Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.
This journal is © The Royal Society of Chemistry 2014

SupplementaryInformation

Facile Synthesis of Hierarchically Porous NiO Microtubes as Advanced Anode Materials for Lithium-Ion Batteries

Nana Wang,[a] Liang Chen,[a] Xiaojian Ma,[a] JieYue,[a] FeierNiu,[a] HuayunXu,[a]* JianYang,[a]* and YitaiQian[b]

[a] *School of Chemistry and Chemical Engineering, Shandong University, Jinan 250100, China.*

Email: yangjian@sdu.edu.cn.

[b]*Hefei National Laboratory for Physical Science at Microscale and Department of Chemistry, University of Science and Technology of China, Hefei, 230026, China*

Experimental section

*Synthesis method:*10 mmol of dimethylglyoxime (dmg) and 9.6 g ofpolyethylene glycol (PEG 2000) were dissolved in 100 mL of absolute ethanol firstly. Then, 100 mL of 0.01 M $NiCl_2 \cdot 6H_2O$ was mixed with this solution by vigorous stirring. After the solution was kept at 0 ^oC for 12 h, the resultant product was collected by filtration and dried at 80 ^{o}Cover night. Finally, the productwas calcined at 500 ^oC for 2 h in air with a rate of 3 ^oC min^{-1}. The gray powders were collected for structure characterization and electrochemical measurements. The synthesis for NiO microrods was conducted without PEG 2000 and the other conditions were kept as the same.

Structure Characterization: The products were characterized by X-ray powder diffraction (XRD) patterns obtained from an advanced X-ray diffractometer (Bruker D8, Germany). SEM images were acquired on a field-emission scanning electron microscope (JEOL JSM- 6700F, Japan). TEM and HRTEM images were achieved from a transmission electron microscope (JEOL JEM-1011, Japan) and an analytic transmission electron microscope (JEOL JEOL-2011, Japan). Nitrogen sorption isotherms were measured using a gas sorptometer (Micromeritics ASAP- 2020HD88 USA). Thermal gravimetric analysis (TGA) was performed in air on a thermal analyzer (Mettler Toledo TGA/SDTA851, Germany).

Electrochemical measurements: Electrochemical performances of porous NiO microtubes were measured on battery cyclers (Land-CT2001A, China) at room temperature. For the working electrode, 70 wt% of active material, 20 wt% of conductive carbon black and 10 wt% of sodium carboxymethyl cellulose (CMC) were dispersed in deionized water and milled for 30 minutes. The slurry was then coated on a copper foil with a wet film thickness of 200 μm. After dried under vacuum at 60 °C for 12h, the typical loading of active materials was ranged between 1.5-2.0 mg cm^{-2}. The cells were assembled in an argon filled glovebox (Mikrouna, Super 1220/750/900) with metallic lithium as an anode, Ceglard 2400 microporous membrane as a separator, and 1 M solution of $LiPF_6$ in a mixture of ethylene carbonate, diethyl carbonate and dimethyl carbonate (*v/v/v* 1:1:1) as a electrolyte. Cyclic voltammetry (CV) measurements were conducted on a LK-2005A electrochemical workstation (Lanlike, China) in the range of 0.01-3V, at a scanning rate of 0.1 mV s^{-1}.

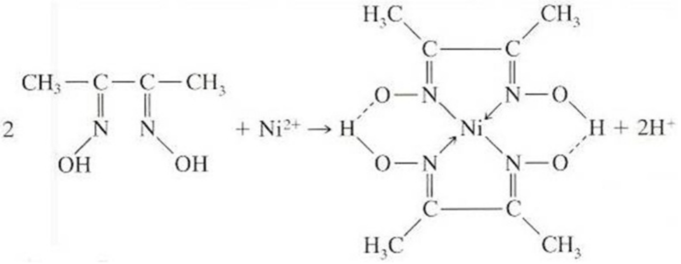

Fig. S1 The reaction between Ni^{2+} and dmg.

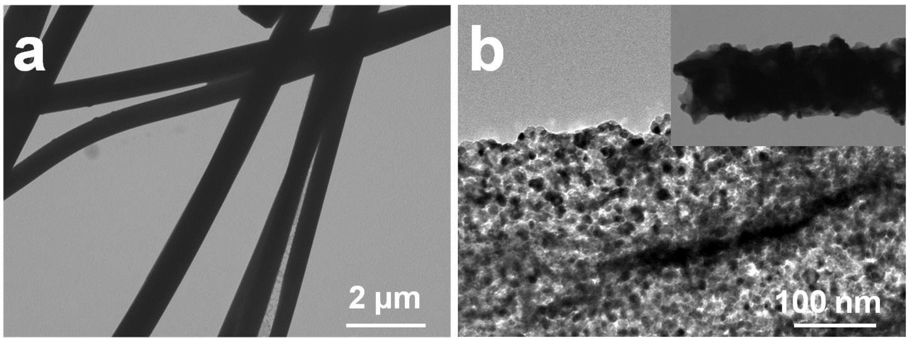

Fig. S2 a) TEM image of $Ni(dmg)_2$ without PEG 2000, b) TEM image of NiO microrods.

