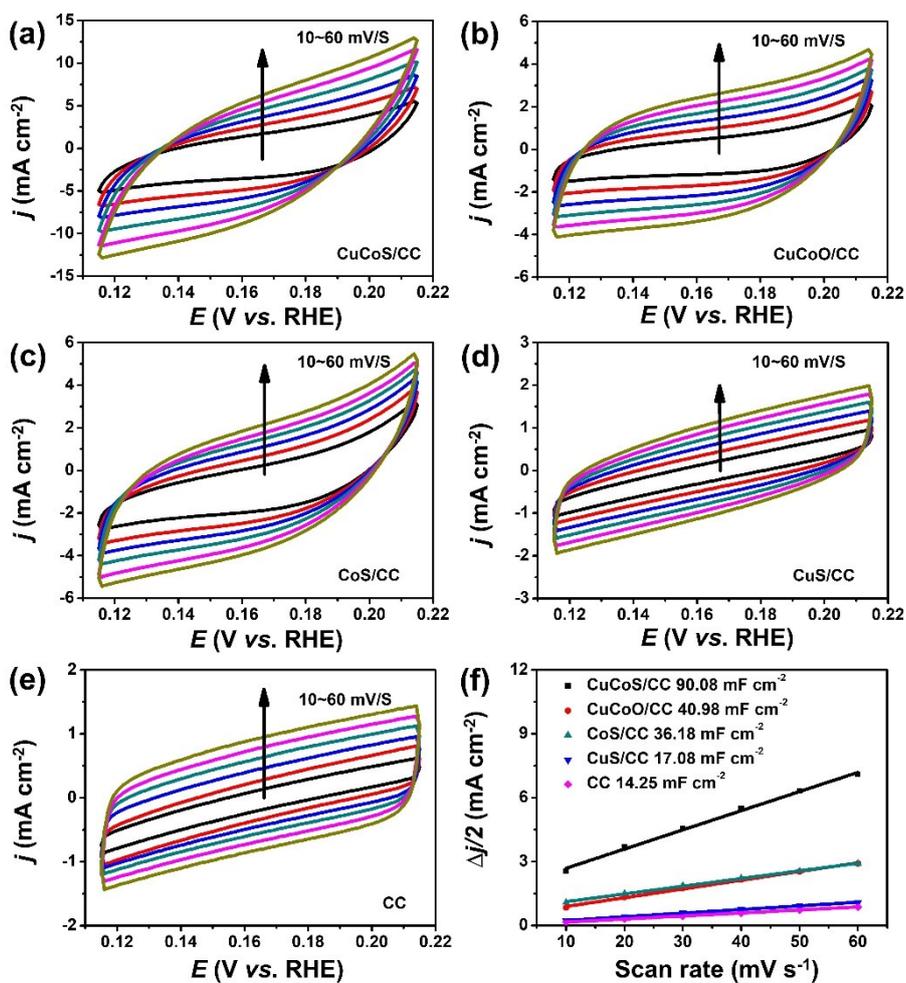


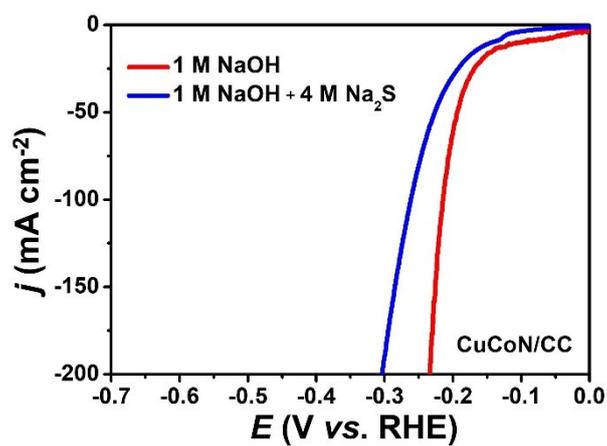
Fig. S8 The potentials of CuCoS/CC and contrast samples with the current densities of 50 mA cm<sup>-2</sup> and 100 mA cm<sup>-2</sup>.



