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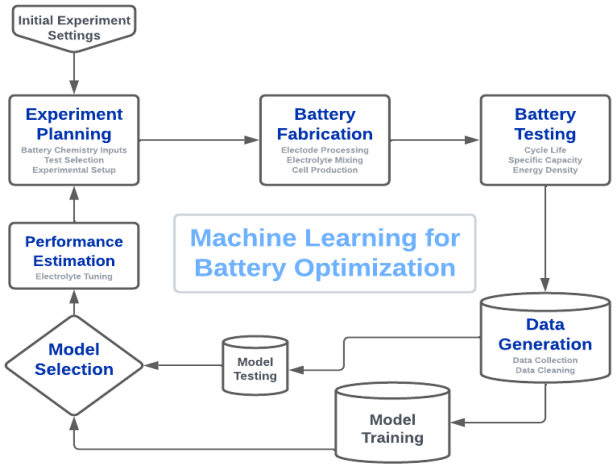
Machine Learning-Assisted Electrolyte Optimization for Next Generation Rechargeable Lithium-ion Batteries

The global battery market is worth over USD 100 billion and is growing. The US Department of Energy targets for next generation batteries are capacities of 400 Wh/kg and 1000 Wh/L, with a cost of USD 100/KWh. A battery is a complicated interconnected system. Modifying one component affects others, with many possible combinations. Screening and optimization of battery electrolytes uses a time-consuming experiment-based empirical process. The purpose of this project was to develop a design of experiments (DOE) approach coupled with machine learning (ML) algorithms to streamline screening and optimization of electrolytes in relation to other battery components, particularly anodes. This approach is expected to accelerate development of game-changing and critical battery technologies.



FUNDING DETAILS

RECIPIENT:
Nanode Battery Technologies Ltd.

PARTNERS:
Alberta GreenSTEM Program, Levven Electronics, National Research Council (IRAP), University of Alberta, VDL Group

TOTAL BUDGET:
$530,445 (Actual)

AI FUNDING:
$221,000

PROJECT DATES:
FEB 2022 – SEP 2023

PROJECT TRL:
Start: 3
End: 7

APPLICATION

More cost-effective advanced battery technologies with longer battery life are needed to address growing demand in applications such as vehicle electrification, energy storage to offset fluctuation in solar and wind electricity generation, and wearable digital devices. This innovation aims to speed up and reduce cost of battery technology development. This new process will benefit startups in development of novel battery components, as well as incremental improvements by battery manufacturers. Consumers will benefit from lower development cost, accelerated market deployment, and a diversity of fit-for-purpose, next generation batteries.

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PROJECT GOALS

The key goals of the project areas were as follows:

- Create a data management system for data acquisition, collection, processing, analyzing, visualization, and modelling in battery research.
- Build an interactive platform for battery scientists and engineers with limited ML knowledge to import data, select and compare models, and guide future experiments.
- Develop and apply ML algorithms for electrolyte optimization to Nanode Battery Technology's (Nanode's) novel battery materials.
- Build a closed-loop optimization system connecting input and output parameters to guide electrolyte optimization and battery lifetime enhancement.
- Accelerate market validation of Nanode's novel anode products to meet customers' requirements.

BENEFITS TO ALBERTA

The successful implementation of this technology or use of the knowledge generated could:

- Improve Alberta's battery research and manufacturing sectors by combining Nanode's battery expertise with Alberta's strong AI/ML community.
- Increase job opportunities in Alberta, and attract and retain highly skilled talent
- Attract international capital investment, collaboration and attention in Alberta's cleantech sector, specifically in the area of battery and, electric vehicle technologies. Potential partners include international incubators and global battery manufacturers.
- Eliminate harmful byproducts from battery anode production by using novel anode materials and a one-step production process.

5 Students Trained

0 Patents

2 Project Jobs

5 Future Jobs

1 New Product/Service

CURRENT STATUS

DECEMBER 2023

The Project is complete. Nanode successfully developed a closed-loop ML system connecting input and output parameters to guide electrolyte selection. Utilizing their DOE approach coupled with ML, Nanode reduced the number of required experiments by 20% for lithium ion batteries and by over 250% for sodium ion batteries. Working with their novel anode material, they improved lithium ion battery life from 100 to 407 cycles, and sodium ion battery life to over 3,000 cycles. They also increased their understanding of mechanisms affecting tin ribbon anode performance.