

# Controllable Synthesis of Flower-Like Hierarchical $\text{CuCo}_2\text{S}_4$ Nanostructure Arrays for High-Performance Hybrid Supercapacitors

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## 1. Characterization

The morphology and microstructure were characterized by scanning electron microscopy (SEM, SU8010) and transmission electron microscopy (TEM, Tecnai G2 F20). X-ray diffraction (XRD, a Rigaku D/max-2550 PC) tests were carried out to analyze the p crystal structure with Cu  $K\alpha$  radiation. The chemical state of the samples was analyzed using X-ray photoelectron spectroscopy (XPS, ESCALAB 250Xi). Fourier-transform infrared spectroscopy (FT-IR) was performed on a Perkin-Elmer Spectrum One B instrument using the KBr pellet technique.

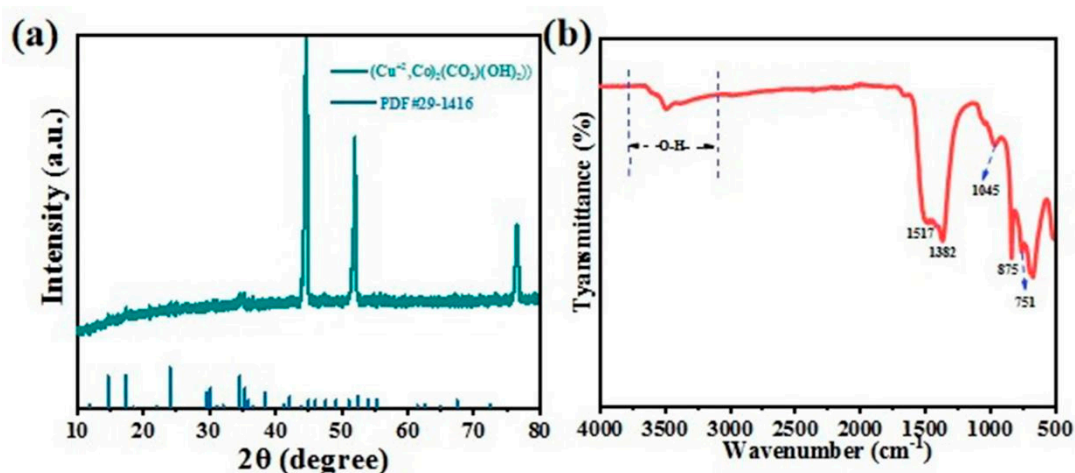


Figure S1. (a) XRD patterns of Cu-CCO, (b) Infrared spectra of Cu-CCO samples.

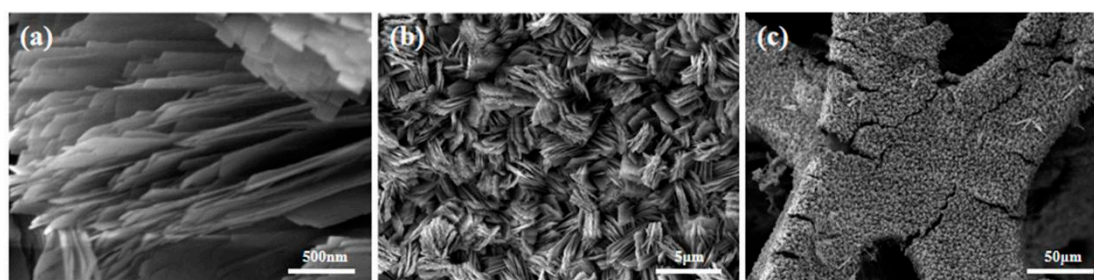


Figure S2. SEM images of Cu-CCO precursor nanosheet arrays.

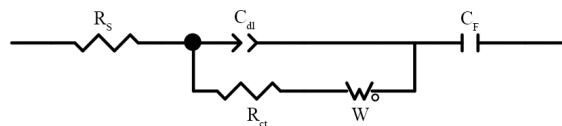


Figure S3. Equivalent circuit for three-electrode configuration cell.

