Supporting Information

Interface engineering of Co_3O_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 Δt is discharge time (h).[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, ΔV is the potential change during the discharge process and Δt 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 ration between the Co_3O_4@NiO electrode and AC electrode is about 1:5.

Part Ⅱ: Figures

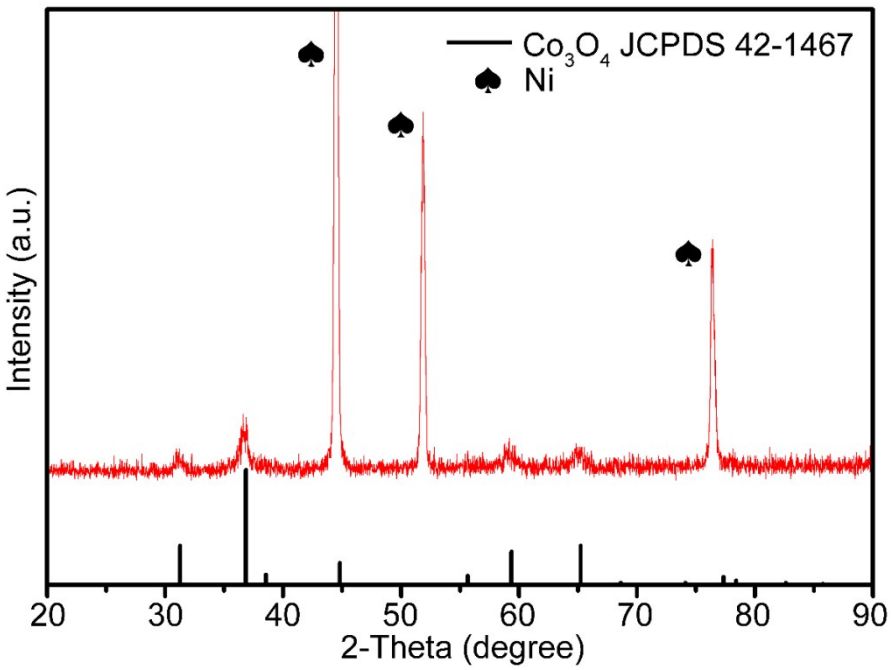

Fig. S1. XRD pattern of Co_3O_4 materials on Ni foam.

