Supplementary Material

F-doped $NiCo_2O_4$@$CoMoO_4$ as an advanced electrode for aqueous Zn-ion batteries

Ze Cen[a], Fang Yang[a*], Jie Wan[a], Kaibing Xu[b]

[a] College of Mechanical and Automotive Engineering, Shanghai University of Engineering Science, Shanghai, 201620, China

[b] Research Center for Analysis and Measurement, Donghua University, Shanghai, 201620, China

E-mail: yfang@sues.edu.cn

1. Experimental Section

1. 1 Material characterization

Scanning electron microscopy (SEM; Hitachi, S-4800), transmission electron microscopy (TEM; FEI, Talos F200S) including energy-dispersive X-ray spectrometry (EDS), X-ray diffraction (XRD, Rigaku, D/max-2550 PC), X-ray photoelectron spectroscopy (XPS; Thermo Fisher, Escalab 250Xi), Electron paramagnetic resonance (EPR; Bruker, A300-10/12).

1. 2. Electrochemical measurements

On the electrochemical workstation (PGSTAT302N, The Netherlands), the three-electrode system was used to investigate the electrochemical performance of the obtained sample electrode. In 1 M KOH solution, the obtained sample, platinum (Pt), and saturated calomel electrode (SCE) were respectively used as working electrode,

counter electrode, and reference electrode. The Zn-ion battery was constructed with a Zn plate (1 × 1 cm^2) and the mixed solution with 1 M KOH and 20 mM $Zn(CH_3COO)_2$.

2. Calculation

For the $NiCo_2O_4$@F-$CoMoO_4$//Zn battery, $NiCo_2O_4$@$CoMoO_4$//Zn battery and three-electrode system, we calculated the electrode's mass specific capacity (mA h g^{-1}) based on this equation:

$$C = \frac{I \triangle t}{3.6m}$$

Where, C is the specific capacity (mA h g^{-1}), I is the discharging current (A), m is the total mass of active materials (g) and △t is discharge time (s).

The energy density (E) and power density (P) of the two electrodes in the $NiCo_2O_4$@F−$CoMoO_4$//Zn battery, $NiCo_2O_4$//Zn battery are calculated based on the following equations:

$$E = \frac{I}{3.6m}\int V dt$$

$$P = \frac{E}{\triangle t}$$

Where I is the discharging current (A), V is the discharging voltage (V), dt is the time differential, m is the total mass of the active electrode materials (g), and Δt is the discharging time (s).

3. Figures

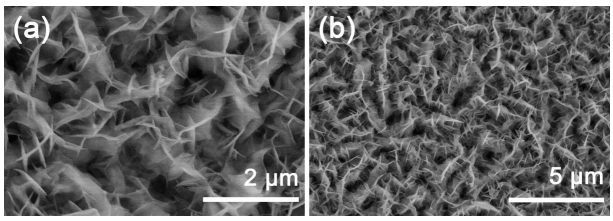

Fig. S1. SEM images of $NiCo_2O_4$@$CoMoO_4$ nanosheets.

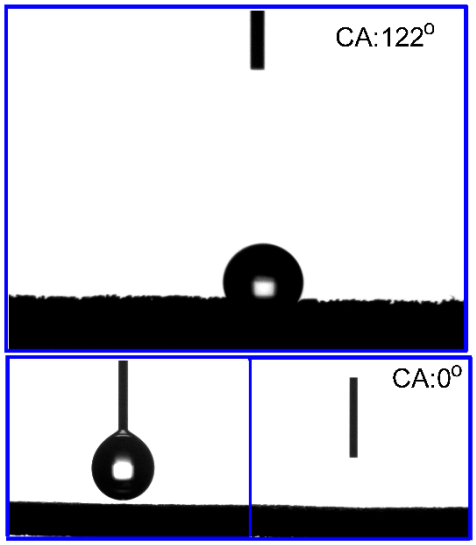

Fig. S2. Contact angles of $NiCo_2O_4$@$CoMoO_4$/Ni foam (upper image) and $NiCo_2O_4$@F-$CoMoO_4$/Ni foam (lower images).

