Docket #: S22-329

Fast-Charging of Hybrid Lithium-ion/Lithium-metal Anodes by Nanostructured Hard Carbon Flower Host

Introducing a groundbreaking advancement in lithium metal anode technology, Stanford researchers have developed an innovation that leverages a flower-like nanostructured hard carbon host (CF) to unlock the full potential of lithium metal. Lithium metal offers a theoretical specific capacity up to tenfold that of graphite. This solution addresses a longstanding challenge, ensuring stable cycling of metallic lithium even under high current densities and realistic cell conditions.

Traditionally, metallic lithium has struggled with cyclic instability at elevated current densities, limiting its application in high-power scenarios. However, the CF-based hybrid lithium-ion/lithium-metal anode technology achieves a remarkable >99% Coulombic Efficiency (CE) at 12 mA/cm^2 (4 mAh/cm^2) and >99.5% CE at 16 mA/cm^2 (2.5 mAh/cm^2) with a standard carbonate electrolyte. Furthermore, in comparison to the prevailing graphite anode material, the CF demonstrates a two-fold specific capacity at low current densities (2 mA/cm^2) and an astounding four-fold specific capacity at high current densities (>10 mA/cm^2). The cyclic stability at these elevated currents surpasses that of graphite, marking a significant leap forward in lithium-ion battery technology.

In a market dominated by graphite, this carbon flower anode material represents a transformative leap forward. With twice the specific capacity at low current densities and four times the capacity at high current densities, coupled with unmatched cyclic stability, it stands poised to redefine the future of high-performance lithium-ion battery technology.

Applications

- High-power electric vehicles
- Grid-scale energy storage
- Portable electronics

Advantages

- Greater longevity and reliability in demanding applications
- Rapid charging
- Lightweight

Publications

- Gong, H., Chen, Y., Chen, S., Xu, C., Yang, Y., Ye, Y., ... & Bao, Z. (2022). Fast-Charging of Hybrid Lithium-Ion/Lithium-Metal Anodes by Nanostructured Hard Carbon Host. ACS Energy Letters, 7, 4417-4426.

Patents

- Published Application: WO2024054984
- Published Application: 20260081160

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