

## Supporting Information

### Ferroelectric Modulation of $\text{CuCo}_2\text{O}_4$ Nanorods for Controllable

#### Alkaline Water Electrolysis

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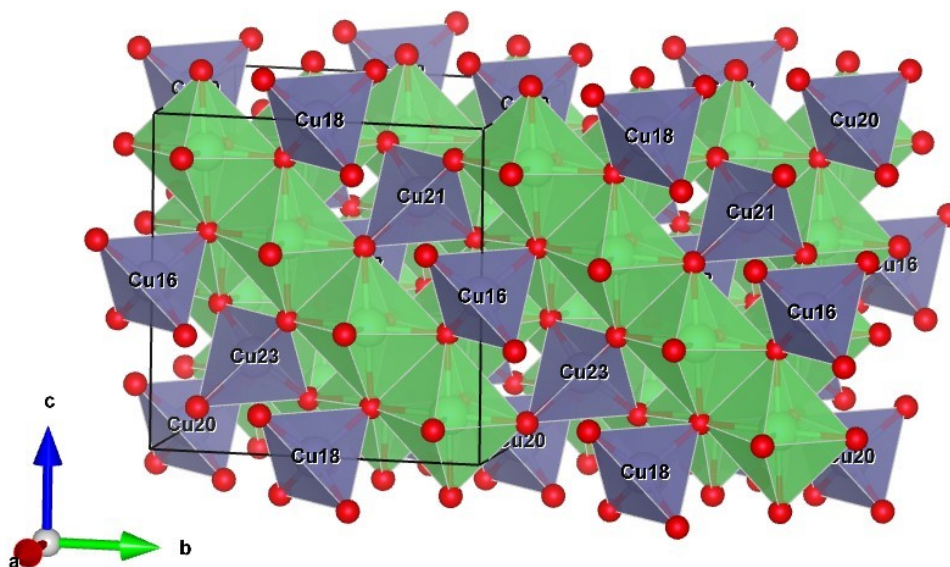


Fig. S1. Crystal topology diagram of polarized  $\text{CuCo}_2\text{O}_4$  nanorods (blue for Cu atoms, green for Co atoms, and red for O atoms).

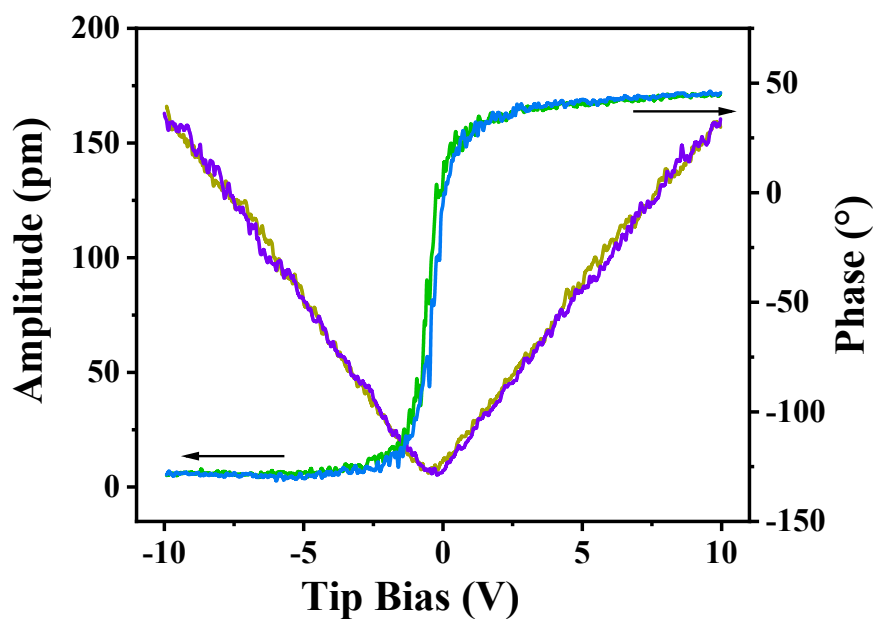


Fig. S2. Amplitude butterfly loops, and piezoresponse phase hysteresis loops for  $\text{CuCo}_2\text{O}_4$  nanorods.

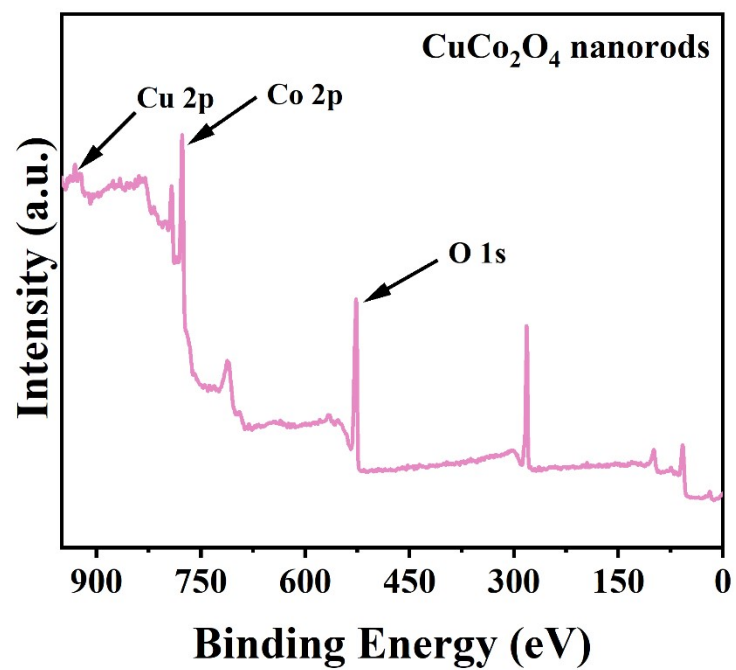


Fig. S3. XPS plot of CuCo<sub>2</sub>O<sub>4</sub> nanorods.

