

Tailored High-performance Si-C-Graphite Paper Anodes in Lithium ion Batteries

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The high-capacity cathode/anode materials have gained tremendous attention because of the increased demands of electric vehicles and energy storage systems with high-energy/power-density batteries. Graphite as one of the most reliable and practical anode materials in commercial lithium ion batteries (LIBs) has always been used as anode in LIBs due to its low cost, good stability and high initial coulombic efficiency (CE $\geq 90\%$), etc. However, the maximum theoretical specific capacity of graphite is low (372 mAh g^{-1}), which hinders its further application for powering electronic items and cannot satisfy the higher energy density requirements of advanced electrical vehicles. Silicon, one of the most promising anode candidates in LIBs, has attracted extensive attention in recent years because of its high theoretical capacity (3579 mAh/g for $\text{Li}_{14}\text{Si}_5$).¹⁻³ However, it is very challenging to prepare high capacity Si-based anodes materials with high (initial) CE and long-term life-span. Si anode suffers a severe cracking for its large volume change ($> 300\%$) during fully charge/discharge process, which will cause rapid capacity fading and low CE of Si anode in LIBs.

In this work, a tailored high-performance Si-C-Graphite paper has been developed via an electrospinning technique. The tailored Si-C-Graphite paper anode in LIB exhibits excellent electrochemical performance in terms of high capacity ($> 1000 \text{ mAh g}^{-1}$), excellent rate capability and high initial CE ($> 80\%$). Especially, the full cell (Si-C-Graphite paper/ $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$, i.e., $x=8, y=1, z=1$) delivers a high energy density of $>300 \text{ Wh kg}^{-1}$ at 0.1 C. This work presents a promising route for a scalable production of high-performance Si-C-Graphite anode material in LIBs.

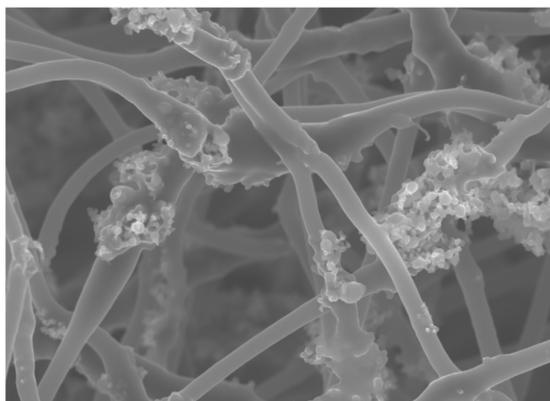


Figure 1 SEM image of Si-C-Graphite paper anode without binder and super P.

References:

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