Supporting Information

Introducing nanodiamond in TiO_2-based anode for improving the performance of lithium-ion batteries

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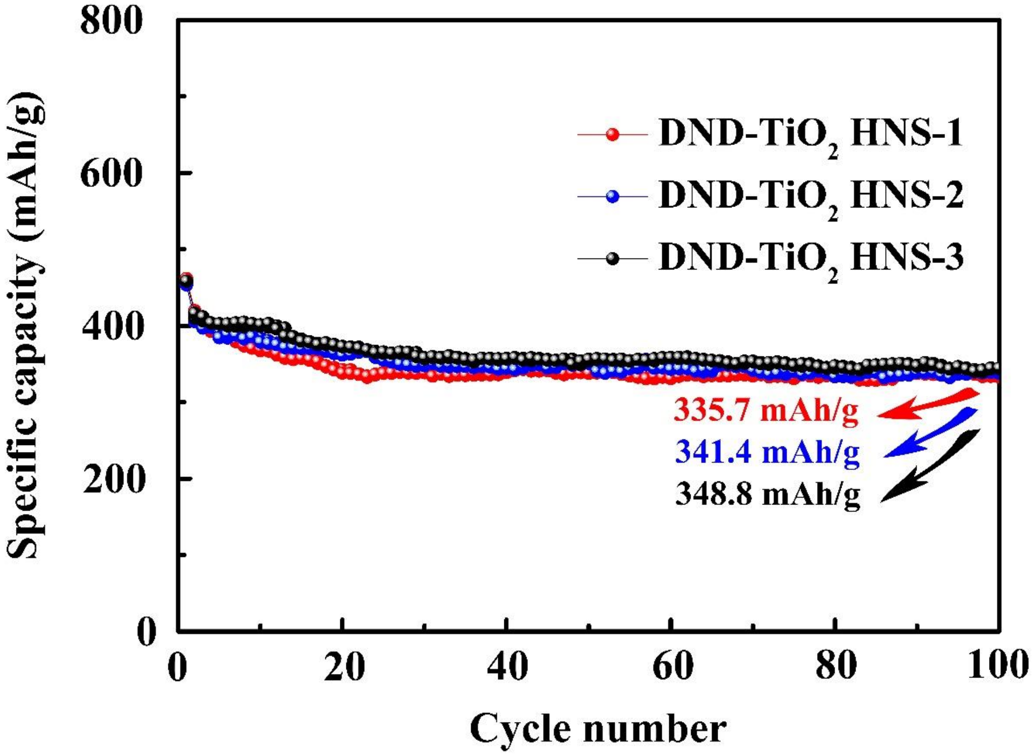

Fig. S1 Repetitive experiments of DND-TiO_2 HNS at a constant rate of 0.5 C.

We perform repetitive experiments using three sets of samples fabricated under the same condition as discussed in the text (DND-TiO_2 HNS-1 and DND-TiO_2 HNS-2 as the control group, DND-TiO_2 HNS-3 used in the manuscript). It can be seen that the first discharge specific capacity of DND-TiO_2 HNS-1 and DND-TiO_2 HNS-2 are 461.6 mAh/g and 453.6 mAh/g, respectively, which is similar with that for DND-TiO_2 HNS-3 (458.2 mAh/g). In addition, the initial Coulombic efficiencies for DND-TiO_2 HNS-1, DND-TiO_2 HNS-2 and DND-TiO_2 HNS-3 are 91.2%, 89.4% and 92.8%, respectively. Moreover, the specific capacity of the control group are 341.4 mAh/g and 335.7 mAh/g after 100 cycles at a rate of 0.5 C, which are similar to the data of DND-TiO_2 HNS-3 (348.8 mAh/g). Consequently, it is demonstrated that the DND-TiO_2 HNS anodes reported in the paper has good reproducibility.

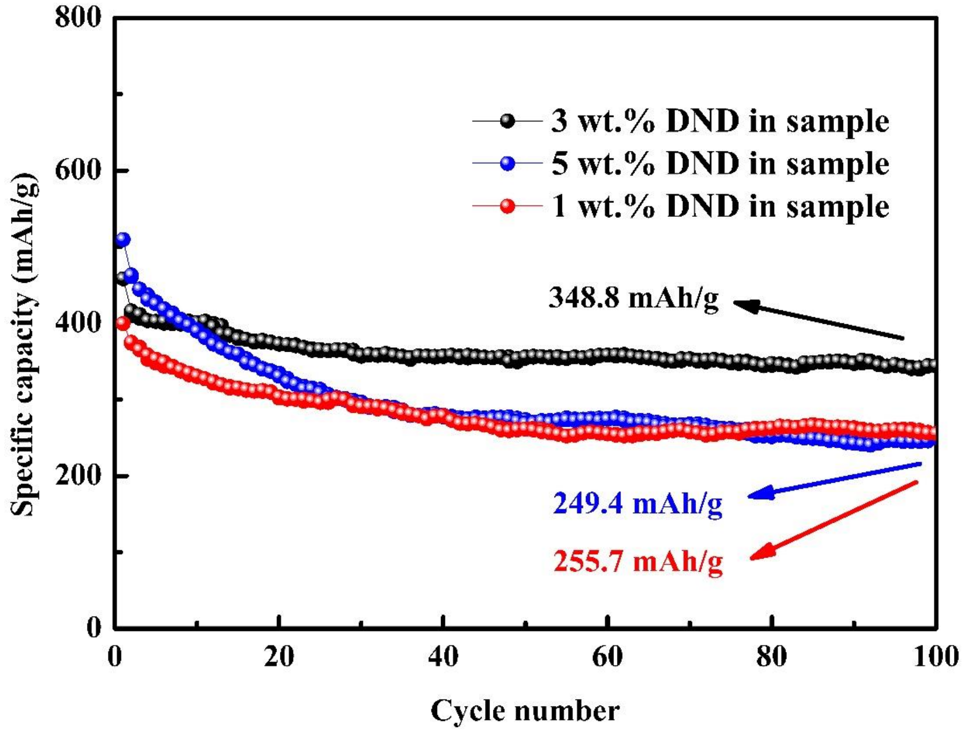

Fig. S2 The cyclic performance profiles of different DND content in samples of DND-TiO_2 HNS at a constant rate of 0.5 C.

