

Supporting Information

Chainlike structures assembled by Co hierarchitectures: synthesis and electrochemical properties as negative materials for alkaline secondary batteries

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Experimental

Sample preparation: Metallic Co hierarchitectures were synthesized via a hydro/solvothermal route using cetyltrimethylammonium bromide (CTAB) as the surfactant. In a typical synthetic procedure, 4 mmol of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ and 2 mmol of CTAB were dissolved in 70 mL of distilled water followed by intensive stirring for 1 h. Then 12 mL of hydrazine monohydrate (80% v/v) was added into the mixture under vigorous agitation. Subsequently, the solution was loaded into a 100 mL Teflon-lined stainless steel autoclave. After heating at 180 °C for 5 h, the tank was allowed to cool to room temperature naturally. The resultant black products were washed repeatedly with distilled water and absolute ethanol and dried in a vacuum at 50 °C for 10 h. Metallic Co with different morphologies were also prepared in ethanol, ethylene glycol and glycerol. The corresponding samples prepared in water, ethanol, ethylene glycol and glycerol were designated as H1, H2, H3 and H4, respectively.

Structural characterizations: The crystalline structures of the samples were examined

by Powder X-ray diffraction (XRD) on a Rigaku D/Max-2500 powder diffractometer (Cu K α radiation, $\lambda=0.15418$ nm). Energy Dispersive Spectroscopy (EDS) was recorded on an Oxford Instrument EDS-7421. Specific surface area was tested by Brunauer–Emmett–Teller (BET) method using a ST-08A specific surface area analyzer. Scanning electron microscopy (SEM) was progressed on a JEOL JSM-6700F (Field Emission) scanning electron microscope.

Electrochemical characterization: The Co electrode was fabricated by a new smear method. It is constructed by mixing the prepared material with carbonyl nickel powders and PTFE in a weight ratio of 25:70:5 to form a paste and coated on a piece of Ni-foam. The electrode plate was then pressed at a pressure of 10 kgf (cm²)⁻¹ for 30 s.

Electrochemical measurements were conducted in a three-compartment cell using the Co electrode as the working electrode. NiOOH/Ni(OH)₂ and Hg/HgO were used as the counter and reference electrodes, respectively. The electrolyte solution was a 6-M KOH aqueous solution.

The cycle life and rate capability were tested by a LAND battery-test instrument (CT2001A). The electrodes were charged at 500 mA g⁻¹ for 1.5 h and discharged at 500 mA g⁻¹ up to the cut-off voltage, which was set at -0.5 V (vs. Hg/HgO). The interval between the charge and discharge was 5 min. All the tests were performed at room temperature.

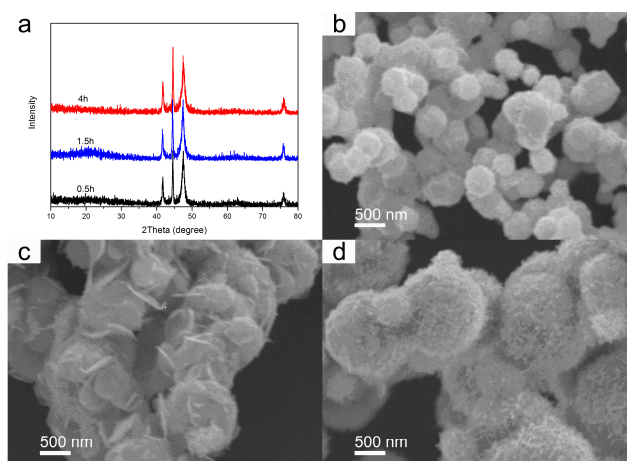


Figure S1. (a) XRD patterns and (b, c, d) SEM images of the Co samples obtained at 180 °C for different hours.

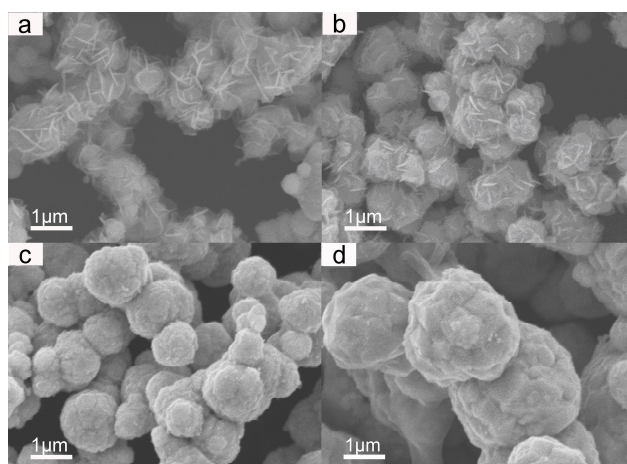


Fig. S2. SEM images of the Co samples obtained at (a) 200 °C, (b) 160 °C, (c) 140 °C and (d) 120 °C.

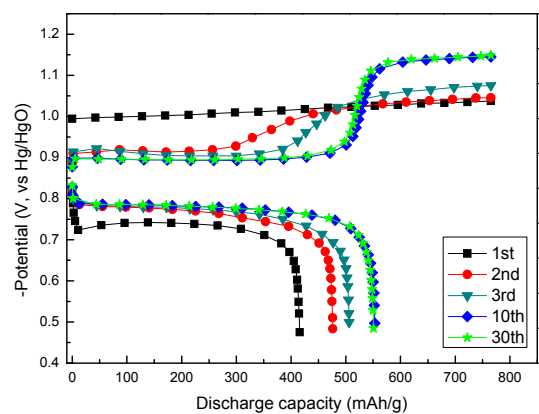


Fig. S3 Charge-discharge curves of the Co electrode prepared in water.

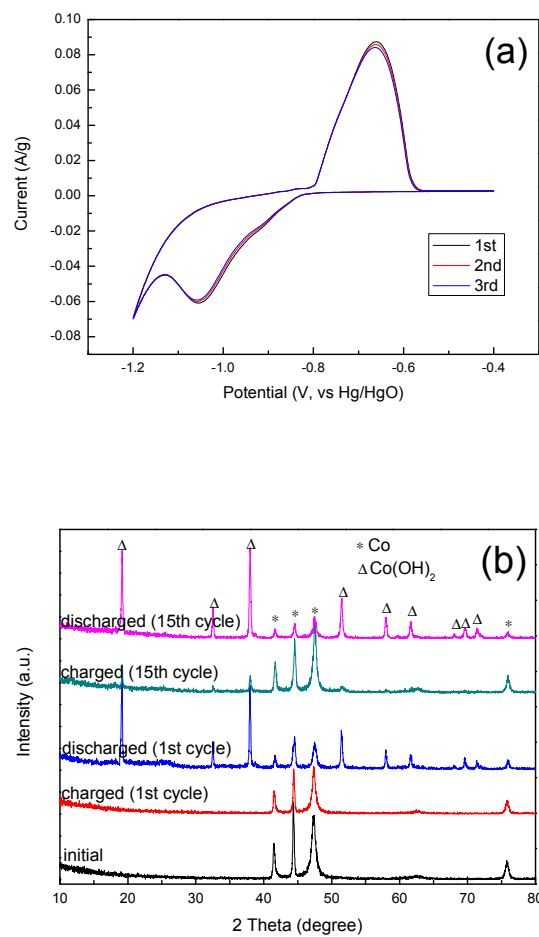


Fig. S4 (a) CV curves of the Co electrode, and (b) XRD patterns of the Co electrode at charged or discharged states after different cycles.