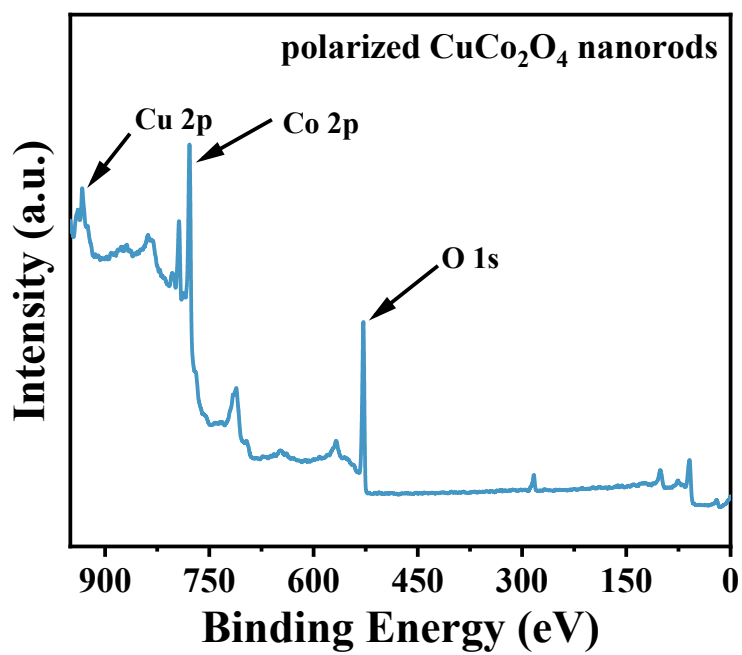


Fig. S4. XPS plot of polarized CuCo<sub>2</sub>O<sub>4</sub> nanorods.

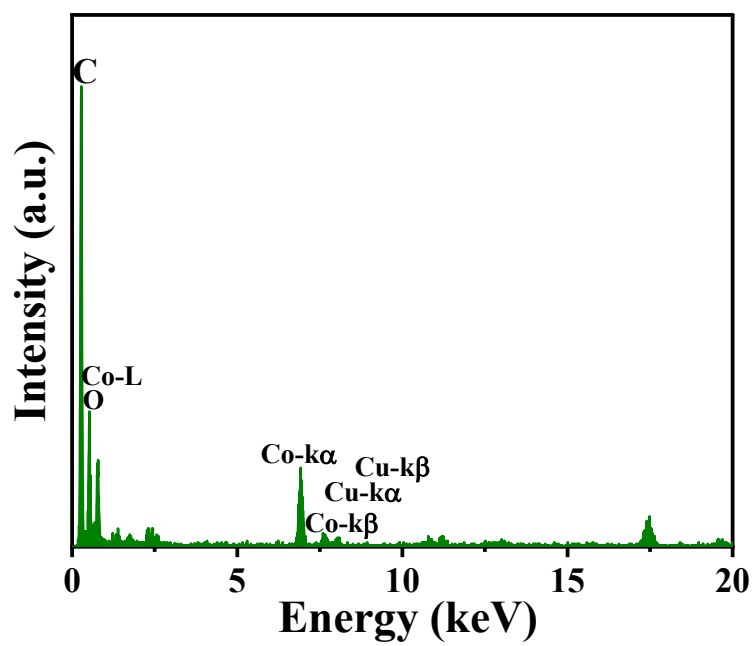


Fig. S5. EDS plot of polarized  $\text{CuCo}_2\text{O}_4$  nanorods.

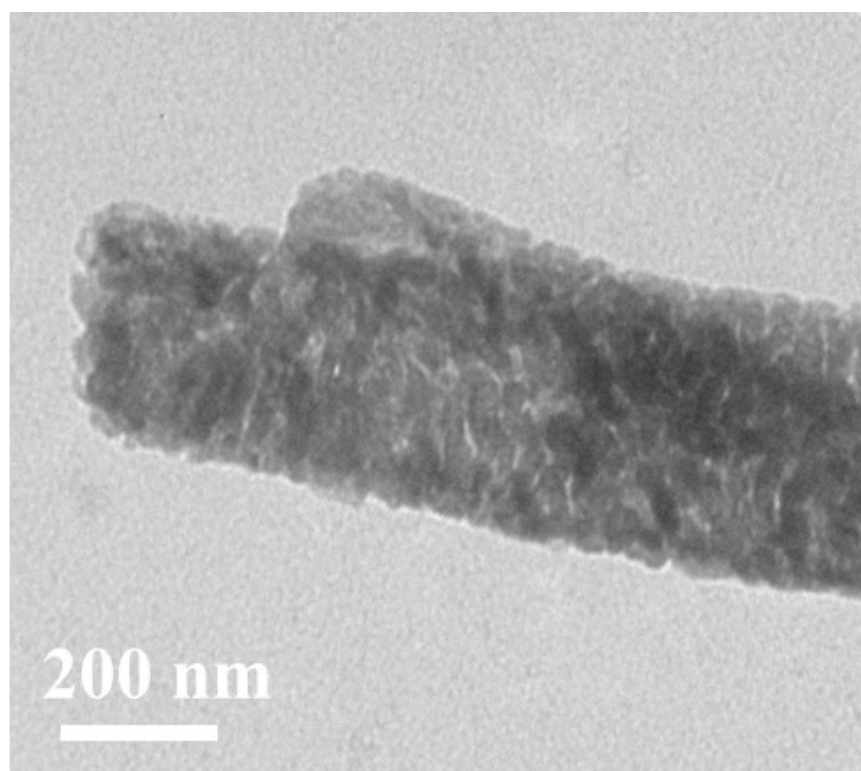


Fig. S6. TEM image of  $\text{CuCo}_2\text{O}_4$  nanorods.

