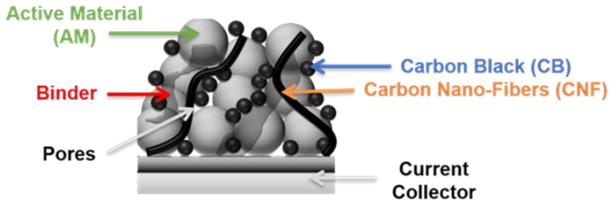
Hawai‘i Natural Energy Institute Research Highlights

Electrochemical Power Systems

Battery Electrode Optimization

OBJECTIVE AND SIGNIFICANCE: Optimization of battery electrodes to improve performance by tuning 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 Designs of Experiments (DoE) as a statistical tool to optimize formulations and to investigate the importance of process parameters while minimizing resources.



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 the DoE approach and a mixture design was applied for the first time in open literature to electrode formulation. Consequently, the relationship between electrode composition, microstructure and electrochemical performance was uncovered on known and novel materials.

In this project, the DoE approach is applied to two types of electrodes: high power electrodes for lithium batteries (ORN funded, in collaboration with the University of Montreal) and sodium intercalation electrodes (DOI funded, in collaboration with Trevi Systems and the University of Nantes) to investigate the feasibility of desalination batteries. Research conducted for this project is completed in the **PakaLi Battery Laboratory**.

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 the two following publications listed so far. Current work is focused on the desalination with the screening of different active materials. We are currently running experiments with materials able to intercalate and release sodium ions in real sea water more than 800 times.

2020, O. Rynne, M. Dubarry, C. Molson, E. Nicolas, D. Lepage, A. Prébé, D. Aymé-Perrot, D. Rochefort, M. Dollé, **Exploiting Materials to Their Full Potential, a Li-Ion Battery Electrode Formulation Optimization Study**, ACS Applied Energy Materials, Vol. 3, Issue 3, pp. 2935-2948.

2019, O. Rynne, M. Dubarry, C. Molson, D. Lepage, A. Prébé, D. Aymé-Perrot, D. Rochefort, M. Dollé, **Designs of Experiments for Beginners—A Quick Start Guide for Application to Electrode Formulation**, Batteries, Vol. 5, Issue 4, Paper 72. (Open Access: **PDF**)

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Collaboration: University of Montreal (Canada), University of Nantes (France)

Contact: Matthieu Dubarry, matthieu@hawaii.edu

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