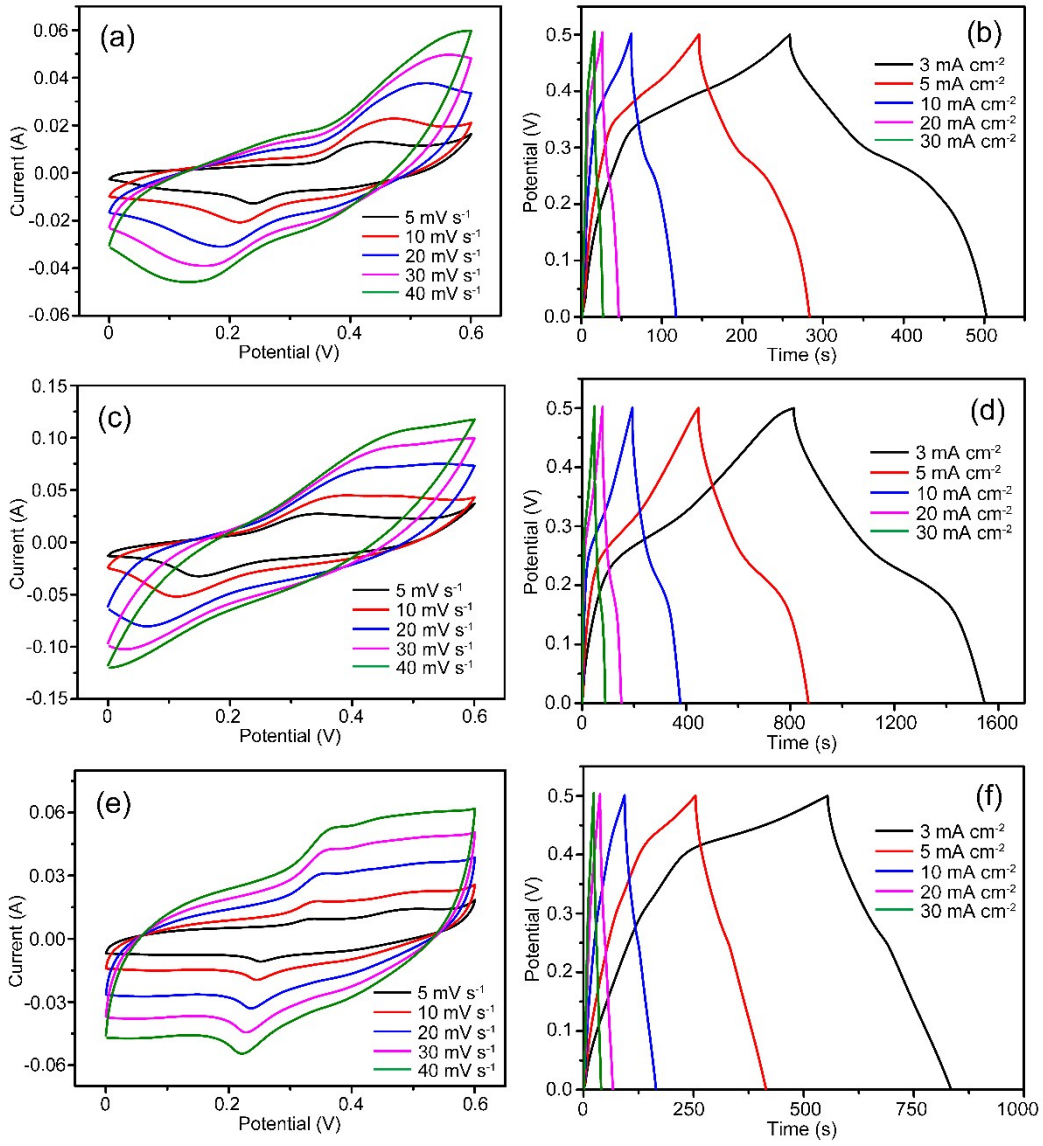

Fig. S2. (a, c, e) CV curves at different scanning rates, (b, d, f) CD curves at different current densities of Co_3O_4, Co_3O_4@$NiCo_2O_4$, Co_3O_4@MnO_2, respectively.

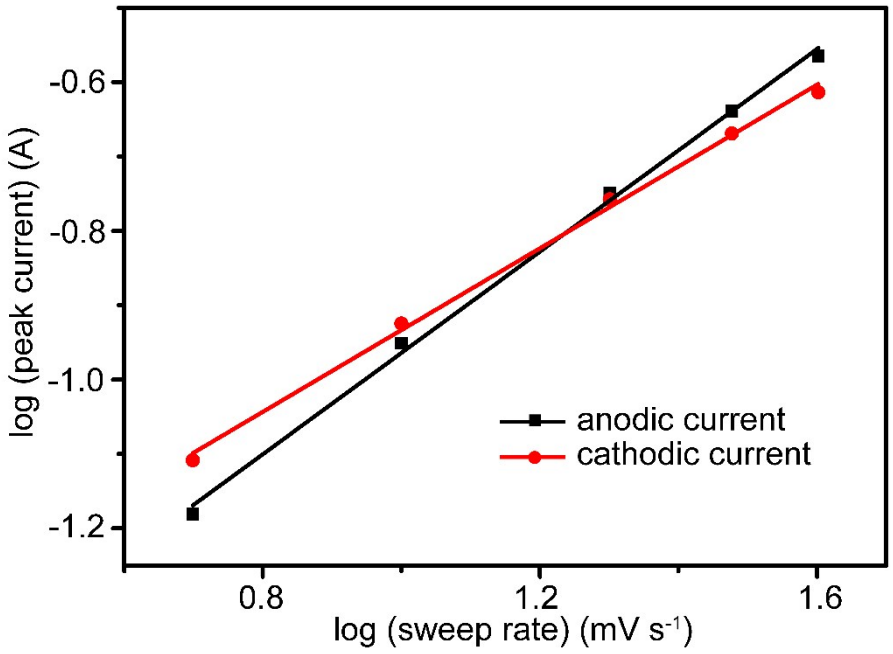

Fig. S3. (a) The relationship between log (i) and log (v) plots of Co_3O_4@NiO electrode.

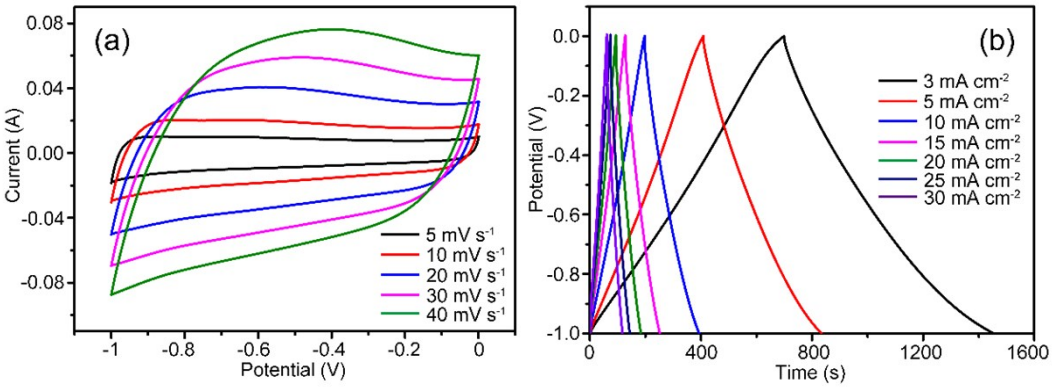

Fig. S4. (a) CV curves and (b) CD curves of AC electrode.