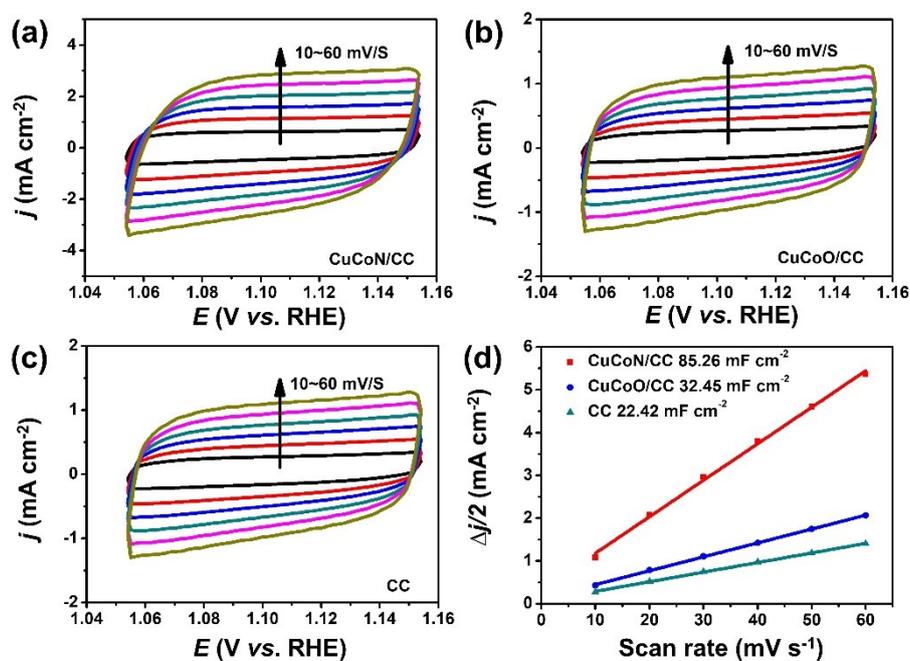
**Fig. S9** LSV curves of CuCoS/CC and contrast samples in 1 M NaOH with 4 M Na<sub>2</sub>S electrolytes.



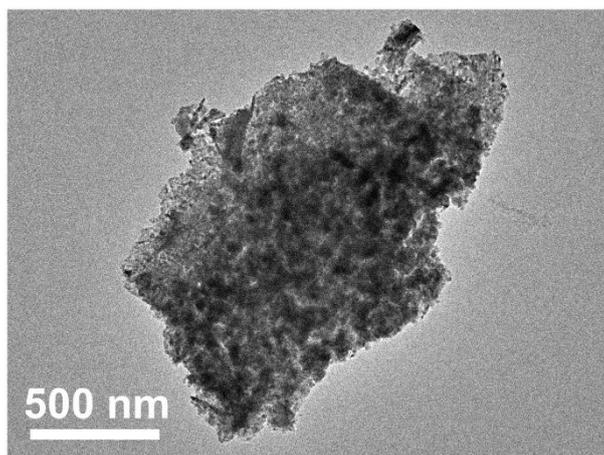
**Fig. S10** (a-e) Cyclic voltammograms for CuCoS/CC and contrast catalysts. (f) Capacitive current densities at 0.165 V were derived from CVs against scan rates for different samples.



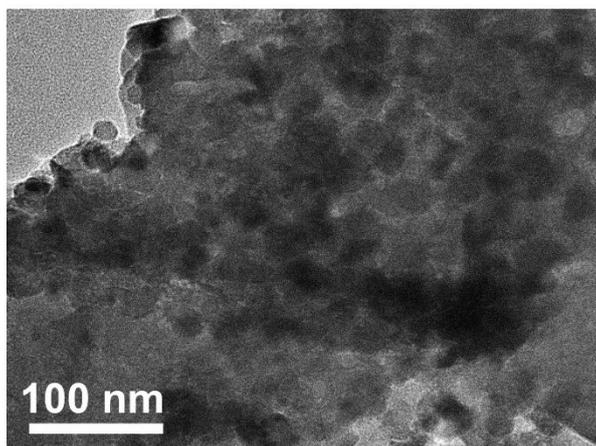
**Fig. S11.** LSV curves of CuCoN/CC in 1 M NaOH or 1 M NaOH with 4 M Na<sub>2</sub>S electrolytes.



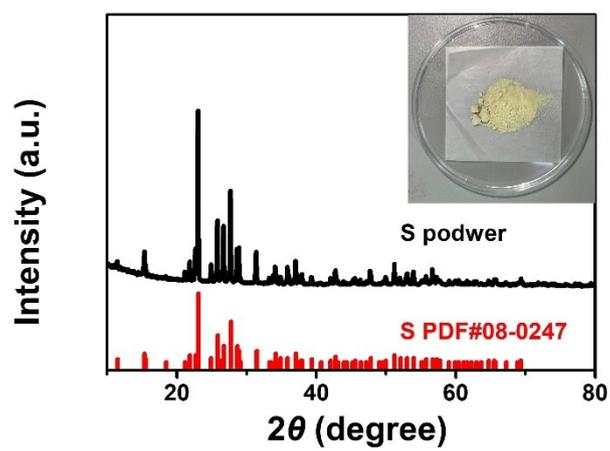
**Fig. S12** (a-c) Cyclic voltammograms for CuCoN/CC and contrast catalysts. (d) Capacitive current densities at 1.105 V were derived from CVs against scan rates for different samples.



**Fig. S13** TEM image of CuCoN/CC after long-term stability testing test.



**Fig. S14** TEM image of CuCoS/CC after long-term stability testing test.



**Fig. S15** XRD pattern of the sulfur powder and the corresponding photograph.