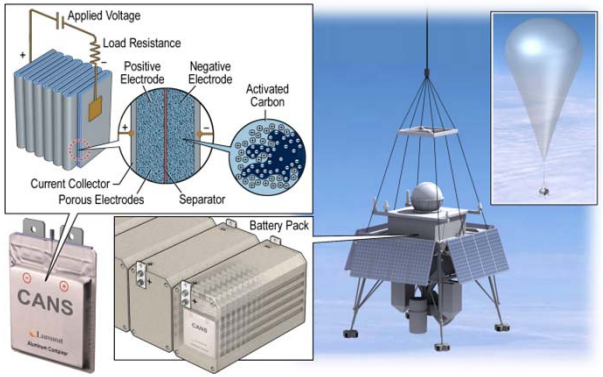
NASA SBIR Technologies

Carbon Nanotube-based Supercapacitor (CANS)

Proposal No: S3-07-9733 Principal investigator: Jun Ai, Luminit, LLC, Torrance, CA
NASA Contract: NNX-12-C-E38P, Technical Monitor: David Stuchlik

Objective

To address NASA's need for low mass electrical energy storage devices for onboard long duration balloon flights at mid-latitudes and altitudes, Luminit, LLC, proposed to develop a new carbon nanotube-based supercapacitor (CANS) based on our mature sol-gel chemical solution deposition technology.



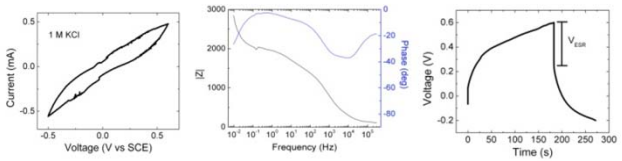
Approach

This new approach incorporates highly porous CNT-sol-gel based electrode materials and alignment of CNT in the sol-gel, which increases the power/energy density and decreases the mass by increasing the effective area accessed by electrolyte ions.

Phase I Accomplishments

- Developed a CANS design and models to achieve maximum power and energy efficiency.
- Developed and fabricated CNT-sol-gel composite materials.
- Fabricated CNT-sol-gel electrodes and unpackaged proof-of-concept single cell two-electrode supercapacitors for the first time.
- Performed experimental testing, e.g. cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), chronopotentiometry.
- Demonstrated the feasibility of CANS with ~10 times higher power density than commercial rechargeable batteries.
- Met the Phase I objectives and increased TRL 2 to TRL 3.

Proof-of-concept CANS



Measured CV, EIS, and Chronopotentiometry

Phase II Plan

- Optimization, fabrication and testing of CNT-sol-gel electrodes to achieve high energy density ~ 60 Wh/kg and high power density ~10 to 100 kW/kg.
- Design, fabrication, assembly and testing of hermetically sealed package, single- and multi-cell CANS devices.
- Fabrication, assembly and testing of flexible and fully-functional prototype CANS device, to meet NASA's balloon system requirements including voltage (28 volts DC), power levels (0.1 to 1 kW) and energy storage levels (1 to 12 kWh).
- Exploration of the commercial potential of CANS technology.

Phase II Deliverable: CANS prototype at TRL 6

NASA and Non-NASA Applications

Luminit's CANS technology will benefit the NASA Terrestrial and Planetary Balloons Mission and find wide commercial applications in solar energy storage, smart grids, electrical vehicles, as well as in consumer markets such as laptops, digital music players, toys, eBook readers, cell phones, iPod, iPhone, iPad, cameras, power generators, power conditioners, and cloud computer systems.

Firm Contacts

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NON-PROPRIETARY DATA