IGEM Grant Report

☐ Progress (due January 1) X Annual (due July 31) ☐ Final (due August 31)

IGEM Grant # IGEM26-001_____ Principal Investigator Hui (Claire) Xiong

Name/Full Title of Project High Energy/Power Layered Oxide Cathode Materials for Sodium Ion Batteries

Submission Date_____7/17/2026_____ Primary Institution___Boise State University _

Section 1: Project and its goals

Our patented layered transition metal oxide cathodes have demonstrated improved capacity and cycling stability in sodium-ion batteries for large-scale energy storage applications with > 70% cost savings. We aim to move up the current Technology Readiness Level (TRL) level (TRL 3) to TRL 5-6 through the Initial Startup track where we continue research and development in optimization of the materials composition, structure, and electrochemical properties as well as utilize industry processes to achieve highly reproducible and mass production for large-scale pouch cell manufacture. Our specific goals are to 1) complete R&D on optimized layered transition metal oxides for superior performance and cost; 2) conduct experimentation for optimization of our coprecipitated precursor for improved microstructure and morphology; and 3) assemble pouch cell full cells for electrochemical testing.

Section 2: Summary of accomplishments and future plans

Accomplishments achieved during this reporting period include additional experimentation on altered precursor size, uniformity, and yield for coprecipitation synthesis procedure needed to produce our materials. Active cathode materials excluding rare earth elements such as Li and Ni were produced demonstrating promising performance with only cost-effective elements (Fe and Mn). Dopants have not been introduced at this time, though experiments in altered composition via Na content manipulation have been completed to determine if optimized materials may be made. This includes the synthesis, characterization, and electrochemical testing of 10 different compositions. We have identified additional compositions which may be promising due to their structures and cycling behavior. Additional testing at higher potential ranges are planned in order to further test these compositions. Our team also had the opportunity to test our battery materials at NECCES (The Northeast Center for Chemical Energy Storage) Dry Room and Battery Facility in Binghamton NY, where we learned valuable lessons on scaling from lab scale to pilot scale. These lessens included particle size homogeneity, slurry consistency, and slurry adhesion to produce higher performing laminates. Lastly, preliminary pouch cell construction utilizing custom Teflon cutout molds demonstrated performance metrics closely matching our coin cell data. These results demonstrate that cell performance is largely retained upon scaling from coin-cell to pouch-cell configurations. Our plans for the upcoming year include expanding our coprecipitation efficiency and reliability, whilst completing electrochemical testing as full cells in both coin cell and pouch cell formats for real world testing.

Section 3: Summary of budget expenditures
Purchase of capital equipment including a pouch cell welder and sealer, mini 4-in-1 vacuum sealer, ultrasonic welder, peristaltic pumps, and a slurry filtration system. The capital equipment includes items for making pouch cells as well as producing the cathode active materials required. Additional purchase of consumable lab equipment includes an analytical balance, mortar and pestles, bags, spatulas, inert gas, calibration weights, gloves, coin cell parts, tool cabinet, sensors for the reactors, tubing, hardware for mounting coprecipitation equipment, separators, and gas for gloveboxes. All these items are essential for sample preparation and/or storage needs. Further plans for improved mixing and handling equipment, additional aluminum foil, waste containers, essential tools, and an additional drying reaction vessel are anticipated in the upcoming year. Additional pouch cell supplies and possibly a battery cycler may also be needed depending on our progress.

Section 4: Economic development/impact
A startup business has been created to continue pursuing additional funding from the private and public sector as of 07/2025.

Section 5: Participants
Faculty: Dr. Claire (Hui) Xiong. Student: Cyrus Koroni. Efforts: Coprecipitation optimization, Na content synthesis, pilot scale laminate production, and electrochemical cycling. Postdoc: Dr. Eric Gabriel. Efforts: Coprecipitation optimization, Na content synthesis, pilot scale laminate production, advanced synchrotron technique analysis of materials, pouch cell full cell exploration and testing, and electrochemical cycling.

Section 6: Long-term sustainability plan
Continued efforts will be completed for research towards optimized materials whilst focusing on pouch cell production. Pouch cell full cell data is the industry standard for testing material's efficacy, thus placing great importance on reaching this milestone. In addition to venturing into pouch cell testing, pilot scale testing must be completed. The NECCES (The Northeast Center for Chemical Energy Storage) Dry Room and Battery Facility is an open user facility that allows for academia and industry members to utilize their state-of-the-art facility to test pilot scale production. Working towards achieving successful laminates and pouch cells at this scale will prove to be invaluable to the success of this project. Minor problems become exponentially enhanced when scaling and identifying problems early on will enable a higher chance of success. Efforts towards collaboration with larger companies with more expertise are planned as well as completing independent testing of materials at national laboratories. Continued funding opportunities such as STTR and SBIR will be prepared to further this work in the future.

Section 7: Expenditure Report
Expenditure Report – Attached.

BOISE STATE UNIVERSITY

OFFICE OF SPONSORED PROGRAMS

Contract-Project Snapshot 7/9/2026

Award: 3999030 **Start Date:** 7/1/2025
Project: 2000003533 **End Date:** 6/30/2026

Project Budget	**Budget**	**Expended**	**Encumbered**	**Remaining**
Salary	$44,890.21	$44,029.03	$861.80	($0.62)
Fringe	$3,012.83	$2,985.81	$68.87	($41.85)
Other Expense	$36,666.06	$36,462.35	$0.00	$203.71
Capital	$35,130.90	$35,130.90	$0.00	$0.00
Student Costs	$0.00	$0.00	$0.00	$0.00
Total	***$119,700.00***	***$118,608.09***	***$930.67***	***$161.24***

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