

Lithium Ion Batteries Development for CubeSats and SmallSats Project

Center Independent Research & Developments: GSFC IRAD Program | Mission Support Directorate (MSD)



ABSTRACT

Lithium Ion (Li-Ion) cells are being developed for high-power batteries in space; especially there is a strong need to miniaturize Li-Ion batteries for CubeSat and SmallSat. For this reason, we propose a process to design and implement Goddard Space Flight Center (GSFC) in-house Li-Ion battery pack which provides us control over testing to design a high quality battery pack with low cost, risk reduction, and being able to adapt interface and mechanical form factor.

ANTICIPATED BENEFITS

To NASA funded missions:

Goddard Modular Smallsat Architecture (GMSA)

To NASA unfunded & planned missions:

Cubesat and Smallsat.

DETAILED DESCRIPTION

Goddard scientists and engineers are developing SmallSat for the Center's and NASA's mission needs. The Goddard in-house Smallsat Li-Ion design address capabilities for NASA's missions in science, exploration and space operation. This technology development includes two processes: Characterize Li-Ion cells and design battery pack as following:

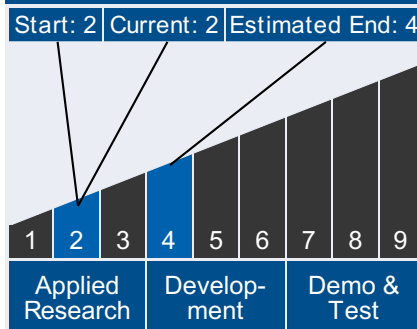


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Technology Maturity



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- a. Characterize Li-Ion cells: Contact Li-Ion cells from vendors authorized distributors to procure Li-Ion cells with two common sizes 18650 (18 mm x 65 mm) and 16340 (16 mm x 34 mm). We simply order sufficient quantity of commercial-of-the-shelf (COTS) cells. We will test for safety and performance at cell level. Cell level testing includes studies of the cell physical design, rate performance, cycle lifetime, self-discharge, thermal properties, Lot Acceptance Tests (LAT) for electrical properties, capacity verification, degradation, impedance matching, and mission profile. The test results will be used as our own Li-Ion cells database which in turn will be used to design a flight battery pack for CubeSat or SmallSat.
- b. Design a battery: As part of this task we will investigate and trade the protection features to either already built-in within the cells or included in the overall battery pack. The protection features to consider include short circuit, over-charging, over-discharging, and to maintain battery temperature.



1 New Technology Report

Management Team

Program Executive:

- PETER HUGHES

Program Manager:

- Michael Johnson

Project Manager:

- WESLEY POWELL

Principal Investigator:

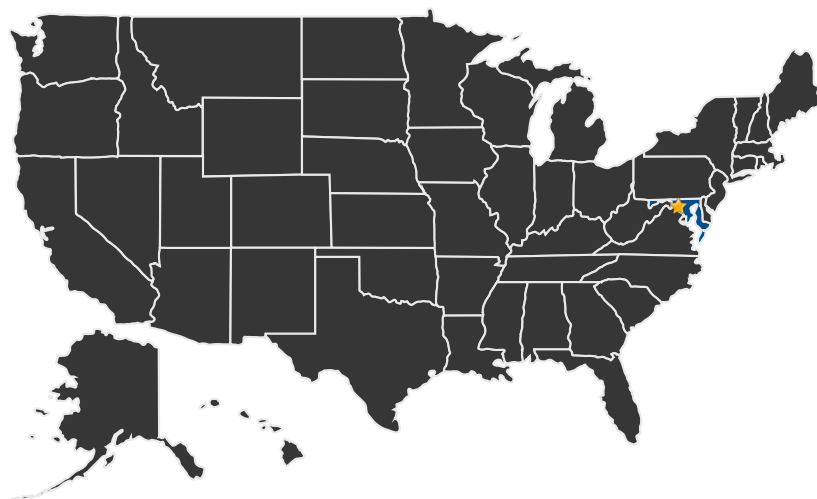
- Hanson Nguyen

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ **Lead Center:**
Goddard Space Flight Center

● **Supporting Centers:**

- Goddard Space Flight Center

PROJECT LIBRARY

New Technology Reports

- 1434465051

Technology Areas

Primary Technology Area:

Nanotechnology (TA 10)

- └ Energy Storage, Power Generation, and Power Distribution (TA 10.2)
 - └ Energy Storage (TA 10.2.1)
 - └ Lithium (Li) Battery Solid Polymer Electrolytes (TA 10.2.1.1)
 - └ Lithium (Li) Battery Solid Polymer Electrolytes (TA 10.2.1.1)

Secondary Technology Area:

Space Power and Energy Storage (TA 3)

- └ Space Power and Energy Storage (TA 3)

Science Instruments, Observatories, and Sensor Systems (TA 8)

- └ Remote Sensing Instruments and Sensors (TA 8.1)
- └ Remote Sensing Instruments and Sensors (TA 8.1)

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IMAGE GALLERY



Five thermal chambers in our lab allow us full capability to test Li-ion cells

Technology Areas (cont.)

- Nanotechnology (TA 10)
 - └ Energy Storage, Power Generation, and Power Distribution (TA 10.2)
 - └ Energy Storage (TA 10.2.1)
 - └ Nanostructured Electrode for Li Ion Battery (TA 10.2.1.4)
 - └ Nanostructured Electrode for Li Ion Battery (TA 10.2.1.4)

DETAILS FOR TECHNOLOGY 1

Technology Title

Design Li-Ion battery pack for small satellite

Technology Description

This technology is categorized as an architecture for unmanned flight

Test and characterize Li-Ion cells to build up database. Then select the best matched to design a Li-Ion battery pack for small satellite.

Capabilities Provided

Li-Ion battery pack with less than 5 cells in series and/or 3 cells in parallel to be used on Cubesats and Smallsats.

Potential Applications

Li-Ion battery pack to be used on Cubesats and Smallsats.