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Electronic Supplementary Information (ESI) for

Carbon Composite Spun Fibers with In-Situ Formed Multicomponent Nanoparticles for Enhanced Performance Lithium-ion Battery Anode

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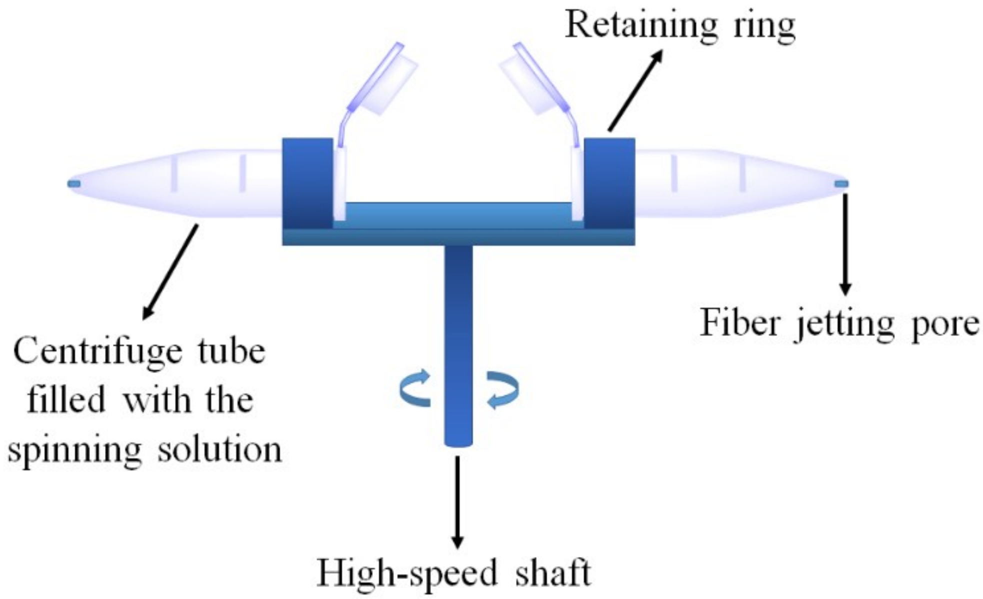

Scheme. S1. The centrifugal spinning apparatus for dry-spinning method.

Table. S1 Comparison of nanofibers fabrication methods.

Methods	**Raw materials**	**Cost**	**Productivity**	**Length-diameter ratio**	**Repeatability**
Wet-spinning[1]	Polymer solution with high viscosity	High cost due to the complex process	Limited by viscous drag and diffusion velocity	Very high	Good
Electro-spinning[2]	Polymer solution or melt mix with inorganics	High energy cost	Low output due to low spinning speed	High	Limited by various technical parameters
Template[3]	Templates and precursors	High cost due to templates removing	Limited by templates and reaction rate	Low	Depended on templates
Hydro-thermal[4]	Inorganic precursors and catalysts	High cost due to high level device	Limited by reaction time and device	Low	Limited by sensitive reaction conditions
Force-spinning[5]	Polymer solution or melt	High cost due to the complex device	High	High	Good
Dry-spinning (this work)	Polymer solution or melt mix with inorganics	Low cost (simple device and materials)	Very high (3-5 g/min)	Very high	Good (facile technical parameters)

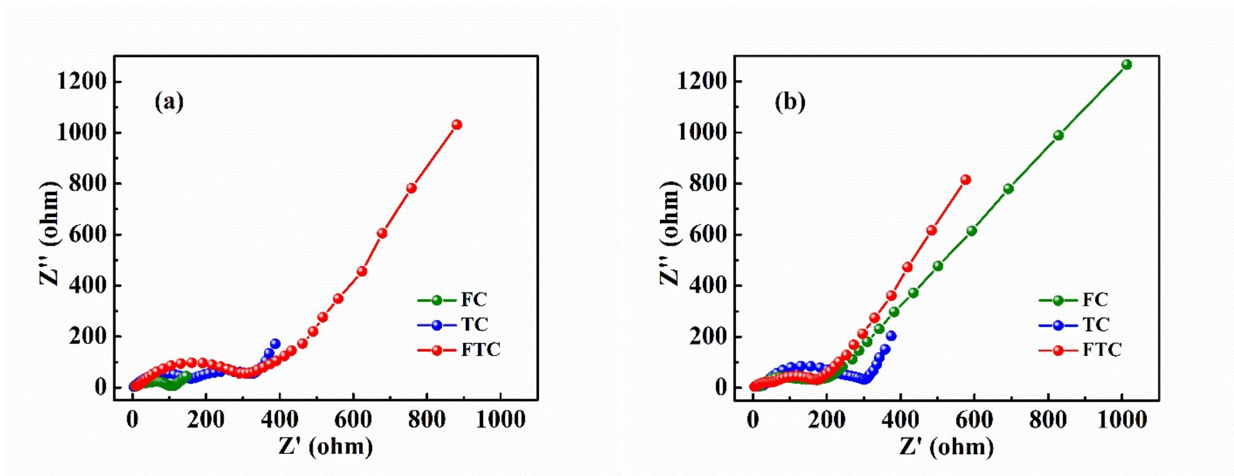

Fig. S1. Nyquist plots of FC, TC and FTC (a) before cycling process and (b) after 200 cycles.

To clarify the electrical conductivity of the FC, TC and FTC composite fibers, electrochemical impedance spectroscopy (EIS) was measured for the cells before and after cycling (Fig. S1). Generally, the Nyquist plots consist of a semicircle in the high and medium frequency and a sloped line in the low frequency. The diameter of the semicircle is in direct proportion to the charge-transfer impedance including electrolyte resistance (R_e), surface film resistance (R_{sf}), and charge transfer resistance (R_{ct}).[6] The slope of the inclined line is in inverse proportion to the Warburg impedance (Z_w) associated with Li-ion diffusion process within the electrode.[7] As displayed in Fig. S1a, the resistance values before the discharge/charge process are ca. 112 Ω of FC, 310 Ω of TC, and 290 Ω of FTC. Apparently, the tendency of electrical conductivity is FC>FTC>TC, indicating that Fe_3C indeed enhanced the electronic conductivity, and conversely TiO_2 hindered the charge transfer of the anodes. After 200 discharge/charge cycles, the Nyquist plots of the anodes have some changes (Fig. S1b). The charge transfer impedances of FC, TC and FTC have become to 173, 305 and 167 Ω, respectively. It is found that the resistance value of FC increased obviously from 112 to 173 Ω, which can be attributed to the electrode structural damage due to the large volume variation of Fe_3O_4 during cycling. By contrast, the electrical conductivity of TC has hardly changed (310 to 305 Ω), suggesting the superior electrode stability of TiO_2 during cycling. For FTC, the electronic impedance has a distinct decrease from 290 to 167 Ω, which proves the synergetic effect within FTC anode further. On one hand, Fe_3C catalytically activates the anode, thereby improving the electrical conductivity during cycling. On the other hand, TiO_2 effectively restrains the electrode destroy resulting from volume change. Therefore, due to the synergetic effect of every component, FTC reveals the best electrical conductivity among all the three anodes after 200 cycles. Meanwhile, the oblique lines of all the three anodes, no matter before or after cycling, exhibit almost the same slope at low frequency, suggesting that there are no obvious differences on the lithium ion diffusion in all samples. This phenomenon indicates the lithium ion diffusions in these anodes are dependent on the stable carbon fiber matrix.

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