Controlled preparation of CoNi$_2$S$_4$ nanorods derived from MOF-74 nanoarrays involving exchange reaction for high energy density supercapacitors

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Fig. S1. SEM image of (a) NiCo-LDH, (b) NiCo-MOF-74 direct sulfidation (NiCo-S).
Fig. S2. The EDS spectrum of CoNi$_2$S$_4$ scraped from Ni foam.

Fig. S3. (a) XRD patterns of NiCo-MOF-74 and NiCo-LDH, (b) FT-IR spectra of NiCo-MOF-74.
Fig. S4. TGA curves of NiCo-MOF-74.

Fig. S5. XRD patterns of CoNi$_2$O$_4$. 
Fig. S6. N₂ adsorption-desorption isotherms curves of (a) NiCo-LDH, (c) NiCo-MOF-74, (e) CoNi₂O₄, (g) CoNi₂S₄; pore-size distribution curves of (b) NiCo-LDH, (d) NiCo-MOF-74, (f) CoNi₂O₄, (h) CoNi₂S₄.
Fig. S7. (a) CV curves of NiCo-LDH at different scan rates, (b) GCD curves of NiCo-LDH at different current densities.

Fig. S8. (a) CV curves of CoNi$_2$O$_4$ at different scan rates, (b) GCD curves of CoNi$_2$O$_4$ at different current densities, (c) CV curves of NiCo-MOF-74 at different scan rates, (d) GCD curves of NiCo-MOF-74 at different current densities.
Fig. S9. (a) CV curves of Ni-foam at different scan rates, (b) GCD curves of Ni-foam at different current densities, (c) areal/specific capacitances of Ni-foam, (d) cycling performances and Coulomb efficiency of Ni-foam.

Fig. S10. (a) specific capacitances of CoNi$_2$S$_4$, (b) Energy and power densities of CoNi$_2$S$_4$. 
Table S1. EIS parameters of electrodes with different electrodes.

<table>
<thead>
<tr>
<th>Electrodes</th>
<th>$R_s$</th>
<th>$R_{ct}$</th>
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<tr>
<td>CoNi$_2$S$_4$</td>
<td>0.43 $\Omega$</td>
<td>0.08 $\Omega$</td>
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<tr>
<td>CoNi$_2$O$_4$</td>
<td>1.53 $\Omega$</td>
<td>0.20 $\Omega$</td>
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<tr>
<td>NiCo-MOF-74</td>
<td>1.18 $\Omega$</td>
<td>0.95 $\Omega$</td>
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<tr>
<td>NiCo-LDH</td>
<td>1.53 $\Omega$</td>
<td>0.09 $\Omega$</td>
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Fig. S11. (a) Cycling performance of CoNi$_2$S$_4$, (b) Cycling performance of ACS device.

Fig. S12. (a) SEM, (b) XRD patterns of CoNi$_2$S$_4$ after cycling test.
Fig. S13. (a) CV curves; (b) GCD curves; (c) areal capacitances of NiCo-MOF-74 grown directly on nickel foam.

Fig. S14. (a) CV curves of NiCo-S at different scan rates, (b) GCD curves of NiCo-S at different current densities, (c) EIS spectra of NiCo-S and CoNi$_2$S$_4$, (d) cycling performances and Coulomb efficiency of NiCo-S.
Fig. S15. (a) CV curves; (b) GCD curves; (c) areal capacitances, (d) EIS spectra of CoNi$_2$S$_4$ without carbon.

Fig. S16. (a) Schematic illustration of ASC, (b) CV curves of AC and CoNi$_2$S$_4$ at a scan rate of 50 mV s$^{-1}$, (c) CV curves of AC at different scan rates, (d) GCD curves of AC at different current densities.
Fig. S17. Two series-connected ASC devices light up the LEDs.