Electronic Supplementary Information

Nanostructured NiO electrode for high rate Li-ion batteries

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Experiments details

Fabrication procedure: Nanostructured NiO electrodes were fabricated by a direct thermal oxidation of Ni foams in air. The Ni foams (100 PPI pore size, 380 g m⁻² surface density, and 1.5 mm thick) were purchased from Changsha Lyrun New Material Co. Ltd., China. In a typical procedure, Ni foams were first sonicated in high purity ethanol for 30 minutes and dried in a vacuum oven at 60 °C for 3 h. Then the pretreated Ni foams were heated at a rate of 25 °C min⁻¹ to 400 °C and held for 1 h by a tube furnace. The mass of Ni foams before and after oxidation were weighed by a microbalance (Mettler, XS105DU) with an accuracy of 0.01 mg. According to the reaction of 2Ni + O₂ = 2NiO, the active weights of NiO (mNiO) are derived from mNiO = Δm × 74.69/16, where Δm is the weight difference of Ni foam before and after oxidation reaction.

Structural Characterization: The structure and morphology of the NiO electrodes were characterized by X-ray powder diffraction (XRD, Rigaku D/Max-2400 with Cu Kα radiation) and field-emission scanning electron microscopy (FE-SEM S-4800, Hitachi).

Electrochemical Characterization: Electrochemical characterizations were carried out using
the CR-2032-type coin cells, which were assembled in a high purity argon filled glove box 
($\text{H}_2\text{O} < 0.5$ ppm, $\text{O}_2 < 0.5$ ppm, MBraun, Unilab, Germany) by using the NiO electrodes as 
the working electrode and lithium foil as the counter and reference electrodes. Celgard 2320 
was used as the separator membrane. The electrolyte was 1 M lithium hexafluorophosphate 
($\text{LiPF}_6$) dissolved in ethylene carbonate : dimethyl carbonate : ethyl methyl carbonate in a 
1:1:1 volume ratio. The galvanostatic discharge-charge cycling and cyclic voltammetry were 
carried out at room temperature by using a multichannel battery tester (Neware BTS-610) and 
an electrochemical workstation (CHI 660C), respectively.

**Capacity correction**

![Figure S1](image)

**Figure S1.** Galvanostatic discharge/charge curves of Ni foam before oxidation.

Figure S1 shows the representative galvanostatic discharge/charge curves of Ni foam 
before oxidation at a current density of 0.1 mA cm$^{-2}$ between 0.02 and 3.0 V. The first charge 
capacity of the Ni foam without oxidation (0.0177 mA h) was deducted from the capacities of 
the oxidized Ni foam.
Cycling stability of the nanostructured NiO electrode

Figure S2. Cycling stability and coulombic efficiency of the nanostructured NiO electrode at 0.2 C (a) and 5 C (b).

Cycling stability and coulombic efficiency of the nanostructured NiO electrode at 0.2 C and 5 C are shown in Figures S2 (a) and (b), respectively. At the low rate of 0.2 C, a reversible capacity of 679 mA h g\(^{-1}\) was achieved in the 2nd cycle, which gradually increased to about 783 mA h g\(^{-1}\) after 50 cycles, whereas the coulombic efficiency steadily kept the values higher than 98.5%. After the first five cycles at the low rate of 0.2 C, with an increase of the rate to 5 C, the electrode can deliver a capacity of 561 mA h g\(^{-1}\) in the initial cycle and retain a capacity of 482 mA h g\(^{-1}\) after 50 cycles.