Supporting Information

Interface engineering of Co$_3$O$_4$ nanowire arrays with ultrafine NiO nanowires for high-performance rechargeable alkaline battery

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Part I: Calculation

For the RAB and three-electrode system, we calculated the electrode’s areal capacitance (mAh/cm$^2$) based on this equation:

$$C = \frac{I \Delta t}{S}$$

Where, C is the specific capacitance (mAh/cm$^2$), I is the applied current (mA), S is the geometrical area of the electrode (cm$^2$) and $\Delta t$ is discharge time (h).\textsuperscript{1}

The energy density (E) and power density (P) of the two electrodes in the RAB device are calculated based on the following equations:

$$E = C \Delta V$$

$$P = \frac{E}{\Delta t}$$
Where $C$ is the specific capacity, $\Delta V$ is the potential change during the discharge process and $\Delta t$ is the discharge time.$^2$

In order to maintain the charge balance of $q^+ = q^-$ between the cathode and anode, the optimal mass ratio should follow the following formula:

$$\frac{m^+}{m^-} = \frac{C^- \Delta V^-}{C^+ \Delta V^+}$$

In which $m^+$, $V^+$, and $C^+$ denote the mass, potential window and specific capacity of the positive electrode, respectively, and $m^-$, $V^-$, and $C^-$ are the corresponding negative one, respectively.$^3$ Therefore, the calculated mass ratio between the Co$_3$O$_4$@NiO electrode and AC electrode is about $1:5$.

**Part II: Figures**

![XRD pattern of Co$_3$O$_4$ materials on Ni foam.](image)

Fig. S1. XRD pattern of Co$_3$O$_4$ materials on Ni foam.
Fig. S2. (a, c, e) CV curves at different scanning rates, (b, d, f) CD curves at different current densities of Co$_3$O$_4$, Co$_3$O$_4$@NiCo$_2$O$_4$, Co$_3$O$_4$@MnO$_2$, respectively.
Fig. S3. (a) The relationship between log (i) and log (v) plots of Co$_3$O$_4$@NiO electrode.

Fig. S4. (a) CV curves and (b) CD curves of AC electrode.
Fig. S5. Ragone plot of the RABs device.

Fig. S6. High-resolution XPS spectra of (a) Ni 2p, (b) Co 2p, (c) O 1s and (d) Mn 2p for the Co$_3$O$_4$@NiCo$_2$O$_4$ and Co$_3$O$_4$@MnO$_2$ Composites

The XPS spectra of Co$_3$O$_4$@NiCo$_2$O$_4$ and Co$_3$O$_4$@MnO$_2$ are shown in Fig. S6.
The binding energy of Ni $2p$ is 874.2, 861.7 eV peak corresponds to Ni$^{3+}$, 872.9, 854.9 eV peak corresponds to Ni$^{2+}$ (Fig. S6a). The strong satellite peak indicates that Ni$^{2+}$ is the dominant element in the lattice. In the Co $2p$ spectra, binding energy at 796.0 and 780.9 eV corresponds to Co$^{2+}$, 795.3 and 780.0 eV corresponds to Co$^{3+}$ (Fig. S6b). In Fig. S6c, the peak at binding energy 531.6 eV indicates the hydroxylation of the surface of the material and the peak at 529.9 eV is a typical metal-oxygen bonding peak. For Mn $2p$ XPS spectra (Fig. S6d), the peaks at binding energies of 654.3 and 642.5 eV correspond to Mn $2p_{1/2}$ and Mn $2p_{3/2}$, respectively.

References