Supporting Information

Facile in situ growth of ZnO nanosheets standing on Ni foam as binder-free anodes for lithium ion batteries

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Experimental

1. Measure the weight of NiO formed on Ni foam.

For the control experimental details of Ni foam, 480 mg (8 mmol) $CO(NH_2)_2$, and 222 mg (6 mmol) NH_4F were dissolved in 30 mL deionized water and 5 mL $(CH_2OH)_2$ to obtain a homogeneous solution. The pre-treated Ni foam disks were placed in the solutions in Teflon-lined stainless-steel autoclaves. After 10 h at 120 ℃, the samples were allowed to cool down to room temperature naturally and washed with deionized water, dried thoroughly, and annealed under air at 450 ℃ for 3 h at a heating rate of 1.5 °C min^{-1}. And the mass of Ni foam after hydrothermal and calcination treatments are 0.3 mg more than those without the two treatments.

2. Samples for ex-situ SEM, XPS, and XRD characterizations.

For ex-situ SEM characterizations during the discharge and charge process, three cells for every process (total 24 cells) were used to investigate the changes in morphology and composites for every potential (pristine, discharge to 1.5, 0.6, 0.01 V, and charge to 0.2, 1.1, 2.0, 3.0 V). For example, for the cell discharged to 0.01 V, the cell was discharged to 1.5, 0.6, and 0.01 V finally. For the cell charged to 0.2 V in Fig. 6e, the cell was discharged to 1.5, 0.6, 0.01 V, and then charged to 0.2 V finally.

After the discharging or charging processes, the electrode disc was taken out from cell, and washed by solvent Diethyl carbonate (DEC) twice to get rid of the electrolyte, and then put in the vacuum at 60 ℃ to evaporate DEC and conduct the SEM, XPS and XRD characterizations.

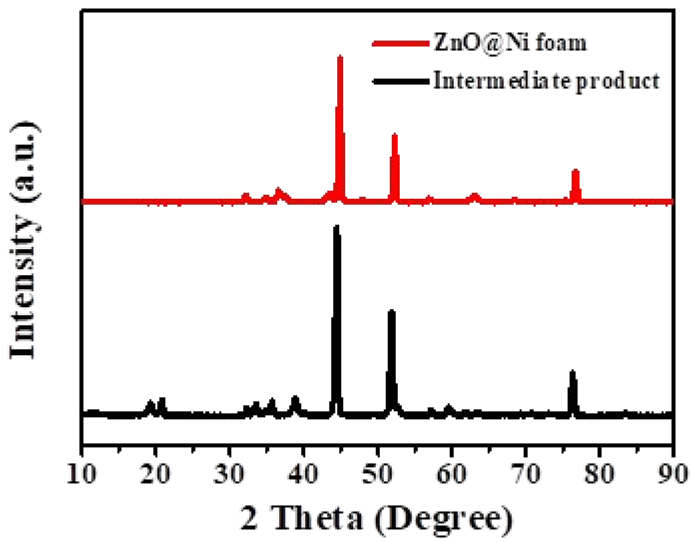

Fig. S1 XRD patterns of the standing nanosheet intermediates in situ grown on Ni foam before calcinations at 450 °C compared with the ZnO nanosheets on Ni foam after calcinations.

