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Effects of Non-Uniform Temperature Distribution on the Degradation of Lithium-Ion Batteries

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RCEU 2022 Project Proposal

Project Title

Effects of Non-uniform Temperature Distribution on the Degradation of Lithium-ion Batteries

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Instructions are on the last page.

I. Project Description

Lithium-ion (Li-ion) batteries are widely used in various applications from consumer electronics and electric vehicles to renewable energy storage. But capacity and power degradation is still a challenge for many applications that require durable and reliable batteries. Our recent studies showed that non-uniform temperature distribution inside Li-ion batteries can exacerbate degradation (https://doi.org/10.1115/1.4045205 and https://doi.org/10.1149/1945-7111/ac2a7c). Figure 1 below shows a comparison between five Li-ion battery cells in a stack and a baseline cell.

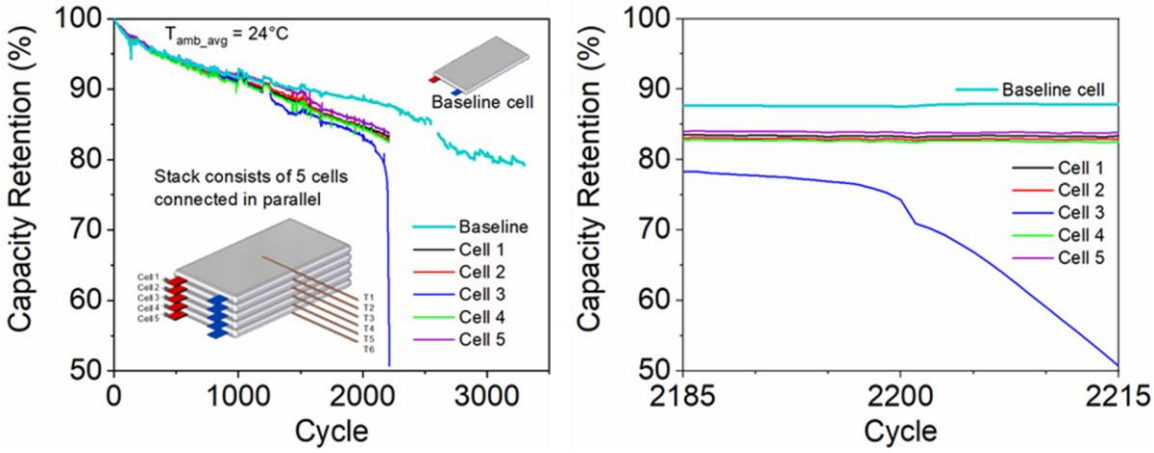

Figure 1. Capacity retention of Baseline cell and individual cells in the stack during cycling in our previous studies.

Built on our previous studies, this project aims to quantitatively investigate the effects of temperature gradient on the degradation of Li-ion battery cells. Single Li-ion cells will be cycled with specified temperature gradient and without temperature gradient. Their degradation behaviors will be compared and further analyzed.

II. Student Duties, Contributions, and Outcomes

a. Specific Student Duties

The student will work under the guidance of the PI (Dr. Zhang) and a graduate student to set up experiments and perform the cycling experiments. The student is required to take lab safety training, export control training and battery testing training. The student is expected to assist and learn data processing for presentation of the project results. The student will attend weekly group meetings and present project progress.

b. Tangible Contributions by the Student to the Project (10% of Review)

The student is expected to contribute to the project in assisting experimental set up, obtaining and processing publishable research data to better understand Li-ion battery degradation, and bringing in different perspective.

c. Specific Outcomes Provided by the Project to the Student (30% of Review)

The student will learn new knowledge on Li-ion batteries, especially on battery failures, and new skills on battery testing by participation in the project and attend weekly group meetings. The student will be professionally trained in research, including defining a research problem, designing and performing experiments, analyzing data and presenting research findings. The student will have opportunity to be co-author of research publications depending on contributions and the project progress.

III. Student Selection Criteria

Due to the experimental nature of the project, the student applicants are expected to have hands-on experiences (but no need to be related to batteries), can perform the duties specified above and are willing to learn new knowledge/skills on batteries. Female and minority student applicants are encouraged to apply.

IV. Project Mentorship *(30% of Review)*

The student will be professionally trained in research from defining a research problem to presentation of research findings. The PI will directly mentor the student through weekly group meetings and individual meetings. The student will present weekly project update and get feedback from the PI and other group members. The student will also be directly mentored on daily basis by an experienced graduate student.