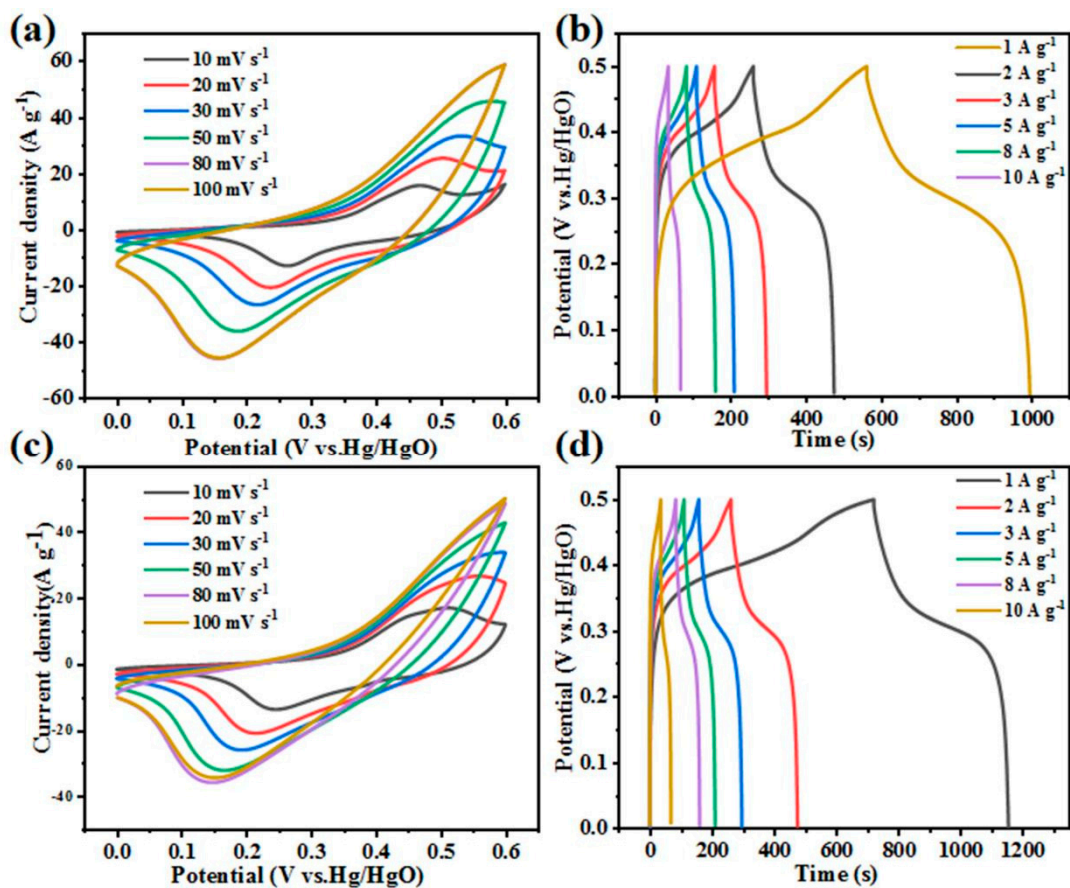


Figure S4. CV and GCD tests at different sulfide concentrations: (a,b) CuCo<sub>2</sub>S<sub>4</sub>-5M; (c,d) CuCo<sub>2</sub>S<sub>4</sub>-7M.

