



NASA EPSCoR
Research Performance Progress Report (RPPR)
Seed Award

I. Collaborating Organizations

A. Academic Collaborators (*do not include names of minors*)

Name	Academic Affiliation	RID Project Role	Nearest person month worked	Contribution to Project	Funding Support
Tyler Derby	University of Delaware	Test setup	5	Design and manufacture the test setups	NASA EPSCoR

B. NASA Collaborators

Name	Title	NASA Center	Nature of the Collaboration

C. Industry Collaborators

Name	Title	Industry/Company Name	Nature of the Collaboration
Chi-Hao Chang	Associate Research Scientist	Dow	Providing industry needs serves as the background for the project

D. New non-EPSCoR grants

Funding Entity	Award Name	Value of New Grant

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E. Other Organizations Involved as Partners

Organization	Nature of the Partnership	Benefit of the Partnership

II. Products

- A. List Journal publications – Please only list papers that have been published. **Please do not remove the table; or alter columns, add additional rows as required.**

Date Published	Published Paper (APA format)
11/2025	A. Bhowmick, X. Gao, W. Lu, J. Chakraborty, J. Xu*. Multiscale electro-chemo-mechanical model of high-capacity amorphous silicon anode material in sodium-ion batteries, International Journal of Solids and Structures, 113753, 2025

- B. List Conference Papers – Please only list papers that are included in conference proceeding. **Please do not remove the table; or alter columns, add additional rows as required.**

Conference Date	Conference Paper (APA format)

- C. List Conference Presentation – Please list conference presentation. **Please do not remove the table; or alter columns, add additional rows as required.**

Conference Date	Presentation Topic (APA format)

11/2025	S. Sun, J. Xu., Electrochemo-Mechanical Coupling in Electrode Materials Under Electrolyte-Induced Interactions, International Mechanical Engineering Conference and Exhibition, 2025, Memphis, USA

- D. List Books and/or other Publications – Please include explanations, help us to learn about your accomplishments. **Please do not remove the table; or alter columns, add additional rows as required.**

Date	Explanations (APA format -Book, Newspaper Op-Ed, ...)

- E. List talk/presentation/event/outreach activity – Please include explanations, help us to learn about your accomplishments. **Please do not remove the table; or alter columns, add additional rows as required.**

Date	List talk/presentation/event/outreach activity (APA format if applicable)
10/2025	J. Xu., Early Warning of Battery Safety Status for Advanced Mobility, 2025

- F. List of new or updated Website(s) or other Internet site(s). **Please do not remove the table; or alter columns, add additional rows as required.**

URL	Short description of purpose of site

- G. Technology/Technique – **Please do not remove the table; or alter columns, add additional rows as required.**

Technology/Technique	Short description of technologies or techniques

H. List patent – Please include Patent Number/Patent Title/ Patent Abstract (or link to it). **Please do not remove the table; or alter columns, add additional rows as required.**

Date Patent Issued	Patent Number/Patent Title/ Patent Abstract (or link to it)

I. List Inventions – Please include Invention Title, List of Inventor(s) and Description. **Please do not remove the table; or alter columns, add additional rows as required.**

Invention Title	List Inventor(s)	Invention Description

J. List Licenses – Please include license issued, Invention Title, List of Inventor(s) and Description. **Please do not remove the table; or alter columns, add additional rows as required.**

Date License Issued	License Assignees	License Title

K. List New/Revised Courses – Please include new/revised courses. **Please do not remove the table; or alter columns, add additional rows as required.**

Course	Course Name/Title	Offering Institution

Number		

- L. Others: List Databases, Physical collections, Audio or video products, Software or NetWare, Models, Instruments or equipment, Data & Research Material (e.g., cell lines, DNA probes, animal models) related to your EPSCoR research. **Please do not remove the table; or alter columns, add additional rows as required.**

Accomplishments title	Short Description of accomplishments

III. Changes/Problems

- A. Actual or anticipated problems or delays and actions or plans to resolve them
- B. Changes that have a significant impact on expenditures

N/A

IV. Impact

Include article and photo w/caption (see instructions). Obtain permission to publish photo from

any recognizable person via NASA Media Release Form. Do not include photos of minors.



Fig. 1 Illustration of laboratory testing used to understand how electrochemical cycling and mechanical stress jointly influence battery safety in space-relevant environments.



Fig. 2. Researchers prepare and instrument battery-test hardware to examine how real-world electrical and mechanical conditions influence battery safety in space-relevant environments.

Understanding Battery Safety in Space

Rechargeable batteries are critical to spacecraft, satellites, and exploration missions, yet failures can have catastrophic consequences in space. This project advances our understanding of battery safety in space by revealing how radiation, temperature extremes, and mechanical stress interact within batteries to trigger failure. The results inform safer battery designs, improved diagnostics, and reliability guidelines for space and terrestrial energy systems. As batteries operate, their internal materials expand and contract, generating hidden stresses that can deform electrodes, damage protective layers, and initiate thermal runaway. These risks are amplified in space environments where radiation, confinement, and limited cooling prevail. Through controlled experiments and physics-based modeling, this research identifies a fundamental failure mechanism of batteries in space.

Federal investment in this work strengthens U.S. leadership in space exploration, energy security, and advanced manufacturing.