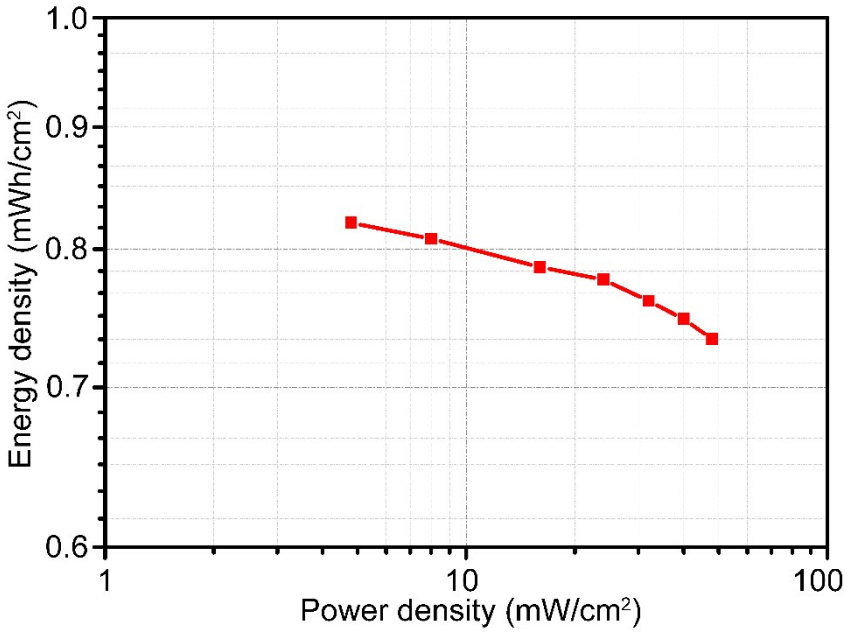

Fig. S5. Ragone plot of the RABs device.

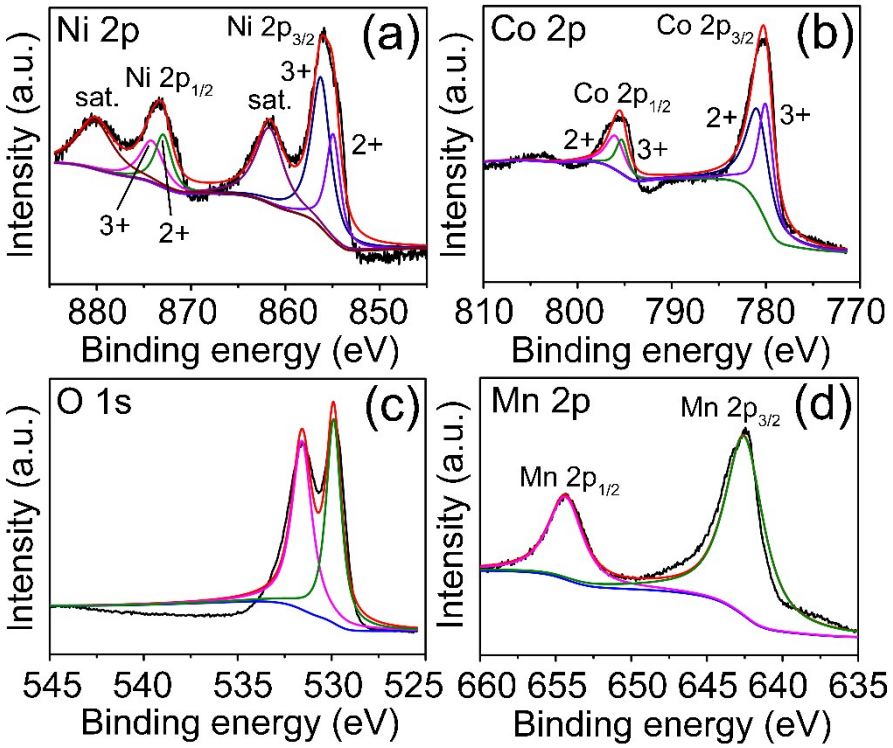

Fig. S6. High-resolution XPS spectra of (a) Ni 2p, (b) Co 2p, (c) O 1s and (d) Mn 2p for the Co_3O_4@$NiCo_2O_4$ and Co_3O_4@MnO_2 Composites

The XPS spectra of Co_3O_4@$NiCo_2O_4$ and Co_3O_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).[3-5] 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).[1, 3, 6] 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.[6-8] 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.[2, 9, 10]

References

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