Electronic Supplementary Information (ESI)

Facile and Environmental-Friendly Synthesis of Ultrathin Nickel Hydroxide Nanosheets with Excellent Supercapacitor Performances

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Experimental

All the chemical reagents used in this experiment were analytical grade and used without further purification.

Synthesis of the ultrathin β-Ni(OH)$_2$ nanosheets

A glutamic acid-assisted hydrothermal approach is considered to form a very tight entanglement of various chains in the net by the interaction of coordination or supermolecular, which control the growth of β-Ni(OH)$_2$ nanosheets from the hydrolysis of Ni(CH$_3$COO)$_2$. The ultrathin β-Ni(OH)$_2$ nanosheets were prepared via a detailed experimental procedure as follows: 0.2 mmol of Ni(CH$_3$COO)$_2$ and 0.1 mmol of glutamate acid were dissolved in 23 mL of ethanol–water mixture solution (v/v = 3:1) and sonicated for 15 min at room temperature. The solution was mixed and transferred into a 50 mL Teflon-lined stainless steel autoclave, heated at 120 ^{o}C for 12 h, and then cooled to room temperature naturally. Finally, the light green products were centrifuged at 8000 rpm for 5 min, washed several times with double-distilled water and ethanol sequentially and dried at 60 ^{o}C for 12 h for further characterization. Due to the mild condition during the hydrothermal process, it is easy to scale up the preparation of ultrathin β-Ni(OH)$_2$ nanosheets toward liter grade with high reproducibility, which show similar morphologies and properties.

Materials characterization

X-ray diffraction (XRD) measurements were carried out on a Shimadzu XRD-6000 powder X-ray diffractometer with Cu Kα radiation (λ = 1.5418 Å) between 10° and 80° at scanning rate of 1° min^{-1}. Scanning electron microscopy (SEM) images were obtained on a Hitachi S-4800 field-emission microscope operated at 10 kV. Transmission electron microscopy (TEM) and high-resolution TEM (HRTEM) images, and the corresponding selected area electron diffraction (SAED) were taken on a JEOL JEM-2100 microscope operated at 200 kV. Atomic force microscopy (AFM) images were acquired under ambient conditions using a mica substrate. The samples were scanned by Fastscan B or C tips in air with Scan-Asyst mode on Fast scan AFM (Bruker, Inc.). The specific porous structural features of the as-prepared ultrathin β-Ni(OH)$_2$ nanosheets were determined using a Brunauer−Emmett−Teller (BET) surface analyzer (Micromeritics ASAP 2020 M+C volumetric adsorption Equipment).

Preparation of working electrodes and electrochemical measurements

The working electrode was prepared by blending the electroactive material ultrathin β-$Ni(OH)_2$ nanosheets with acetylene black (AB) and poly(vinylidene fluoride) (PVDF) binder in a weight ratio of 80:15:5. In practice, the typical mass of the ultrathin β-$Ni(OH)_2$ nanosheets were dissolved in N-Methyl pyrrolidone (NMP), then the AB and PVDF was added respectively. Thereafter, the solution was sonicated for 30 minutes and stirred overnight to form a homogeneous slurry. The resulting slurry was painted on the conductive substrate (stainless steel mesh) and dried at 120 °C for 12 h in vacuum oven as supercapacitor electrode. All electrochemical measurements were carried out on CHI 660D electrochemical workstation (CH Instruments) using a three-electrode system at room temperature using 6 M KOH as electrolyte. The counter electrode and reference electrode were platinum foil (1 cm^2) and Hg/HgO electrode, respectively.

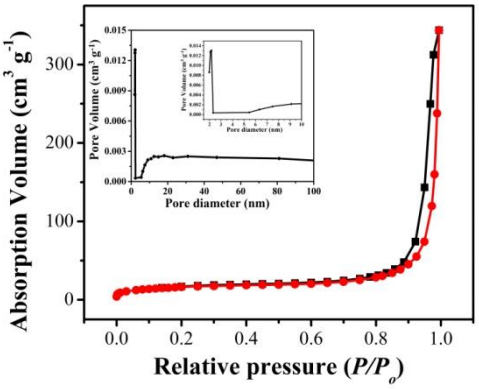

Fig. S1 N_2 adsorption-desorption isotherms.

