JOURNAL of ELECTROCHEMICAL SCIENCE and TECHNOLOGY

SUPPORTING INFORMATION

High Performances Aqueous Nickel-bismuth Batteries Assembled with Highly Crystalline Bi_2O_3 and CoNi-$CoNiO_2$@NiCo Layered Double Hydroxides Heterostructure Nanoarrays

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https://doi.org/10.33961/jecst.2025.00780

VOLUME 17 ISSUE 3 AUGUST 2026

ELECTROCHEMICAL CALCULATIONS

CV curves were tested at different scan rates, and the relationship between the current density (i) of redox peak and scan rate (v) is determined by the **Equation (1)** and **Equation (2)**. Linear fitting of cathodic/anodic peak current versus scan rate can be obtained by the **Equation (2)**

$$i = a \cdot \nu^{b} \quad (1)$$

$$\log i = \log a + b \log v \quad (2)$$

Herein, when the b value is approaching to 0.5, the electrochemical reaction is dominated by the electrolyte ion diffusion controlled-process [1]. While the b value is approaching to 1.0, the surface capacitive behavior plays an important role in the electrochemical reaction [2]. If the b value is between 0.5 and 1, the electrochemical reaction is controlled by both the diffusion-control process and the surface capacitive effect [3].

The specific gravimetric capacity of electrode active materials in the three-electrode system can be calculated form GCD curves according to the following **Equation (3)**.

$$C_m = \frac{I \cdot \Delta t}{m} \quad (3)$$

C_m (mAh/g) represents the specific gravimetric capacity, I (A) is the discharge current, m (g) is the mass of active materials, and Δt (s) is the discharging time.

Before assembling, the mass of the cathode and anode active materials need to be balanced according to the **Equation (4)**.

$$M^{+}/M^{-} = C_m^{-}/C_m^{+} \quad (4)$$

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M^+ and M^- represent the mass of cathode and anode active materials, respectively, and C_m^- and C_m^+ stand for the specific gravimetric capacity of the anode and cathode active materials, respectively.

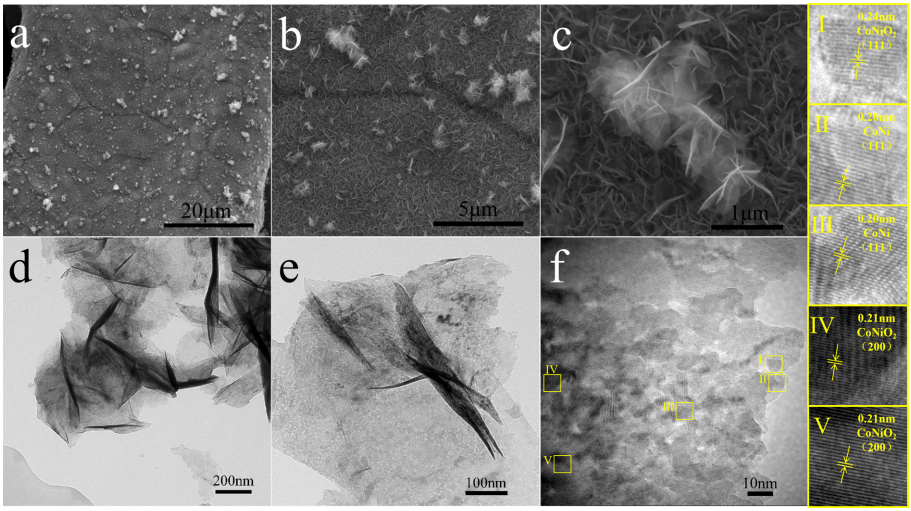
The gravimetric specific capacity (C_{cell}, mAh/g) of the aqueous rechargeable battery can also be calculated by the equation (3), and m (g) represents the total mass of active materials of the whole battery.

The energy density (E, Wh/kg) and power density (P, W/kg) of the battery can be calculated from **Equation (5)** and **(6)**, respectively.

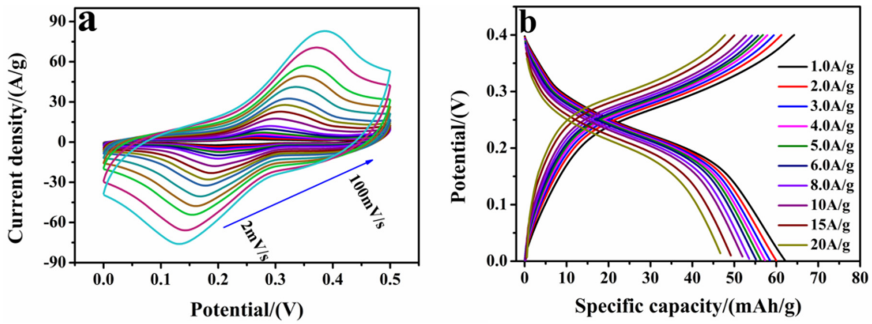
$$E = \int_0^{\Delta t} IV_{(t)} dt \quad (5)$$

$$P = E/\Delta t \quad (6)$$

where I (A/g) represents the current density, $V_{(t)}$ (V) stands for the discharge potential, Δt (s) represents the discharging time, and dt stands for the time differential.



Supplementary Fig. 1. SEM (a~c) and TEM (d~f) images of CoNi-$CoNiO_2$



Supplementary Fig. 2. Electrochemical performances of CoNi-$CoNiO_2$: CV curves at different scan rates (a); GCD curves at different current densities (b)

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