OBJECTIVE AND SIGNIFICANCE: This project aims at the optimization of battery electrodes to improve performance by understanding local degradation mechanisms and by tuning the electrode architecture.

BACKGROUND: Advanced energy conversion devices typically rely on composites electrodes made of several materials interacting with one another. Understanding their individual and combined impact on degradation is essential in the pursuit of the best possible performance and safety. In this project, we use our expertise in Li-ion battery diagnosis as well as Designs of Experiments (DoE) to optimize formulations and to investigate the importance of process parameters while minimizing resources.

Figure 1. Schematic of the typical electrode architecture for intercalation-based batteries.

Defining new approaches to minimize experiments and time to reach an optimal battery electrode composition is highly beneficial to the field. To this end, we used a DoE mixture design that was applied for the first time in open literature to electrode formulation. Consequently, the relationship between electrode composition, microstructure, and electrochemical performance was uncovered.

In this project, the DoE approach was applied to two types of electrodes: high power electrodes for lithium batteries (ONR funded, in collaboration with the University of Montreal) and sodium intercalation electrodes (DOI then ONR funded, in collaboration with Trevi Systems) to investigate the feasibility of desalination batteries.

PROJECT STATUS/RESULTS: This is an ongoing project. A high-power battery system was optimized in collaboration with the University of Montreal. This work has led to two publications.

Current work is focused on the desalination with the optimization of Prussian blue analogues for Na ion intercalation in seawater. We are currently running experiments with materials able to intercalate and release sodium ions in real sea water more than 15,000 times with improved performance compared to traditional materials (CDI).

In addition, our expertise in battery degradation was used to help researchers at the Naval Research Laboratory to characterize the impact of local temperature gradients on individual electrodes and by researchers at Sandia National Laboratories to investigate the impact of overcharge.

Research conducted for this project is completed in the PakaLi Battery Laboratory. This program led to the three publications and a proceeding, which are listed on the following page).

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Collaborations: University of Montreal (Canada); University of Nantes (France); Naval Research Laboratory; Sandia National Laboratories

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ADDITIONAL PROJECT RELATED LINKS

PAPERS AND PROCEEDINGS:


PRESENTATIONS:

7. 2019. O. Rynne, et al., Influence of the Formulation on the Microstructure and Thus Performance of Li-Ion Batteries, Presented at the 235th ECS Meeting, Dallas, TX, May 26-30.