Title: Overcoming Kinetics Limitations in Materials and at Interfaces for Low-Temperature, High-Energy Batteries

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Ph.D./Postdoc (TBD)

Research Objectives

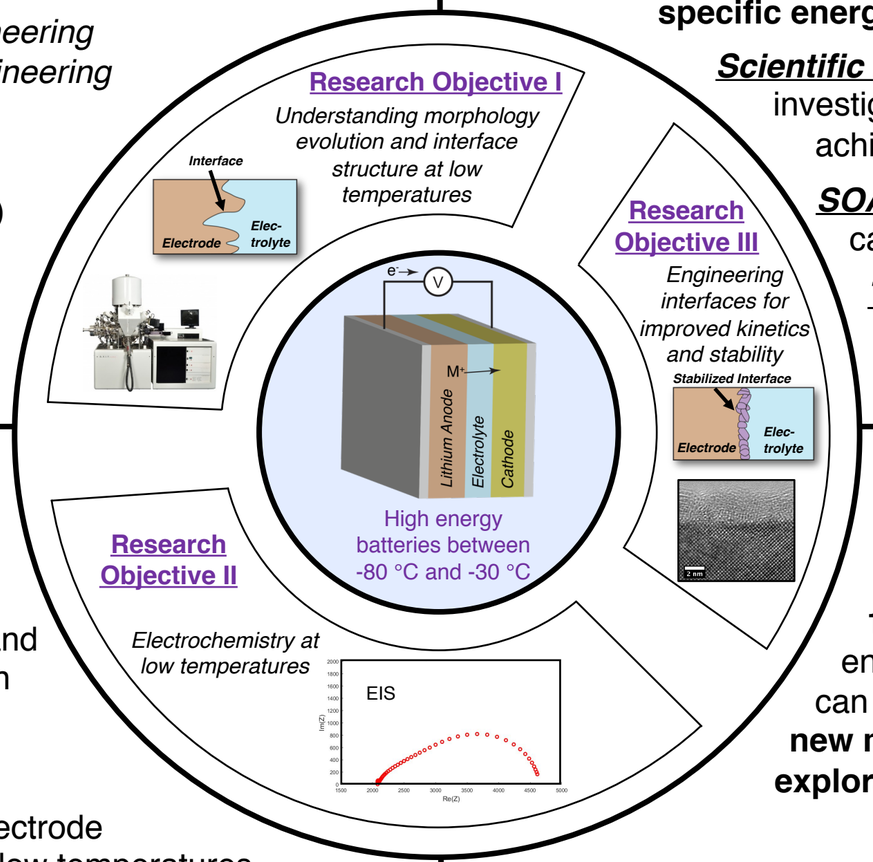
***Overall Objective**:* Understand and control morphological transformations and electrochemical kinetics within high-capacity electrodes for low-temperature secondary batteries.

***Technological Innovation**:* The development of high capacity electrodes with fast kinetics and good reversibility at **low temperatures** would enable **secondary batteries with high specific energy** for space applications.

***Scientific Innovation**:* Integrate fundamental investigation and interfacial engineering to achieve improved performance.

SOA: Graphite anodes in Li-ion batteries cannot operate efficiently at < -30 °C.

TRL: This technology will move from TRL 1 to TRL 2 as a result of this project.



Approach

Three integrated research thrusts (**see central figure**) will overcome kinetics limitations by understanding and controlling electrode behavior between 25 °C and -80 °C.

Research Objective I: Understand electrode morphology and interface structure at low temperatures.

Research Objective II: Use electrochemical methods to pinpoint parameters that govern kinetics at low temperature.

Research Objective III: Engineer interfaces for improved charge transfer kinetics and stability at low temperature.

Potential Impact

1. Secondary batteries with high energy (>150 Wh/kg, >150 Wh/L) that can operate down to -80 °C could enable **new mission possibilities for planetary exploration and reduced payload weight.**

2. Understanding and overcoming kinetics limitations of high capacity electrodes at low temperatures would also impact other applications, such as stationary energy storage and backup power in cold climates.