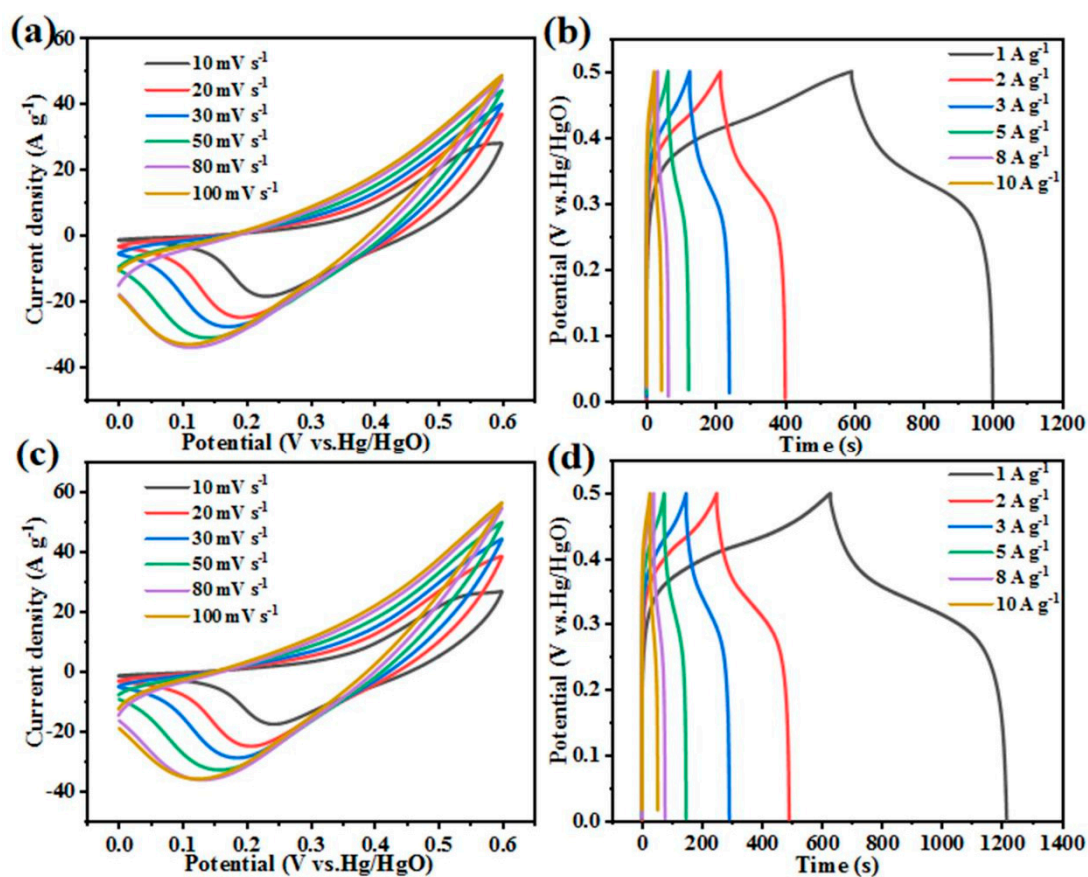


Figure S5. CV and GCD tests with different vulcanization times: (a,b) 4h; (c,d) 8h.

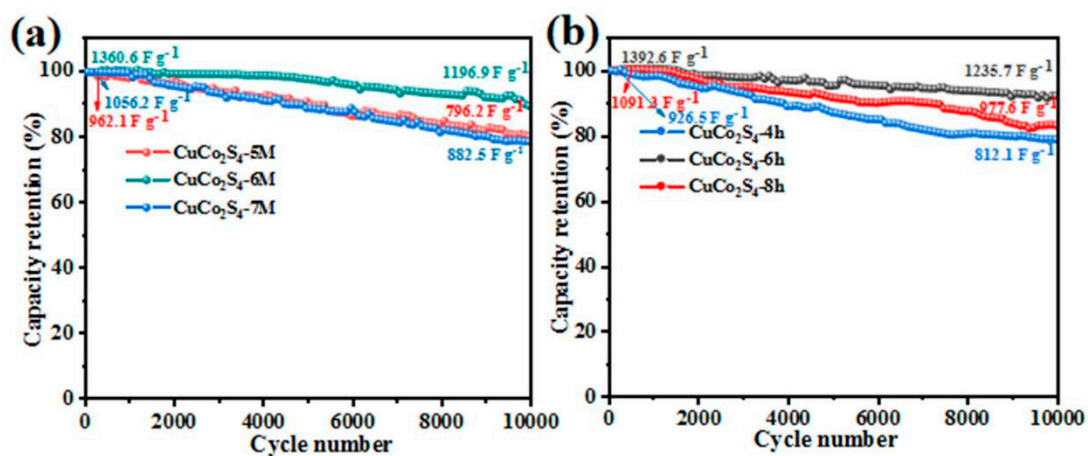


Figure S6. Cycling performance of  $\text{CuCo}_2\text{S}_4$  electrodes with (a) different sulfide concentrations and (b) different vulcanization times after 10,000 cycles at  $10 \text{ A g}^{-1}$ .

Table S1. Performance comparison of similar materials.

Device	Power density ( $\text{W kg}^{-1}$ )	Energy density ( $\text{Wh kg}^{-1}$ )	Cycling performance
HU- $\text{CuCo}_2\text{S}_4$ //AC	4000	49.8	88% retention after 5000 cycles
$\text{CuCo}_2\text{S}_4$ -MoS <sub>2</sub> //AC	400	38.22	89% retention over 1000 cycles
$\text{CuCo}_2\text{O}_4$ @MoNi-LDH//AC	795.9	68.1	88% retention after 6000 cycles

CuCo <sub>2</sub> O <sub>4</sub> @NiMnLDH//AC	730	92.2	85.28% retention after 5000 cycles
CuCo <sub>2</sub> O <sub>4</sub> @NiO//AC	750	38.9	Retention of 81.3% after 6000 cycles
<b>CuCo<sub>2</sub>S<sub>4</sub>/RGO</b>	<b>812.1</b>	<b>61.8</b>	<b>92% retention after 10,000 cycles</b>