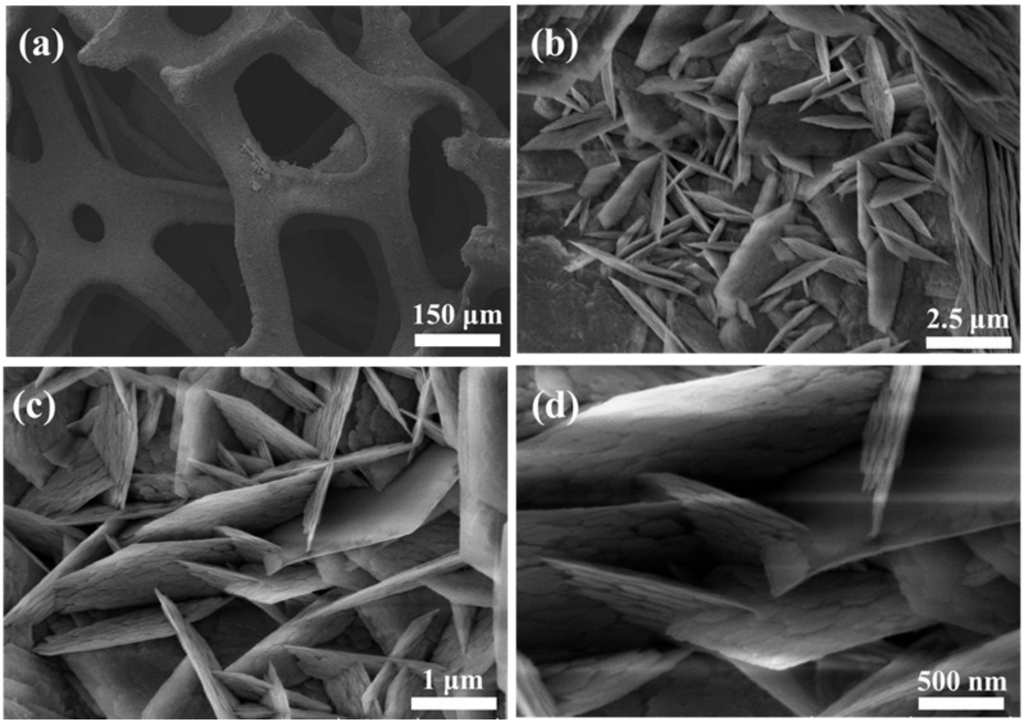

Fig. S2 SEM images of the standing nanosheet intermediates in situ grown on Ni foam before calcinations at 450 °C.

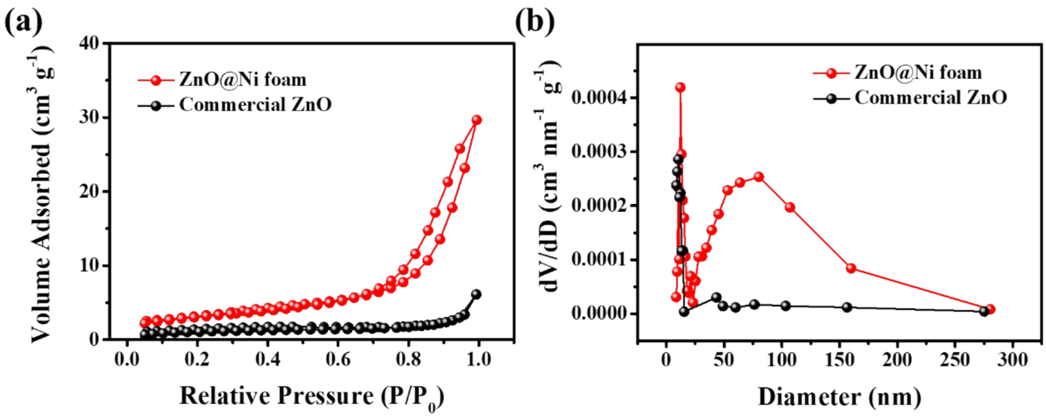

Fig. S3 N_2 adsorption–desorption isotherms (a) and Barrett-Joyner-Halenda pore-size distribution curves (b) of ZnO nanosheets@Ni foam and commercial ZnO powders.

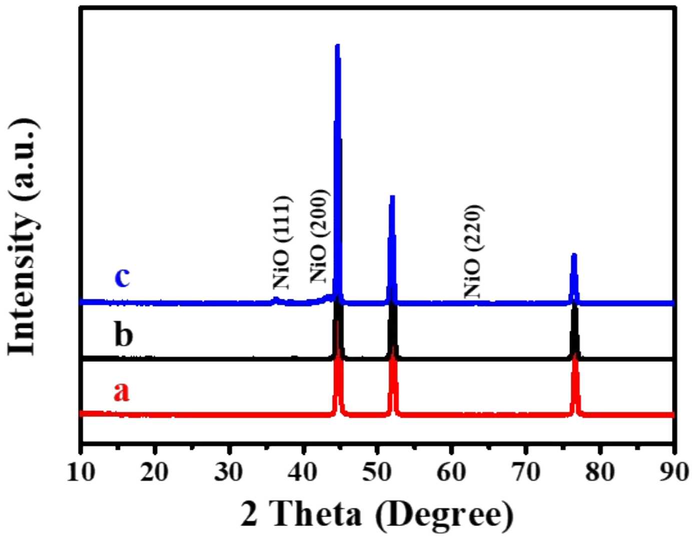

Fig. S4 XRD patterns of Ni foam before treatment (a), after hydrothermal treatment (b), and after hydrothermal and calcination treatments (c).

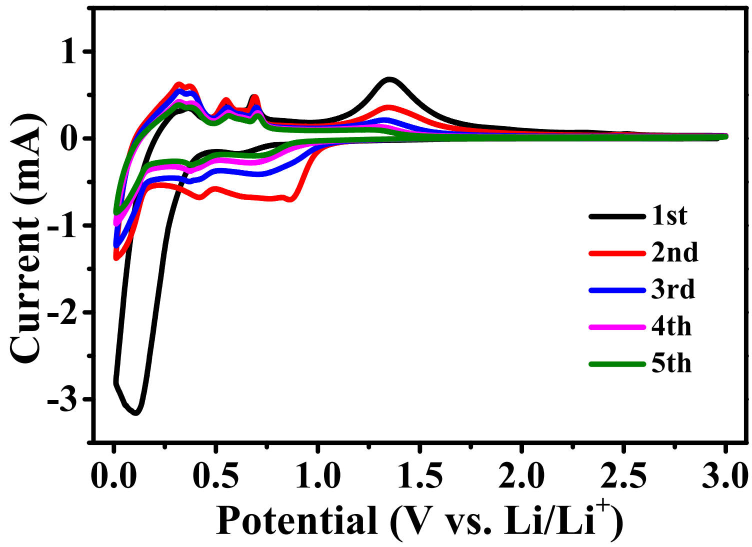

Fig. S5 CVs of commercial ZnO powders on Cu foil at 0.1 mV s^{-1}.

