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Electronic Supplementary Material

# $NiMoO_4$ nanowires supported on Ni foam as novel advanced electrodes for supercapacitors

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## Part I: Experimental

*Synthesis of $NiMoO_4$ nanowires on Ni foam:*

All the reagents were analytical grade and used without further purification. The nickel nitrate and sodium molybdate were obtained from Tianjin Chemical Reagent Co. $NiMoO_4$ NWs were prepared by a facile hydrothermal synthesis method. Prior to the synthesis, the Ni foam substrate (length × diameter × thickness = 6 × 2 × 0.1 cm) was rinsed with ethanol and water for 30 min respectively, and then placed standing against the wall of a Teflon-lined autoclave. The reaction solution was obtained by mixing 2.5 mmol of $Ni(NO_3)_2 \cdot 6H_2O$ and 2.5 mmol of $Na_2MoO_4 \cdot 7H_2O$ in 50 mL of distilled water under constant magnetic stirring and then transferred into Teflon-lined stainless steel autoclave liners. The washed Ni foam substrate was immersed into the reaction solution. The liner was sealed in a stainless steel autoclave and maintained at 150 °C for 6 h and then cooled down to room temperature. After the reaction was over, the Ni foam coated with a light green product was taken out from the autoclave and washed by ultra-sonication in deionized water followed by acetone for a few minutes in order to remove the residual nanoparticle debris, then dried in an oven at 60 ℃ for 12 h. Finally, the Ni foam with the as-grown hydrate precursors was annealed at 400 ℃ for 1 h in pure argon to obtain $NiMoO_4$ NWs.

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*Characterization:*

The crystal structure of the samples was characterized with X-Ray diffraction (XRD, Cu Kα irradiation; λ=1.5418 Å) with a SIEMENS D5000 X-ray diffractometer. The morphology and microstructure of the synthesized sample were characterized by a scanning electron microscopy (SEM, Hitachi S4800) and a transmission electron microscope (TEM; JEOL-2010 with an accelerating voltage of 200 kV).

*Electrochemical measurements:*

The electrochemical measurements were conducted using a three-electrode mode in a 2 M KOH aqueous solution. The Ni foam supported electroactive material (1 $cm^2$ in area) was directly used as the working electrode. A standard calomel electrode (SCE) was used as the reference electrode and a Pt foil as the counter electrode. The mass loading of the $NiMoO_4$ NWs on Ni foam was about 1.5 mg $cm^{-2}$. The area specific capacitance of the electrode was calculated according to the following equations:

$$C = \frac{i \times t}{\Delta u} \qquad (1)$$

where $C$ is the capacitance of the electroactive materials, $\Delta u$ is the potential (V), $i$ is the discharging current density (A $cm^{-2}$ or A $g^{-1}$) and $t$ is discharge time (s). Typical CV curves were measured between -0.2 and 0.8 V. All the electrochemical experiments were performed on a CHI660e electrochemical workstation (Chenhua, Shanghai). Electrochemical impedance spectroscopy (EIS) measurements were made with a superimposed 5 mV sinusoidal voltage in a frequency range from 0.01 Hz to 100 kHz at open circuit potential.

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## Part II: Supplementary Figures

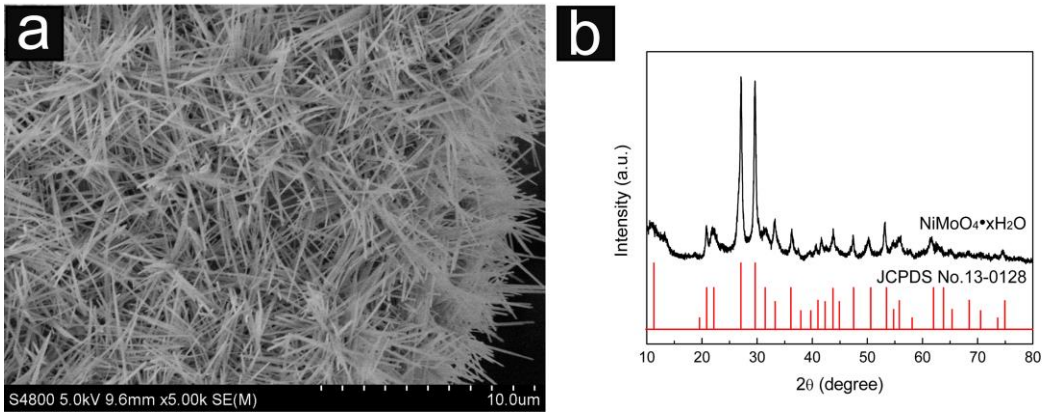


**Fig. S1** (a) SEM image of the as-synthesized $NiMoO_4$ precursor. (b) The XRD pattern of the $NiMoO_4$ precursor scratched from Ni foam.

