Sensor-based Prognostics to Avoid Runaway Reactions & Catastrophic Ignition (SPARRCI)

SPARRCI

National Aeronautics and Space Administration

NASA

Ensuring Safe, Reliable Power for Electric Aircraft

Overview/Description

State-of-the-art batteries suffer from catastrophic failures, resulting in over-engineered, heavy failure containment solutions to provide safety. Next-generation lithium-based batteries offer higher specific energy with additional safety concerns. With early detection of failure mechanisms via implementation of embedded sensors and nondestructive evaluation techniques, fault detection algorithms ensure catastrophic failures are eliminated. The result is a safe, higher-energy battery to enable electric aircraft.

SPARRCI will provide safe, high-energy batteries to power existing and next-generation aircraft concepts

Feasibility Assessment

- Identify conditions for reproducibly growing lithium dendrites to provide a reliable failure mechanism and identify failure precursors
- Assess functionality, compatibility and survivability of sensors within battery material environment; demonstrate sensor functionality to detect failure precursors
- Develop nondestructive evaluation (NDE) models and techniques to provide additional failure precursor detection
- Develop nominal and off-nominal prognostics/diagnostics and battery models to predict failure and provide battery state-of-health
- Demonstrate an integrated NDE/sensor approach utilizing failure algorithms that will mitigate catastrophic failure in a battery pack

Benefits:

- **Efficiently mitigate battery hazards, resulting in a smarter, safer battery**
- **Accelerate adoption of next-generation, higher-performing chemistries by adding inherent safety**

Partners

NASA Glenn Research Center
Battery Failure Analysis & Sensor Development

NASA Langley Research Center
Nondestructive Evaluation Modeling & Techniques

NASA Ames Research Center
Prognostic Algorithms & Battery Modeling

Cornerstone Research Group
Cell Scale-up & Battery Pack Build

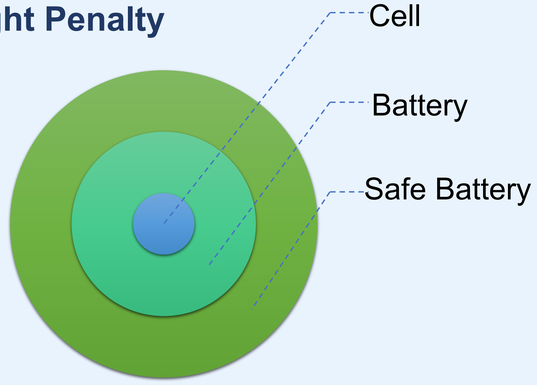
Recent Results / Status

- Demonstrated early compatibility, adhesion, and electrical continuity of sensors printed directly on battery components
- Completed optical microscopy setup for visual confirmation of lithium dendrite growth
- Held team kick-off meeting to discuss teaming efforts across disciplines
- Determined path forward for meeting early feasibility milestones

Next Steps

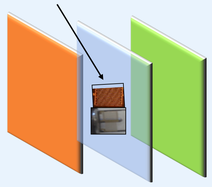
- Continued communication with Boeing Research & Technology and Boeing-Air Force Research Lab reps to discuss collaboration and technology demonstration platform opportunities
- Down-selection of battery components to build NDE and battery models
- Data sharing across teams to develop nominal battery models

State-of-the-Art Battery Weight Penalty



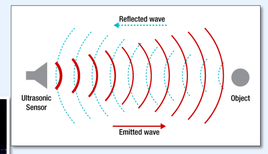
Significant Weight Added!

Cell-embedded Sensors



Machine Learning/Fault Detection

Nondestructive Evaluation



Battery Weight ↓

Safety ✓

Aircraft Performance ↑

CONVERGENT AERONAUTICS SOLUTIONS

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