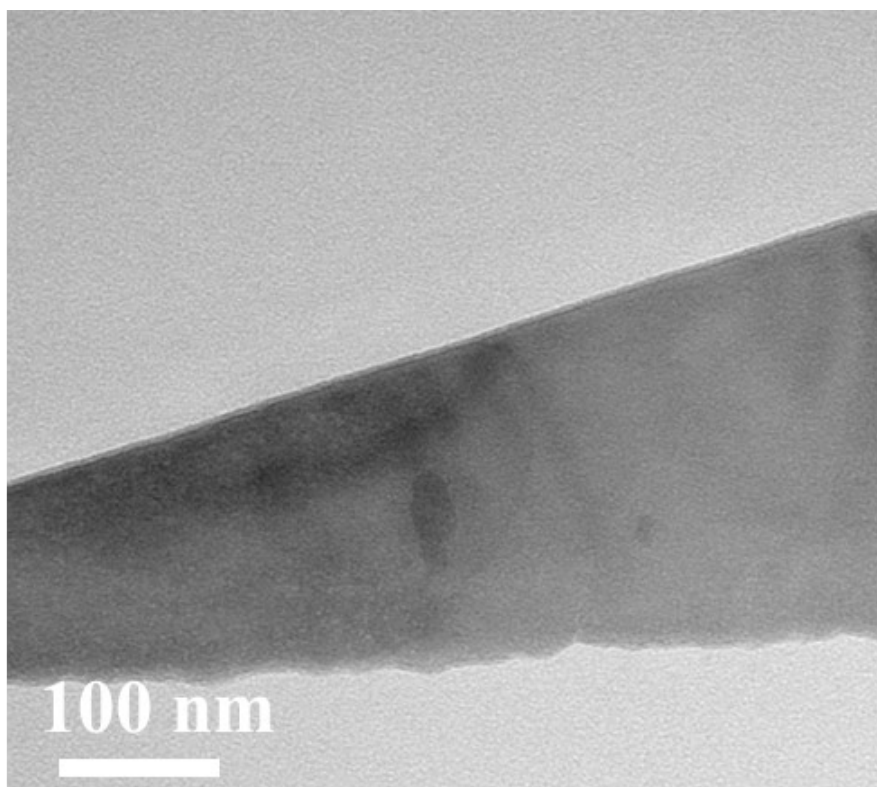


Fig. S7. TEM image of  $\text{CuCo}_2\text{O}_4$  nanorods-pre.

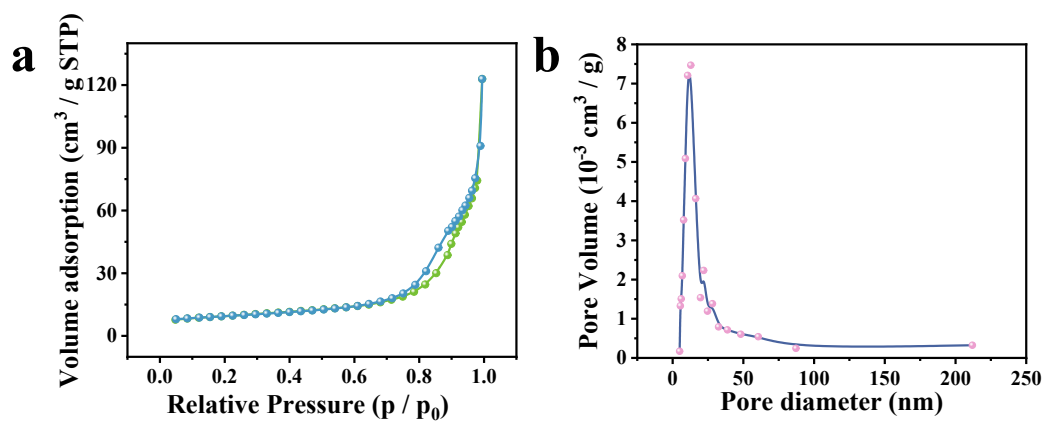


Fig. S8 (a) BET data and (b) pore width distribution curves for polarized  $\text{CuCo}_2\text{O}_4$  nanorods.