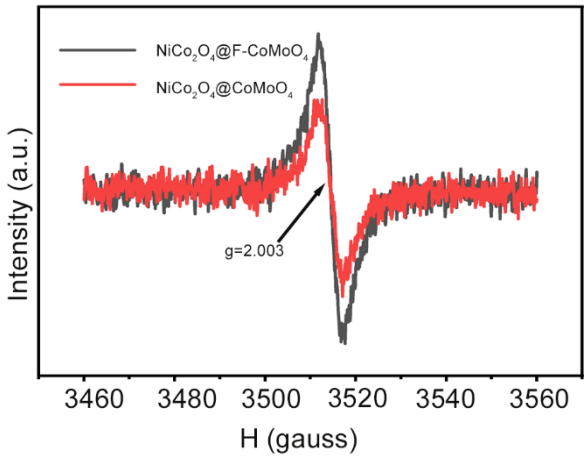

Fig. S3. EPR spectra of $NiCo_2O_4$@$CoMoO_4$ and $NiCo_2O_4$@F-$CoMoO_4$ samples.

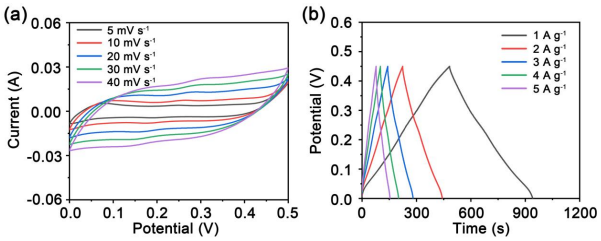

Fig. S4. (a) CV curves and (b) CD curves of $NiCo_2O_4$@$CoMoO_4$ electrode.

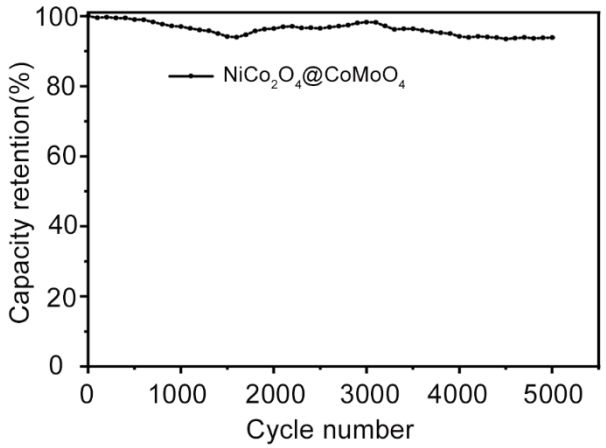

Fig. S5. Cycle performance of the $NiCo_2O_4$@$CoMoO_4$//Zn battery.

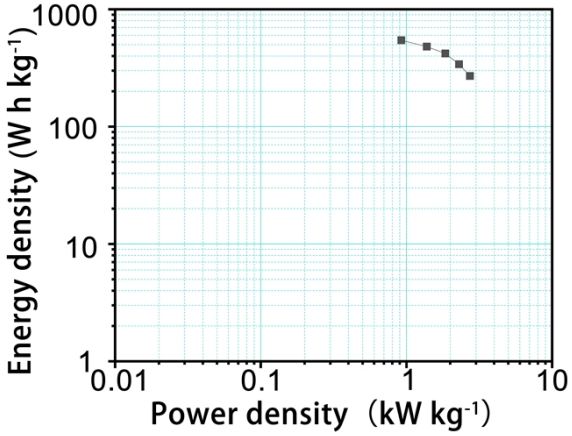

Fig. S6. The Ragone plot of $NiCo_2O_4$@F-$CoMoO_4$//Zn battery.