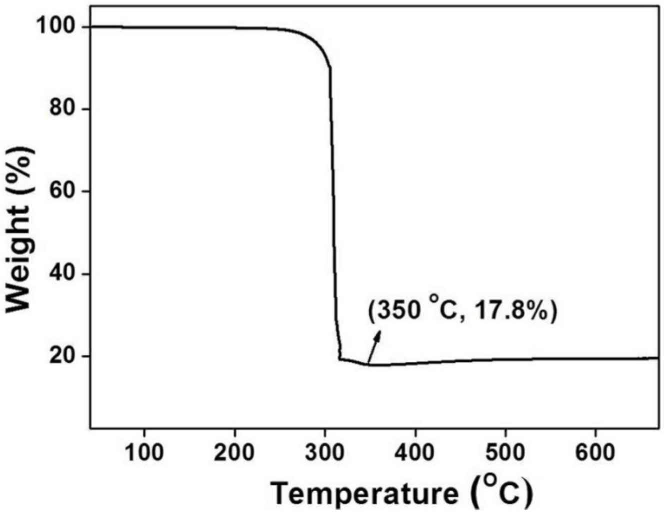

Fig. S3 TGA curve of the obtained precursor Ni(dmg)$_2$.

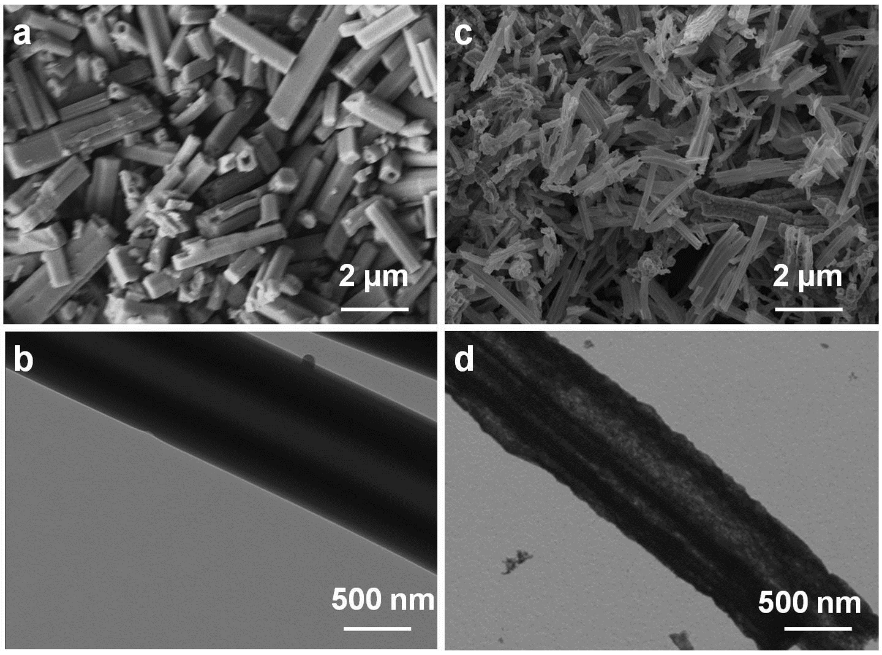

Fig.S4 SEM and TEM images of (a-b) Ni(dmg)$_2$ obtained at 25^{o}Cand (c-d) porous NiO microtubes.

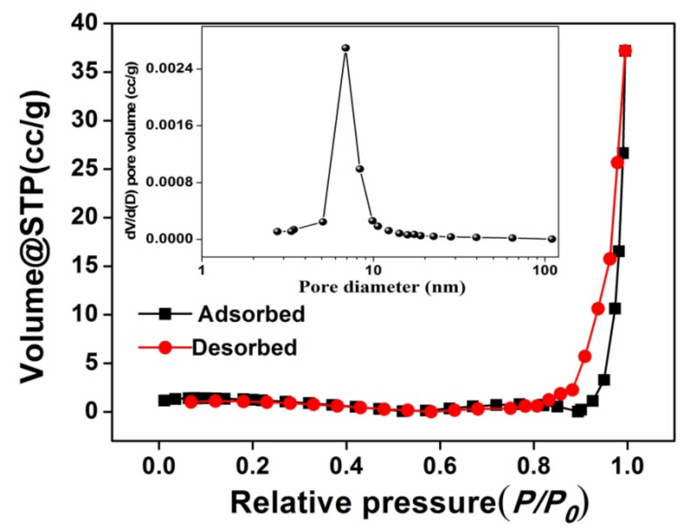

Fig. S5 N_2 adsorption/desorption isotherm curves at 77 K, and the pore size distribution diagrams (inset of Fig. 3) of porous NiO microtubes.

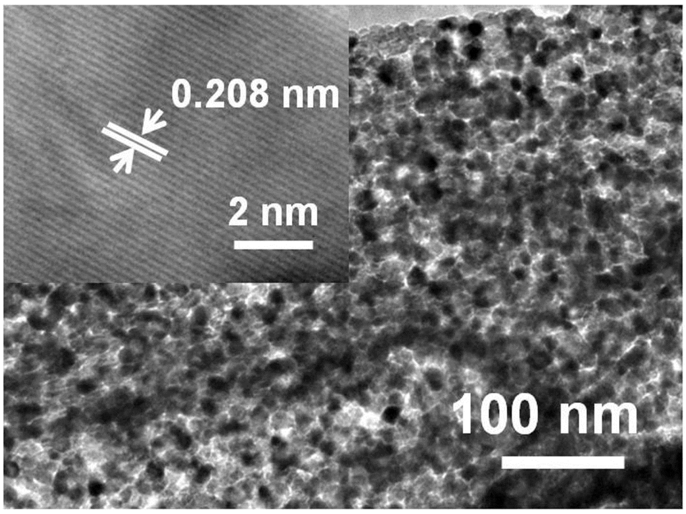

Fig. S6 HRTEM images of the porous NiO microtubes.