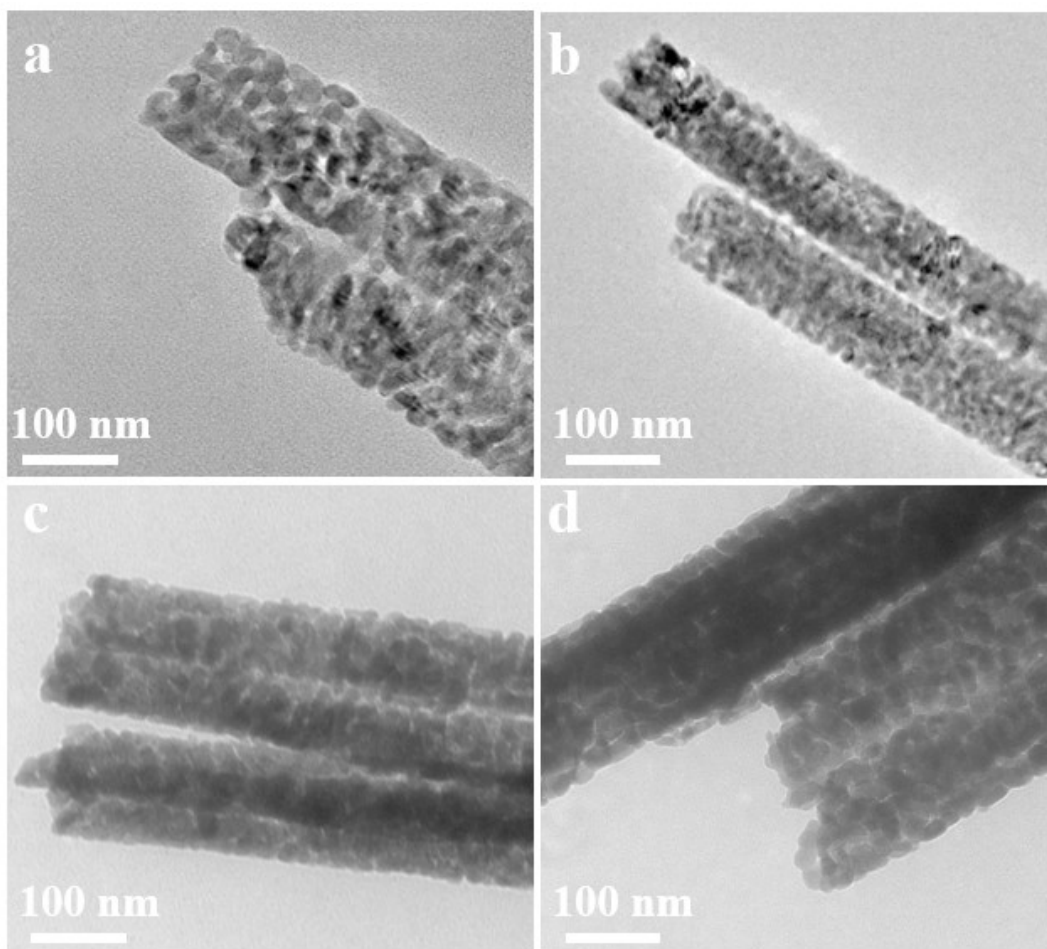


Fig. S9. SEM images of (a) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-18kV; (b) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-20kV; (c) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-22kV; (d) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-24kV.

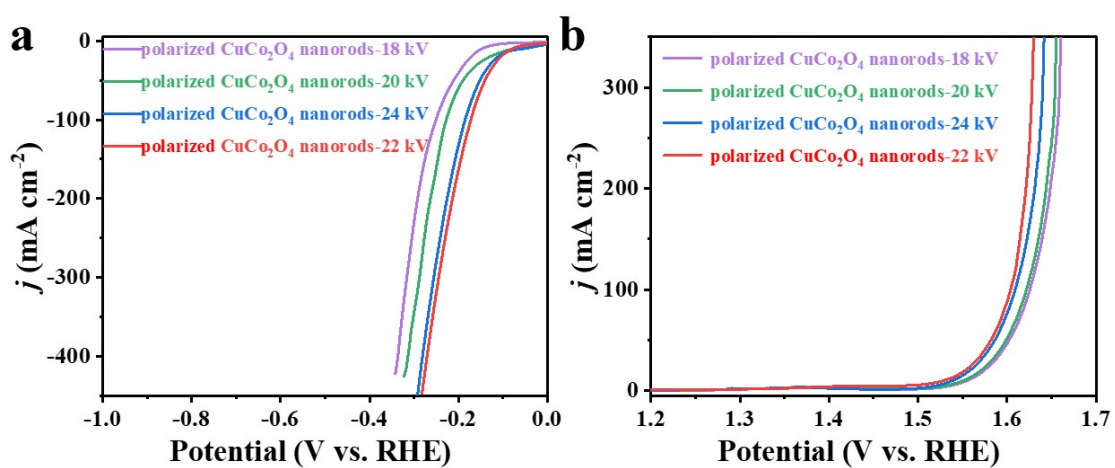


Fig. S10. Electrocatalytic properties of samples at different voltages: (a) HER; (b) OER.

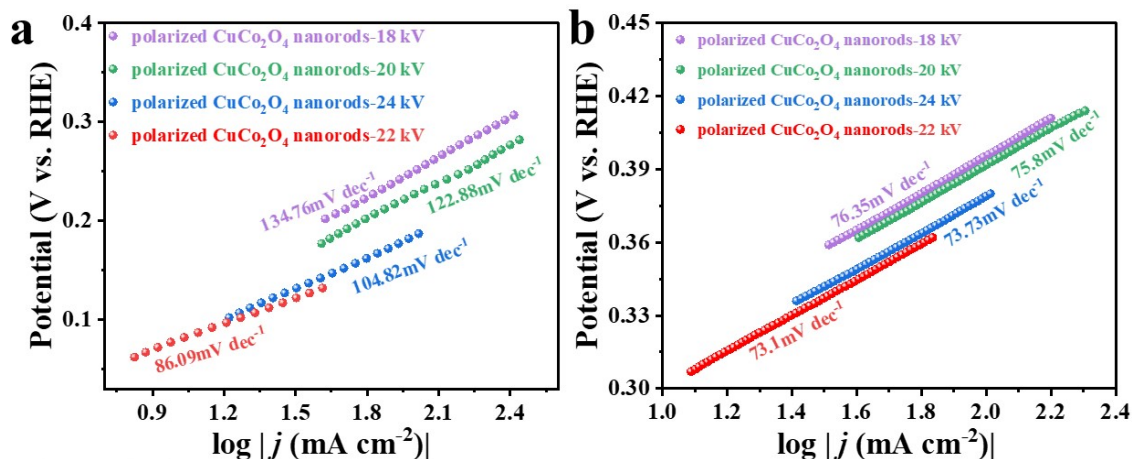


Fig. S11. Tafel efficiency of samples under different voltages: (a) HER; (b) OER.