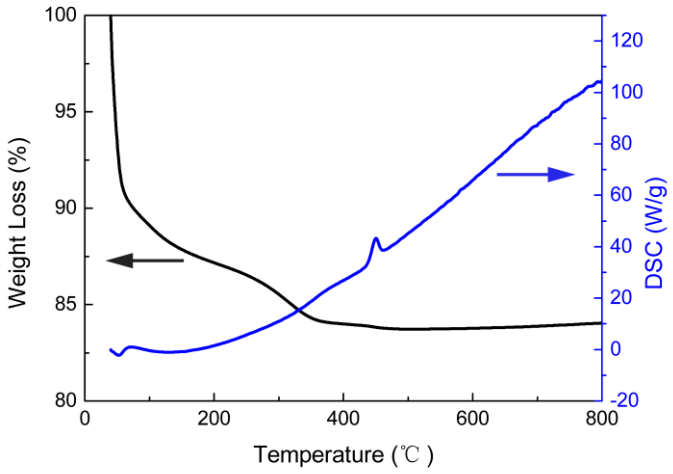


**Fig. S2** TGA-DSC curves for the precursor $NiMoO_4$.

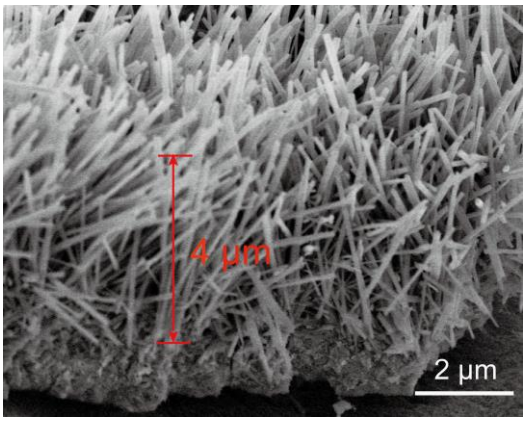


**Fig. S3** SEM image of the $NiMoO_4$ NWs from the side view.

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Fig. S1 (a) showed SEM image of the precursor $NiMoO_4$ and the morphology did not change after calcination. Fig. S1 (b) showed the XRD patterns of the $NiMoO_4$ precursor. All the diffraction peaks of the precursor could be well indexed to $NiMoO_4 \cdot xH_2O$ (JCPDS No: 13-0128). TGA-DSC curves have further demonstrated $NiMoO_4 \cdot xH_2O$ precursor thermal decompose to $NiMoO_4$ nanowires. (Fig. S2). The total weight loss of $NiMoO_4 \cdot xH_2O$ is 16% and the weight becomes stable below 400℃. Fig. S3 showed SEM image of the $NiMoO_4$ NWs from the side view. The length of the nanowires is about 4 μm.

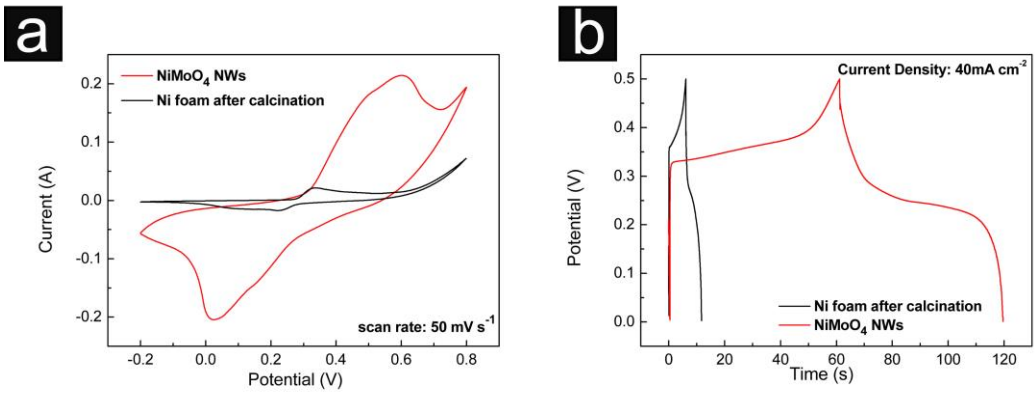


**Fig. S4** The comparison of the $NiMoO_4$ NWs on Ni foam and bare Ni foam after calcination at 400 °C with the same areal charge–discharge current of 40 mA $cm^{-2}$.

