

High-Capacity, High-Voltage Composite Oxide Cathode Materials

For use in lithium-ion batteries

This SBIR project integrates theoretical and experimental work to enable a new generation of high-capacity, high-voltage cathode materials that will lead to high-performance, robust energy storage systems. At low operating temperatures, commercially available electrode materials for lithium-ion (Li-ion) batteries do not meet energy and power requirements for NASA's planned exploration activities. NEI Corporation, in partnership with the University of California, San Diego, has developed layered composite cathode materials that increase power and energy densities at temperatures as low as 0 °C and considerably reduce the overall volume and weight of battery packs.

In Phase I of the project, through innovations in the structure and morphology of composite electrode particles, the partners successfully demonstrated an energy density exceeding 1,000 Wh/kg at 4 V at room temperature. In Phase II, the team enhanced the kinetics of Li-ion transport and electronic conductivity at 0 °C. An important feature of the composite cathode is that it has at least two components that are structurally integrated. The layered material is electrochemically inactive; however, upon structural integration with a spinel material, the layered material can be electrochemically activated and deliver a large amount of energy with stable cycling.

Applications

NASA

- ▶ Lunar landers
- ▶ Extravehicular activities
- ▶ Lunar surface systems
- ▶ Rovers

Commercial

- ▶ Hybrid electric vehicles
- ▶ Consumer electronics:
 - Laptops
 - Mobile phones
 - Cameras
 - Camcorders
 - Portable televisions and radios
 - Power tools
- ▶ Medical devices
- ▶ Electric bicycles and scooters
- ▶ Military vehicles



Phase II Objective

- ▶ Enhance the kinetics of Li-ion transport and electronic conductivity at 0 °C in composite electrode materials

Benefits

- ▶ Maintains high energy and power densities at low temperatures
- ▶ Improves battery efficiency
- ▶ Stabilizes and enhances battery cell safety

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