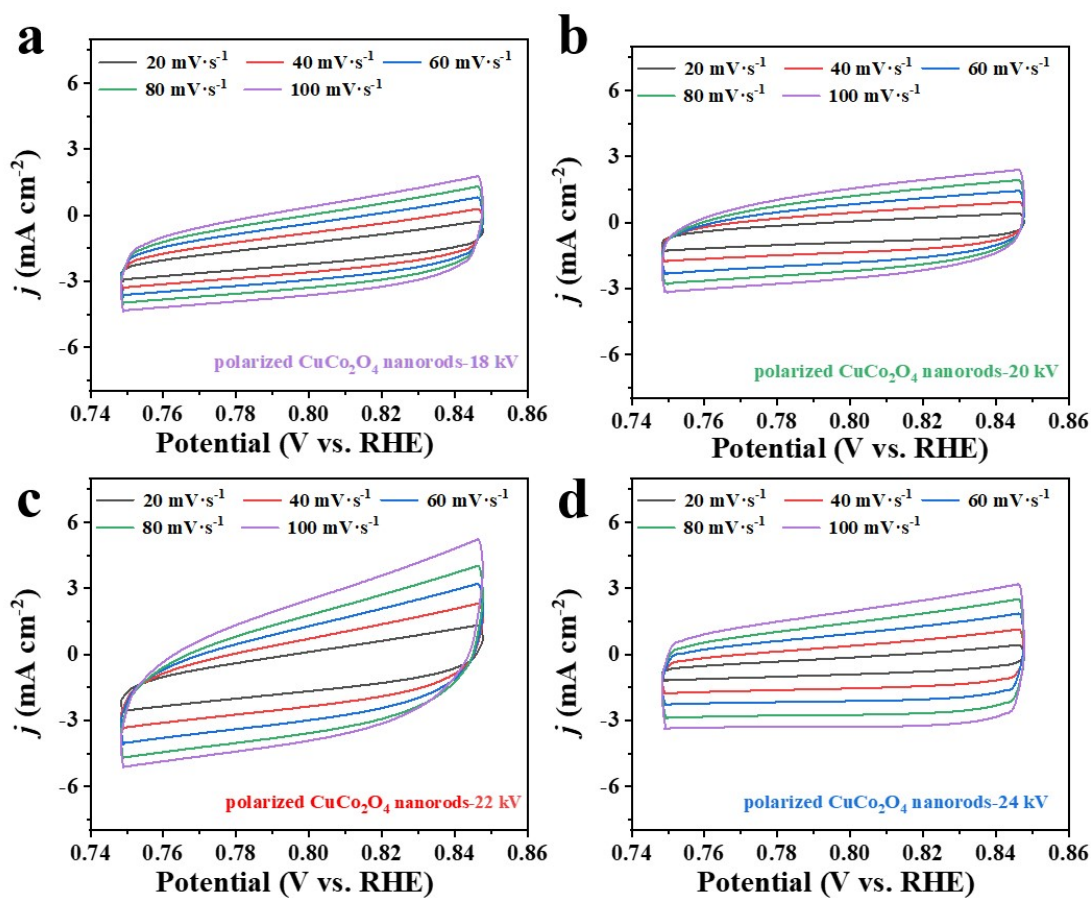


Fig. S12. CV curves for samples under different voltages: (a) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-18kV; (b) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-20kV; (c) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-22kV; (d) polarized  $\text{CuCo}_2\text{O}_4$  nanorods-24kV (20-100  $\text{mV s}^{-1}$  with 20  $\text{mV s}^{-1}$  intervals).

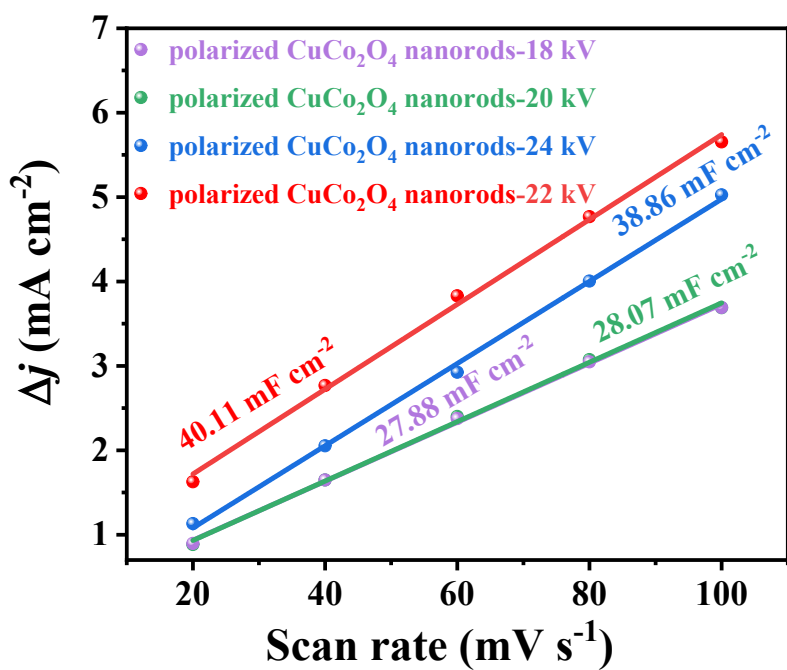


Fig. S13. Cdl plot of samples under different voltages.

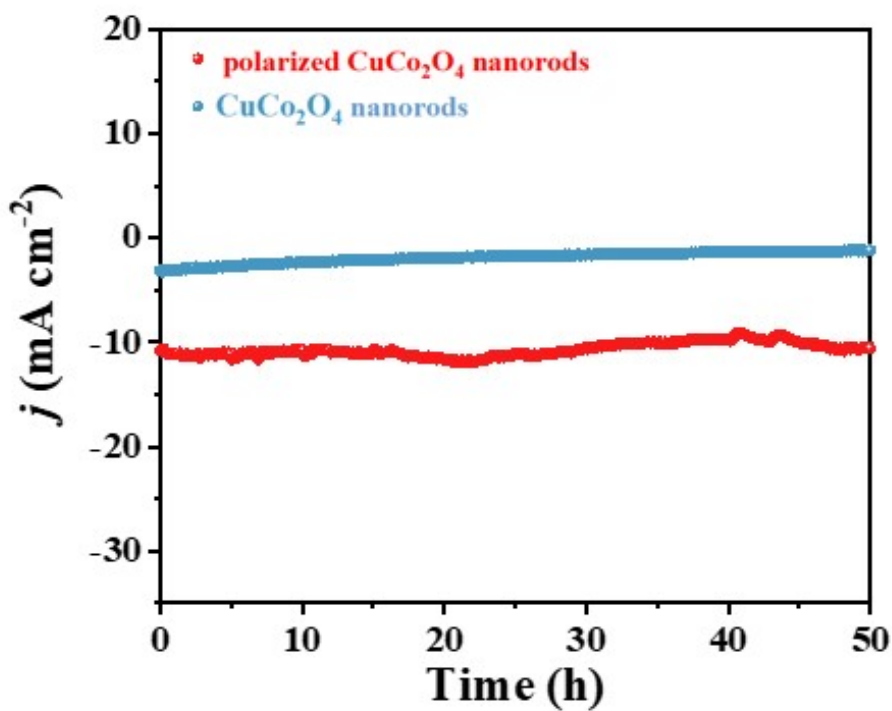


Fig. S14.  $i-t$  curves of polarized  $\text{CuCo}_2\text{O}_4$  nanorods and  $\text{CuCo}_2\text{O}_4$  nanorods at  $10 \text{ mA cm}^{-2}$ .