In order to determine the effect of DND amount on the rate cycling performance of the samples, 1 wt.%, 3 wt.% and 5 wt.% (compared to tetrabutyl titanate) of DND content are investigated as comparative tests. The specific capacity of the three anodes of DND-TiO_2 are 249.4 mAh/g, 348.8 mAh/g and 255.7 mAh/g, respectively, after 100 cycles at a rate of 0.5 C. It reveals that the optimized DND content in the DND-TiO_2 HNS anodes is ~3 wt%.

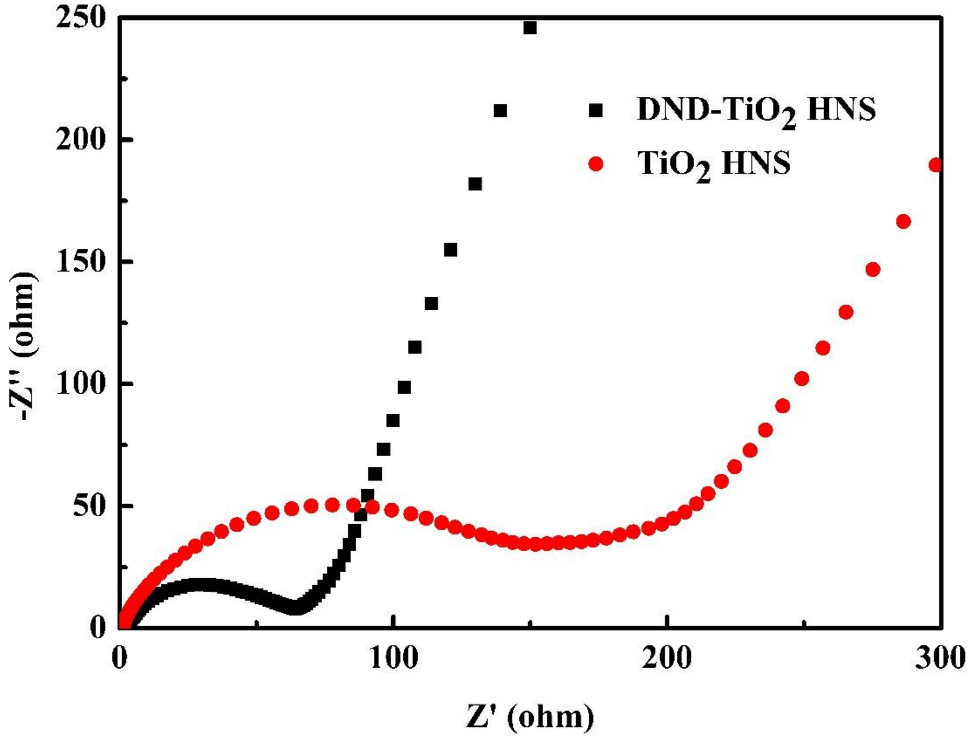

Fig. S3 Nyquist plots for the EIS of DND-TiO_2 and pure TiO_2 HNS anodes before cycling.

The Nyquist plots for both electrodes show oblique lines in the low frequency range, while there is only one semicircle in the high frequency range. The oblique line and the high frequency oblate correspond to the diffusion process and charge transfer impedance of Li^+ at the electrode/electrolyte interface, respectively. Compared with the resistance of the pure TiO_2 HNS anode (151.9 Ω), DND-TiO_2 HNS anode has smaller resistance value (64.1 Ω), indicating the introduction of DND can effectively improve the electron transport.

Table S1.

Comparison of electrochemical performances of the TiO_2-carbon based anodes for lithium-ion batteries.

Electrode Material	Electrochemical Performance	Ref.
TiO_2/C	140.2 mAh/g at 500 mA/g after 1000 cycles	1
Carbon-coated TiO_2(B)/anatase nanosheets	158.6 mAh/g at 800 mA/g after 500 cycles	2
Mesoporous H-TiO_2/GC hollow spheres	137 mAh/g at 5 C after 1000 cycles	3
TiO_2-RGO nanocomposite	154 mAh/g at 1200 mA/g after 300 cycles	4
C-TiO_2	159.8 mAh/g at 1C after 960 cycles	5
Hierarchical nanosheet constructed C/TiO_2 hollow composites	204 mAh/g (1 C), 135.2 mAh/g (10 C)	6
Porous TiO_2/C nanocomposite shells	168.8 mAh/g (5 C), 139.9 mAh/g (10 C)	7
Porous core/shell TiO_2 spheres	158 mAh/g (5 C), 136 mAh/g (10 C)	8
TiO_2 with soft carbon	122.8 mAh/g at 500 mA/g after 1000 cycles	9
C-TiO_2 composite	140 mAh/g at 5.88 C after 1000 cycles	10
C@TiO_2 composite aerogel	133 mAh/g at 10 C after 3000 cycles	11
DND-TiO_2 hollow nanosphere	246.3 mAh/g at 5 C after 800 cycles	This work

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