

Supplementary Materials

Innovational Chemical Vapor Deposition Coated TiO₂@TC Anode Enhancing Li-Ion Batteries Performances

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General information

All reagents commercially available were used as received. For example, Titanium dioxide powder (TiO₂) were from Shanghai Aladdin Bio-Chem Technology Co., Ltd.. The carbon additive of carbon black was provided by Lion Co., Ltd.. Polyvinylidene difluoride binder (PVDF), lithium hexafluorophosphate (LiPF₆), ethylene carbonate/diethyl carbonate/dimethyl carbonate (EC/DEC/DMC) were purchased from DoDo-Chem (China). The X-ray diffraction (XRD) spectra was performed on X'Pert PRO MPD. The Raman results were measured by LabRam HR Evolution. The morphology images of the samples were collected by the field-emission scanning electron microscope (FE-SEM, Hitachi, S3400N). The transmission electron microscopy (TEM) images were collected by FEI Tecnai F20. The cyclic voltammetry (CV) test was measured by a CHI instrument electrochemical workstation (650E). All cells (CR2032) were assembled in the Ar-filled glove box. The galvanostatic charge-discharge curves were collected by a CT2001A cell test instrument (LAND Electronic Co.) under room temperature. All the half and dual-ion batteries were tested at room temperature.

Synthesis of TiO₂@C and TiO₂@TC

Initially, TiO₂ powder was evenly spread in a quartz boat and placed inside a CVD furnace. Under the protection of argon gas flowing at 40 ml/min, the temperature was

raised to 600°C. Upon reaching this temperature, acetylene was introduced while adjusting the argon flow rate to 60 ml/min for acetylene and 20 ml/min for argon. The deposition process lasted for 10 minutes. Afterward, acetylene was shut off, and the sample was maintained at 600°C for 30 minutes with an argon flow of 40 ml/min before cooling to room temperature. This resulted in the formation of TiO₂@C nanoparticles, specifically the sample with a thicker carbon layer mentioned in the article.

Subsequently, the obtained TiO₂@C sample was laid flat in a quartz boat and placed in a muffle furnace. Under argon protection, the temperature was raised to 800 °C and maintained for two hours, yielding the TiO₂@TC. This process involved annealing and graphitization of the carbon layer.

Half cells: The TiO₂@C and TiO₂@TC anodes were simply fabricated by 80 wt% active materials, 10 wt% carbon black and 10 wt% polyvinylidene difluoride binder (PVDF). The neat loading mass of active materials on Cu foil was >12 mg cm⁻². The electrolyte for Li-ion half cells was 1M LiPF₆ in ethylene carbonate/diethyl carbonate/dimethyl carbonate (EC/DEC/DMC). The separator was Whatman glass fiber. The anode was Li metals. All half cells (CR2032) were assembled in the Ar-filled glove box. The CV test was tested at the scan rate of 0.2 mV s⁻¹ between 1.0 and 3.0 V (vs. Li⁺/Li) using electrochemical workstation (CHI 650e). All the capacities were reported based on the mass of active materials in half cells.

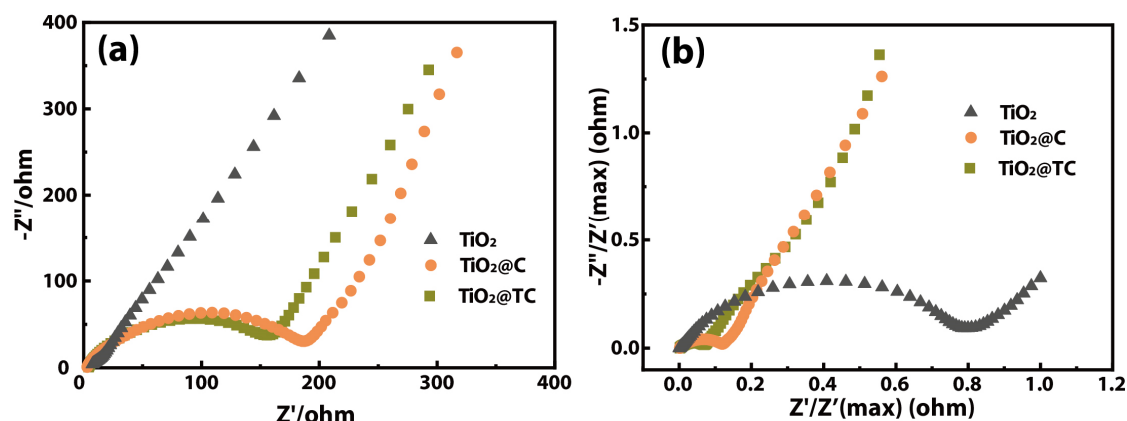


Figure S1. (a) The EIS tests for TiO_2 , $\text{TiO}_2@\text{C}$ and $\text{TiO}_2@\text{TC}$ in a small range; (b) The EIS results for TiO_2 , $\text{TiO}_2@\text{C}$ and $\text{TiO}_2@\text{TC}$ with $-Z''/Z'(\text{max})$ on the y-axis and $Z'/Z'(\text{max})$ on the x-axis.

Table S1. The comparisons of $\text{TiO}_2@\text{TC}$ anode with other $\text{TiO}_2@\text{C}$ anode by different carbon coat technique.

Anodes	Treatments	Stable capacity ^[a]	Cycle life and stability ^[b]	Ref
$\text{TiO}_2@\text{TC}$	Chemical vapor deposition	167	69%@200 cycles (0.5 C)	This work
$\text{TiO}_2\text{-QDs/GNs}$	Hydrothermal	228	70%@100 cycles (1 C)	[1]
HUTS@C	Hydrothermal	167.5	73%@200 cycles (1 C)	[2]
LTO-RTO@C	Hydrothermal	128	94%@200 cycles (2 C)	[3]

[a] Stable discharge capacity observed, the unit is mAh g^{-1} (redox electron number); [b] The ratio of the last-cycle capacity value to the peak value (current density).

Reference:

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