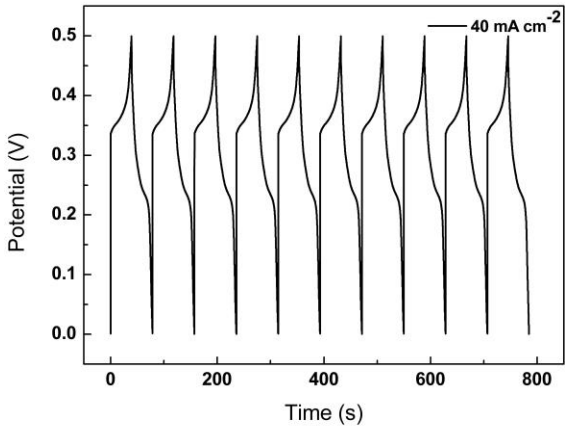


**Fig. S5** First ten charge/discharge curves of the $NiMoO_4$ electrode at a current density of 40 mA $cm^{-2}$.

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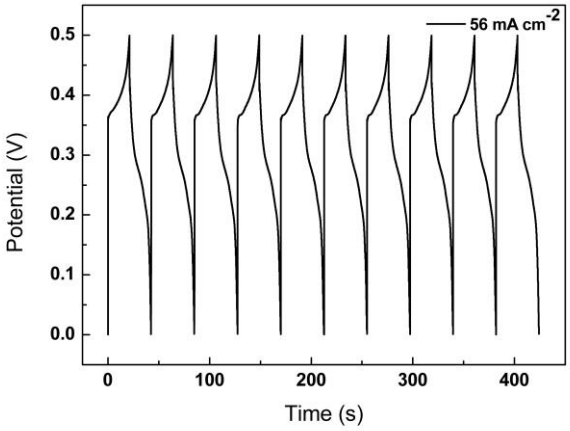


**Fig. S6** First ten charge/discharge curves of the $NiMoO_4$ electrode at a current density of 56 mA $cm^{-2}$.

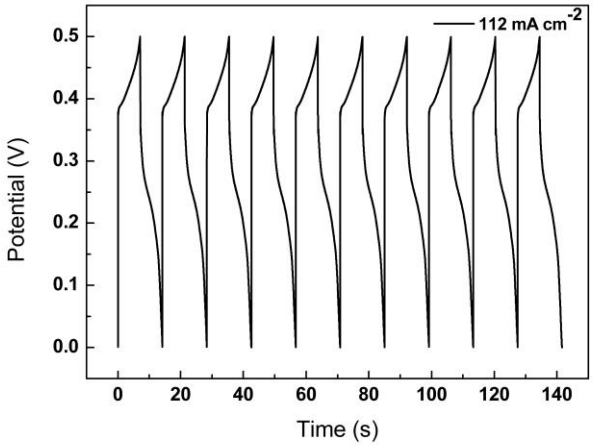


**Fig. S7** First ten charge/discharge curves of the $NiMoO_4$ electrode at a current density of 112 mA $cm^{-2}$.

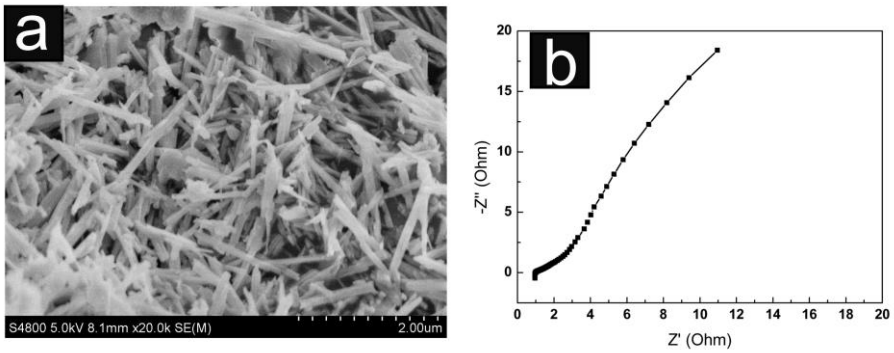


**Fig. S8** (a) SEM image of the $NiMoO_4$ NWs on Ni foam electrode after 6000 cycles. (b) Electrochemical impedance spectra after 6000th cycles.