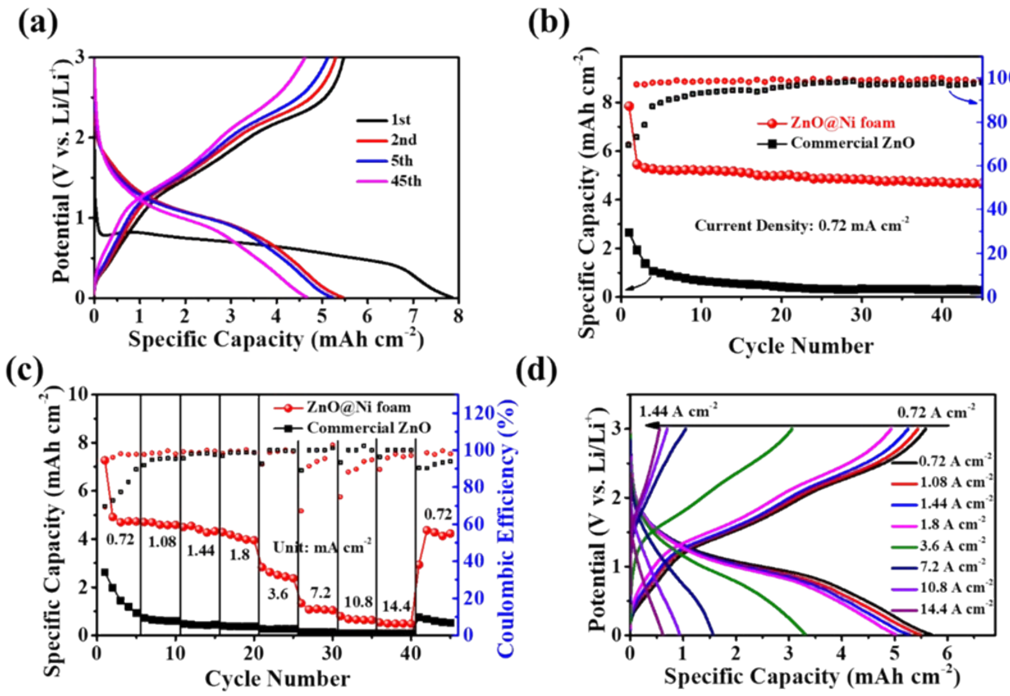

Fig. S6 (a) Galvanostatic charge–discharge curves at 0.72 mA cm^{-2} of ZnO nanosheets@Ni foam at different cycles; (b) Cycling performance at 0.72 mA cm^{-2} and (c) rate performance at various current densities of ZnO nanosheets@Ni foam and commercial ZnO@Cu foil; (d) Galvanostatic charge–discharge curves at various current density.

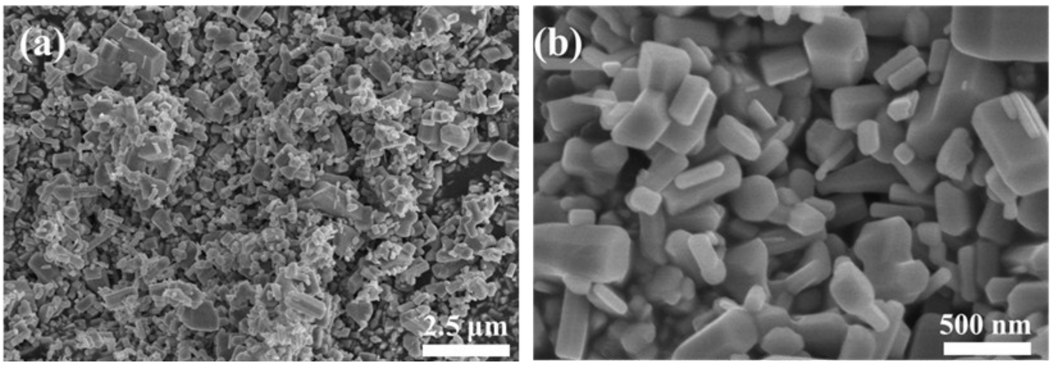

Fig. S7 SEM images of the commercial ZnO particles.