SRNL SAVANNAH RIVER NATIONAL LABORATORY

techbriefs

Nanostructured Anodes for Lithium-Ion Batteries

Savannah River Nuclear Solutions (SRNS), managing contractor of the Savannah River Site (SRS) for the Department of Energy, has developed new anodes for lithium-ion batteries that are reported to increase the energy density four-fold. It is widely known that the energy capacity of Lithium-Ion batteries is limited by the widely used graphite anode that intercalates lithium ions as LiC_6. The theoretical capacity of LiC_6 is 372mAh/g. To power an electric car for 300 miles, the energy density has to be increased 3 to 4 times from current level.

Background

Current carbon-based anodes are fabricated through a series of processes of mixing carbon, binder and conductive additives in organic solution, pasting the slurry on current collector and baking to remove solvent. It involves intensive labor, fire safety and environment emission control resulting in high cost.

Directly formed aligned nanorods of metals and metal oxides on the current collectors that can bind a higher number of lithium cations than the conventional graphite design. Nanorods have the advantage of large surface areas for lithium ions to access and the flexibility to withstand the expansion and contraction experienced by multiple charge/discharge cycles, which contributed high energy and power densities with expected longer cyclic life. Direct deposition of nanorods on a current collector will also translate into simple and lower cost manufacturing.

In one study, aluminum nanorods were directly formed on a titanium substrate and were demonstrated as an anode in a lithium-ion test cell to show a four-fold increase in energy density. The aluminum nanorod anode was tested with a lithium cathode in a LiPF6 propylene- and dimethyl-carbonate electrolyte to show initial discharging capacity of 1243 mAh/g from 3V to 0.01V and was recharged to 3V with 440 mAh/g capacity

Cobalt oxide nanorods were also formed on a titanium substrate and tested to show substantially higher capacities than the commonly used graphite anodes. The cell tests have shown an initial discharging capacity of 2484 mAh/g from 2.7V to 0.01V and was recharged to 3V with 1433 mAh/g capacity.

at a glance

- **patent pending**
- **increase energy density**
- **longer cyclic life**
- **replaces graphite anodes**
- **simple and lower cost manufacturing**

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Nanotechnology

Ongoing studies show numerous metals and metal oxides can be considered for nanorod formations to elevate charge capabilities of the anodes in lithium-ion batteries. The replacement of graphite anodes is inevitable as the demand for battery power increases for transportation markets.

Technology transfer

The Savannah River National Laboratory (SRNL) is the U.S. Department of Energy's (DOE) applied research and development laboratory at the Savannah River Site (SRS). With its wide spectrum and expertise in areas such as homeland security, hydrogen technology, materials, sensors, and environmental science, SRNL's cutting edge technology delivers high dividends to its customers.

The management and operating contractor for SRS and SRNL is Savannah River Nuclear Solutions, LLC. SRNS is responsible for transferring its technologies to the private sector so that these technologies may have the collateral benefit of enhancing U.S. economic competitiveness.

Partnering opportunities

The Savannah River National Laboratory is an applied science laboratory with a growing alternative energy Program that includes battery development. Lithium-ion battery development will continue using additional metals and metal oxides and collaborative partners are welcome.

SRNS invites interested companies with proven capabilities in this area of expertise to develop commercial applications for this process under a cooperative research and development agreement or licensing agreement. Interested companies will be requested to submit a business plan setting forth company qualifications, strategies, activities, and milestones for commercializing this invention. Qualifications should include past experience in the commercial uses of similar processes, reasonable schedule for commercial process launch, an established customer base, and evidence of sufficient financial resources for process development and launch.

for more information

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