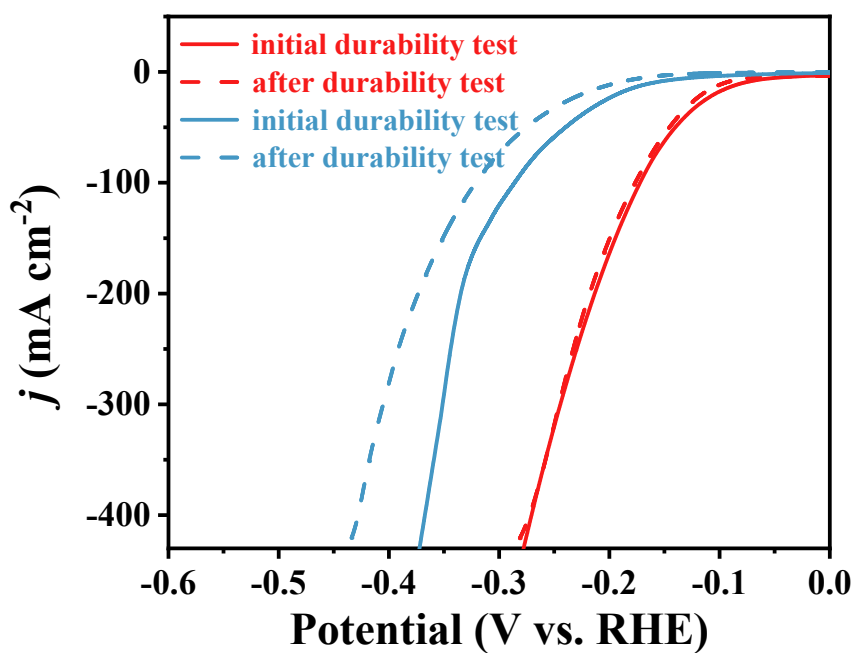


Fig. S15. HER polarization curves of polarized  $\text{CuCo}_2\text{O}_4$  nanorods and  $\text{CuCo}_2\text{O}_4$  nanorods before and after long-term durability testing.

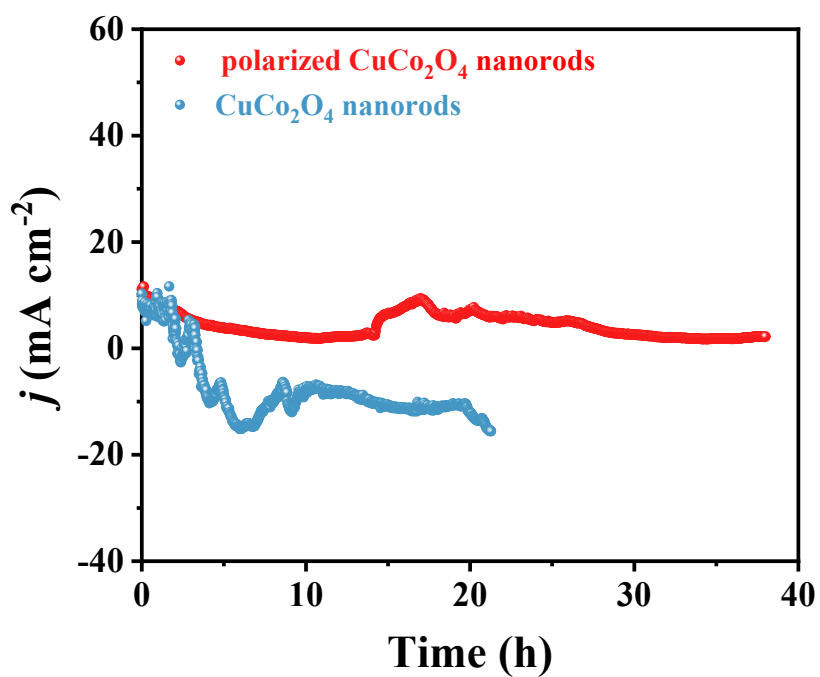


Fig. S16. i-t curves of polarized  $\text{CuCo}_2\text{O}_4$  nanorods and  $\text{CuCo}_2\text{O}_4$  nanorods at  $10 \text{ mA cm}^{-2}$ .



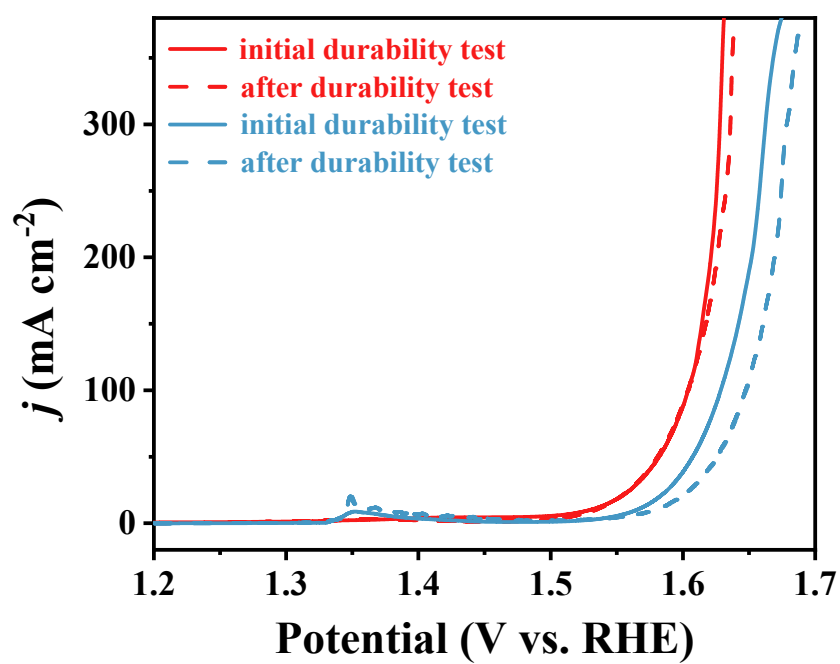


Fig. S17. OER polarization curves of polarized CuCo<sub>2</sub>O<sub>4</sub> nanorods and CuCo<sub>2</sub>O<sub>4</sub> nanorods before and after long-term durability testing.

