Scalable Synthesis of Sulfur Nanosponge Cathode for Lithium-Sulfur Battery with Greatly Improved Cyclability
Technology #16066

Applications

This technology can be applied to lithium-sulfur batteries for energy storage.

Problem Addressed

Sulfur is cost-effective, non-toxic, earth-abundant, and has a high theoretical capacity when used for lithium batteries. However, lithium-sulfur batteries typically have poor cyclability due to the active material dissolving into the electrolyte and mechanical damage to the cathode from volume changes during cycling. This invention increases cycle life by slowing down sulfur loss into the electrolyte and by using a structure that can expand or contract in response to volume changes.

Technology

Many lithium polysulfides are soluble in the commonly used electrolytes. This means that much of the active material in the cathode can be lost to the electrolyte in just a few cycles, which severely limits the battery's cycle life. Strategies to protect the sulfur from the electrolyte typically involve encapsulating the sulfur within a protective layer. This technology takes the opposite approach and uses carbon black, commonly added to battery cathodes to improve electrical conductivity, as the base to construct a sulfur-covered nanosponge to drastically extend the life of the battery. Test cells constructed from the nanosponge cathodes have achieved a discharge capacity of 290 mAh/g after 500 cycles at 0.2 C.

The sponge structure preserves sulfur content in the cathode by reducing the surface area of sulfur directly exposed to the electrolyte. The carbon also serve as a sieve that allows the small lithium ions to enter the cathode but prevents the larger lithium polysulfide molecules from leaving, effectively trapping the sulfur within the cathode and keeping it available for lithiation on the next cycle. Additionally, the carbon base is mechanically robust enough to allow the sponge to expand and contract in response to volume changes during battery cycling to maintain good electrical contact with the sulfur active material. This allows every part of the cathode to participate in the lithiation/delithiation process, maximizing the available energy storage capacity.

Advantages

- Increases the cycle life of lithium-sulfur batteries
- Low-cost, reliable synthesis method that can be scaled up for commercial production

Categories For This Invention:

Energy
Energy Storage
Batteries
Lithium Batteries
Other (Batteries)

Intellectual Property:
Sulfur nanosponge cathode for lithium-sulfur battery and methods of manufacture thereof
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Sulfur nanosponge cathode for lithium-sulfur battery and methods of manufacture thereof
US Patent Pending

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External Links:
Ju Li Group
http://li.mit.edu/

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