High-rate Aluminum Anode for Lithium-ion Battery with Long Cycle Life and Ultrahigh Capacity
Technology #17380

Applications

High-capacity anode materials have the ability to provide Lithium-ion batteries with higher capacities and longer life cycles. Major Lithium-ion battery manufacturers, as well as companies selling consumer electronics and hybrid electric vehicles, would benefit from this technology.

Problem Addressed

Alloy-type anodes, such as silicon and tin, are gaining popularity in rechargeable Lithium-ion batteries, but their rate capabilities have so far been poorer than graphite and many oxide electrodes. Theoretically, Aluminum should be an attractive anode material for rechargeable Lithium-ion batteries due to its low cost, high capacity, low potential plateau, and high electrical conductivity; however, the practical performance falls short of the theoretical promise. This invention improves current technology by creating an Aluminum-based core surrounded by a tunable interspace to achieve 10C charge/discharge rate with reversible capacity exceeding 650 mAh/g even after 500 cycles.

Technology

The technology makes use of a yolk-shell nanocomposite of aluminum core and a TiO2 shell, with a tunable interspace, to achieve a longer lasting and ultrahigh capacity Lithium-ion battery. The yolk-shell nanocomposite particles feature a void between the shell and the core, which allows for the expansion and shrinkage of the core during the charging and discharging phases. An inert TiO2 shell conducts both Li+ and electrons and even if the yolk pulverizes, all of the active content will still remain confined in the closed shell and will not lose electrical contact. The manufacturing process is a one-pot synthesis method that gives specific capacities at an industrial scale.

Advantages

- Simple
- Industrially scalable
- Cost-effective
- Only uses Earth-abundant elements

Categories For This Invention:

Energy
Energy Storage
Batteries
Lithium Batteries
**Intellectual Property:**

Aluminum based electroactive materials  
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**Publications:**

* A Nanotechnological Accident May Lengthen Battery Lives  
The Economist  
August 15, 2015  
* High-rate Aluminium Yolk-shell Nanoparticle Anode for Li-ion Battery with Long Cycle Life and Ultrahigh Capacity  
Nature Communications  
August 5, 2015  
* “Yolks” and “Shells” Improve Rechargeable Batteries  
MIT News  
August 5, 2015

**External Links:**

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

**Image Gallery:**

![Image of aluminum based electroactive materials](image_url)