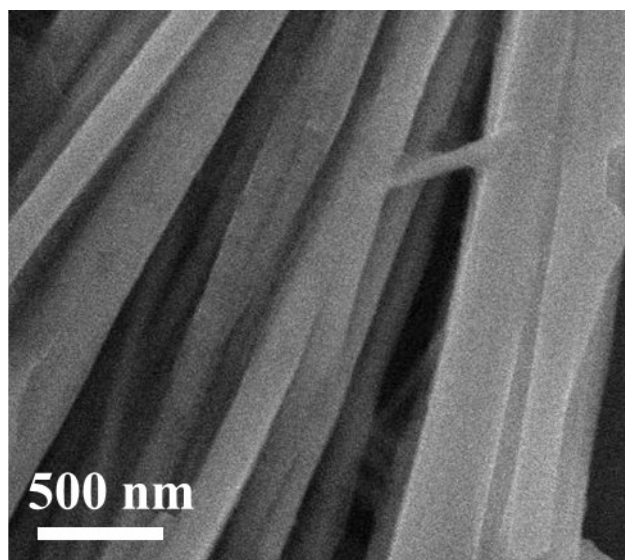


Fig. S18. SEM image of polarized CuCo<sub>2</sub>O<sub>4</sub> nanorods after long-term stability test.

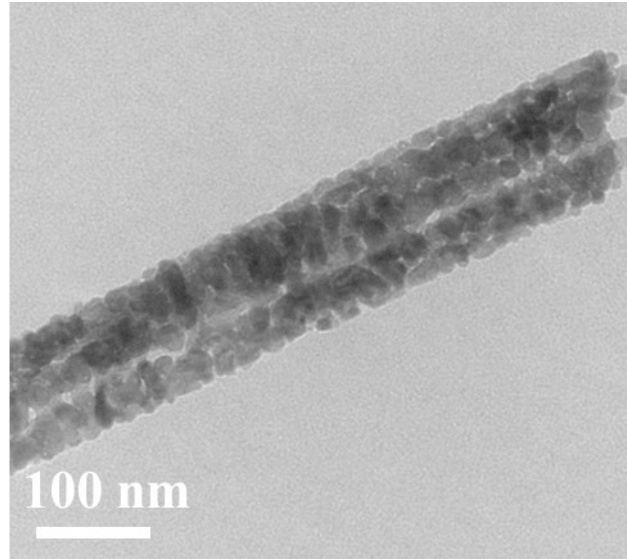


Fig. S19. TEM image of polarized  $\text{CuCo}_2\text{O}_4$  nanorods after long-term stability test.

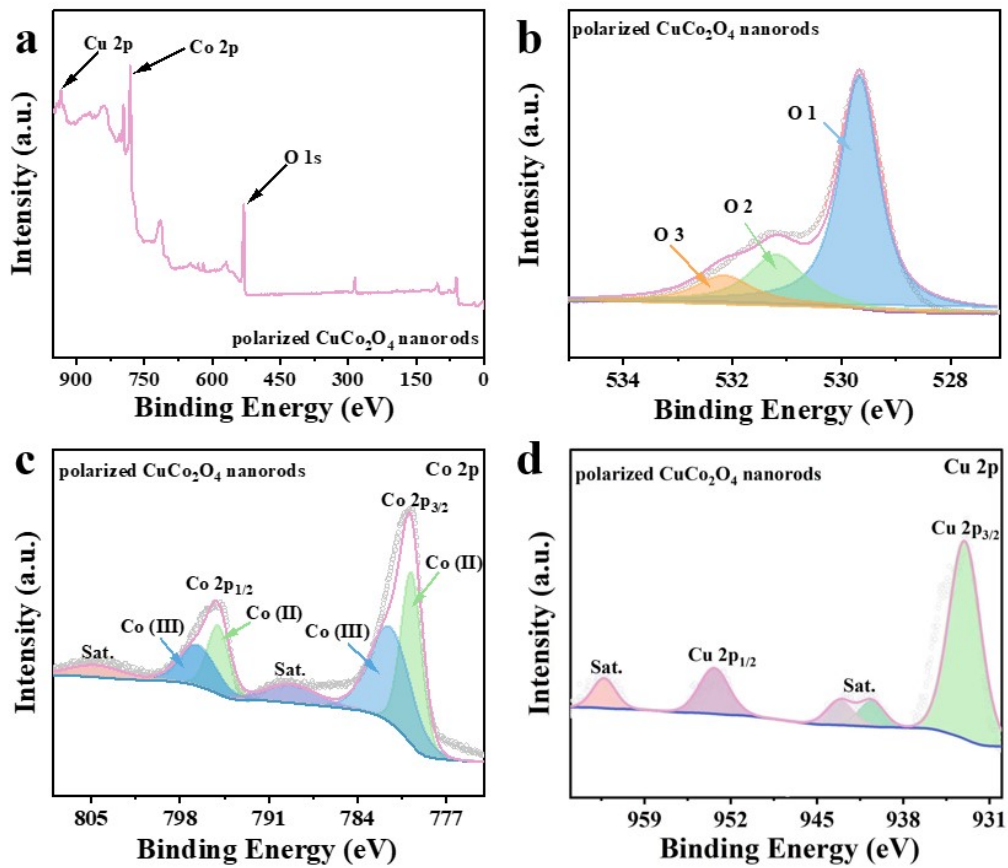


Fig. S20. XPS plots of polarized  $\text{CuCo}_2\text{O}_4$  nanorods after long-term stability test: (a) full; (b) O 1s; (c) Co 2p; (d) Cu 2p.

