

Silicon Whisker and Carbon Nanofiber Composite Anode

For spacecraft, electric vehicles, and bulk energy storage units

Silicon is an attractive anode material for lithium-ion (Li-ion) batteries because of its theoretical high-charge capacity; however, silicon anodes have limited applications because silicon's volume changes by 300 percent upon insertion and extraction of lithium, which results in capacity fading.

Physical Sciences Inc., has developed a silicon whisker and carbon nanofiber composite anode for use in Li-ion batteries that provides capacity greater than 1,000 mAh/g for more than 200 cycles (at 100 percent depth of discharge). The innovation's unique silicon architecture and structural reinforcement (made possible by the nanofibers) combine to provide a synergistic improvement in reversible capacity and electrochemical cycling. In addition, the developed powder can be handled and processed into electrodes using established procedures and equipment. The resulting battery system has the capability to provide an energy density of greater than 220 Wh/kg. A scalable synthesis process enables low-cost incorporation into electric vehicles and bulk energy storage units.

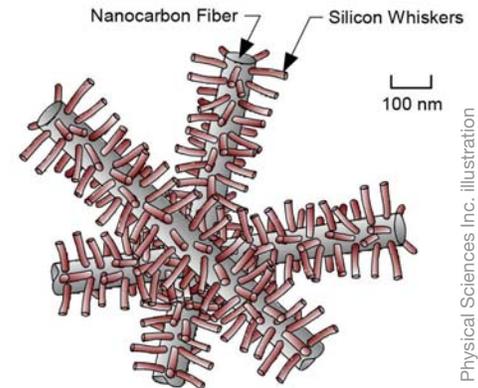
Applications

NASA

- ▶ Crew and launch vehicles
- ▶ Portable power for landers, rovers, and astronaut equipment
- ▶ Storage systems for crew exploration and spacecraft
- ▶ Stationary energy storage systems

Commercial

- ▶ Hybrid electric vehicles
- ▶ Consumer electronic devices



Silicon Whiskers/Nanowires on Carbon Nanofiber J-8382

Phase II Objectives

- ▶ Demonstrate production levels of grams per batch
- ▶ Achieve full cell anode capacity of >1,000 mAh/g at a charge rate of 10 (C/10) and 0 °C
- ▶ Establish a full cell cycle life of over 300 cycles
- ▶ Display an operating temperature of -30 °C to +30 °C
- ▶ Demonstrate a rate capability of C/5 or higher
- ▶ Deliver to NASA three 2.5 Ah cells (energy density >220 Wh/kg)
- ▶ Exhibit the safety features of the anode and full cells
- ▶ Design a 1 kWh prismatic battery pack

Benefits

- ▶ High capacity
- ▶ High power
- ▶ Improved cycle life
- ▶ Low cost

Firm Contact

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