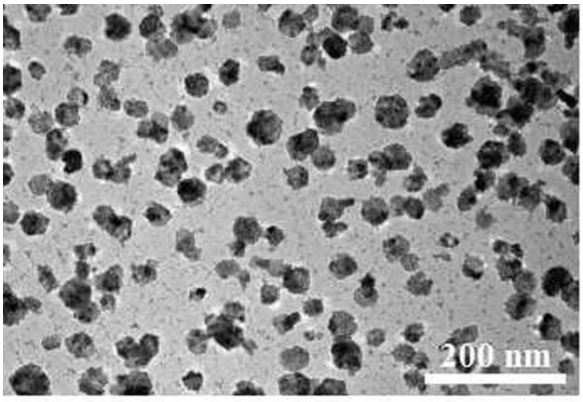

Fig. S2 TEM images of $Ni(OH)_2$ nanoplates prepared in the absence of glutamic acid.

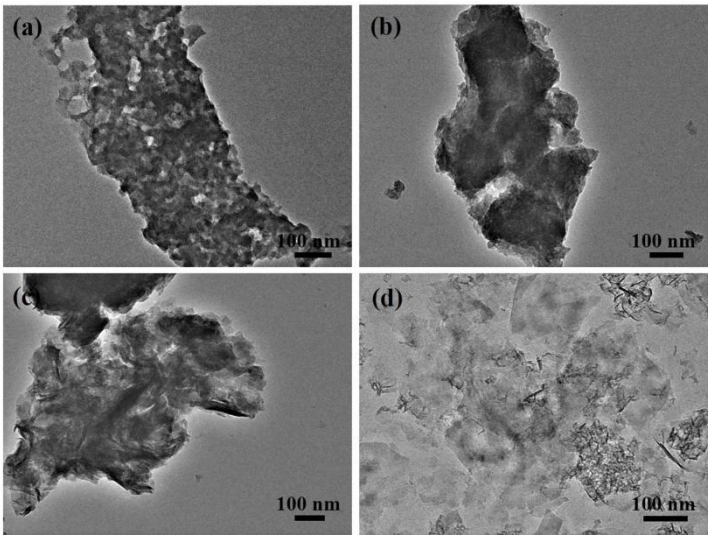

Fig. S3 TEM images of $Ni(OH)_2$ nanoplates prepared at different reaction stages: (a) *t*=0.5 h; (b) *t*=3 h; (c) *t*=6 h; (d) *t*=9 h.

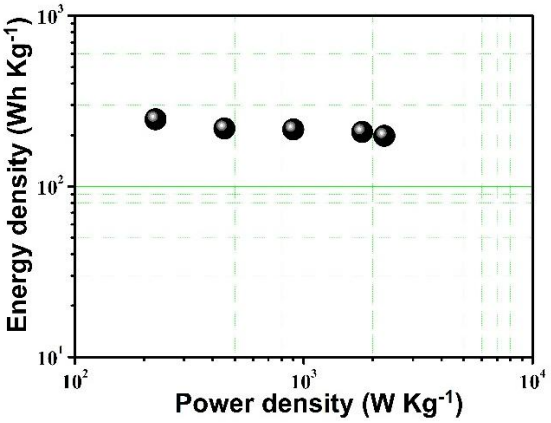

Fig. S4 Ragone plots of the ultrathin β-$Ni(OH)_2$ nanosheets electrode.

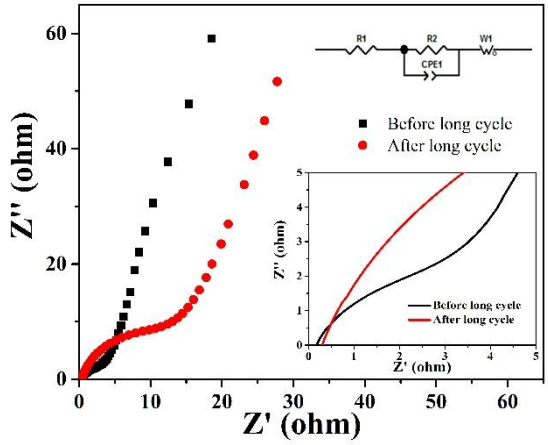

Fig. S5 Nyquist plots of the ultrathin β-$Ni(OH)_2$ nanosheets. The inset shows the high-frequency region of the Nyquist plot and equivation circuit for impedance section.