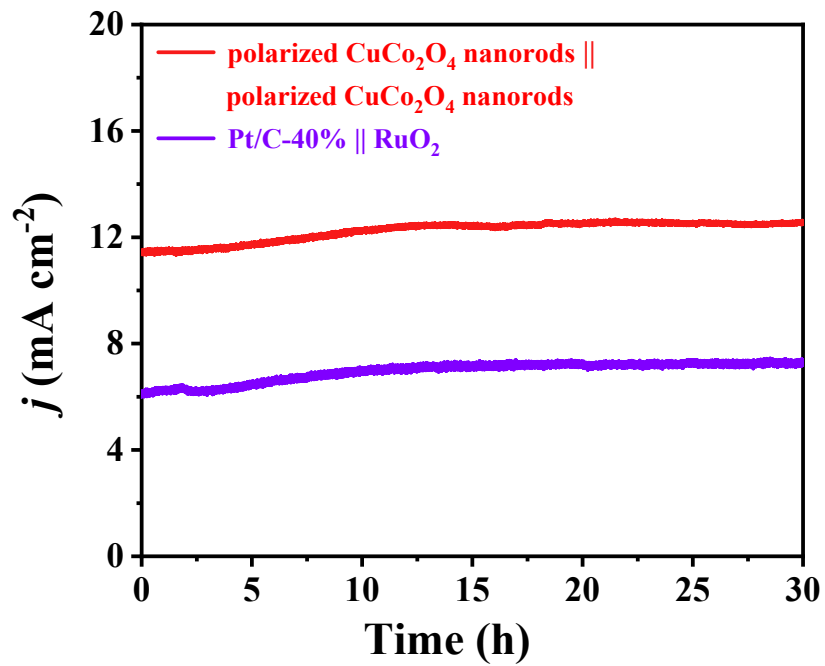


Fig. S21. i-t curves of polarized  $\text{CuCo}_2\text{O}_4$  nanorods/NF(+/-) and  $\text{RuO}_2/\text{NF}(+)\|\text{Pt}/\text{C}/\text{NF}(-)$ .

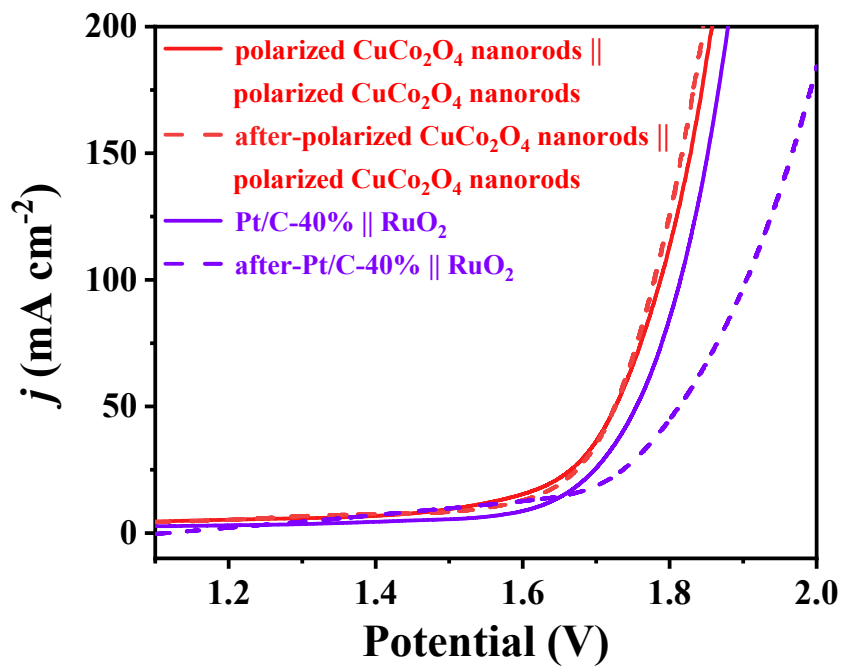


Fig. S22. Polarization curves of polarized  $\text{CuCo}_2\text{O}_4$  nanorods/NF(+/-) and  $\text{RuO}_2/\text{NF}(+)\|\text{Pt}/\text{C}/\text{NF}(-)$  before and after long-term durability testing.

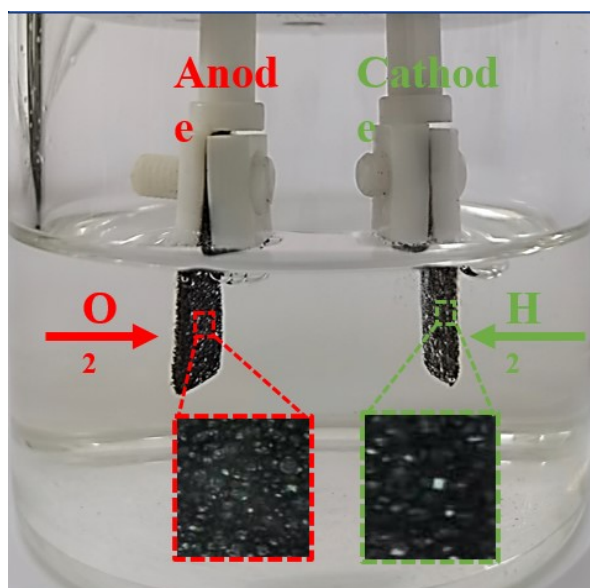


Fig. S23. Digital photographic images of the electrolytic cell for polarized  $\text{CuCo}_2\text{O}_4$  nanorods/NF(+/-), showing the spillage of  $\text{H}_2$  and  $\text{O}_2$  on the cathode and anode respectively.



Fig. S24. Electrolyzer for polarized  $\text{CuCo}_2\text{O}_4$  nanorods/NF(+/-) at time points 0 s, 100 s, 200 s, 300 s, 400 s, 500 s, 600 s, 700 s: (a, b, c, d, e, f, g, h) volume diagram for  $\text{H}_2$  production; (i, j, k, l, m, n, o, p) volume diagram for  $\text{O}_2$  production.

Table S1. The ICP-AES results of polarized  $\text{CuCo}_2\text{O}_4$  nanorods.

Element	Cu	Co	O	Total
Mass fraction %	7.8	32.1	60.1	100.00