

Mesoporous Silicon-Based Anodes

For high-capacity, high-performance lithium-ion batteries

A new high-capacity anode composite based on mesoporous silicon is being developed. With a structure that resembles a pseudo one-dimensional phase, the active anode material will accommodate significant volume changes expected upon alloying and dealloying with lithium (Li). The mesoporosity is created without the aid of a surfactant template using a novel, high-volume synthetic process. The anode composite based on this material is designed to have a reversible Li-ion capacity exceeding 600 mAh/g—or nearly twice that obtainable with graphite anodes—and much higher capacities could be attainable. Phase I successfully demonstrated the synthesis of this new meso-silicon (Si) material as well as its high electrochemical activity and rechargeability. Phase II expanded the investigation of the development of mesoporous Si-based Li-ion anodes. The optimum anode was evaluated in Li-ion cells containing 4-V oxide cathodes.

Applications

NASA

- ▶ Power for landers, rovers, and extravehicular activities (EVAs)
- ▶ Space-related applications in Moon and other planetary habitats

Commercial

The new anodes will result in high-performance Li-ion batteries suitable for the following commercial applications:

- ▶ Electric vehicle propulsion
- ▶ Portable consumer products:
 - Cellular phones
 - Portable power tools
 - Cameras
 - Laptop computers



Phase II Objectives

- ▶ Expand the investigation of the development of a mesoporous, Si-based Li-ion anode
- ▶ Evaluate the optimum anode in Li-ion cells containing 4-V oxide cathodes

Benefits

- ▶ Reversible Li-ion capacity exceeding 600 mAh/g (nearly twice that obtainable with graphite anodes)
- ▶ Nonflammable
- ▶ Subambient temperature operation

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