Hawaii Natural Energy Institute Research Highlights

Electrochemical Power Systems

Evaluation of Commercial Li-ion Cells Based on Composite Electrode for Plug-In EVs

OBJECTIVE AND SIGNIFICANCE: Degradation assessment of commercial blended Li-ion batteries for plug-in electric vehicle applications at different temperatures using non-invasive characterizations.

BACKGROUND: Evaluating commercial Li-ion batteries presents some unique benefits. One of them was to use cells made from established fabrication process and form factor, such as those offered by the 18650 cylindrical configuration, to provide a common platform to investigate and understand performance deficiency and aging mechanism of target chemistry. Such an approach afforded to derive relevant information without influence from processing or form factor variability that may skew our understanding on cell-level issues.

A series of 1.9 Ah 18650 lithium ion cells developed by a commercial source using a blended positive electrode comprising {LiMn1/3Ni1/3Co1/3O2 + LiMn2O4} were being used as a platform for the investigation of certain key issues, particularly path-dependent aging and degradation in future plug-in hybrid electric vehicle (PHEV) applications, under the US Department of Energy's Applied Battery Research (ABR) program.

Due to the blended nature of the positive electrode, the features (or signature) derived from the incremental capacity (IC) of the cell appear rather complex. In this work, the method to index the observed IC peaks was discussed. Being able to index the IC signature in detail was critical for analyzing and identifying degradation mechanism later in the cycle aging study. Research conducted for this project was completed in the PakaLi Battery Laboratory.

PROJECT STATUS/RESULTS: Project completed. 30+ cells were tested under different conditions. The cell-to-cell variations were characterized and the impact of temperature excursions was assessed. This work led to 5 publications.

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Contact: Matthieu Dubarry, matthieu@hawaii.edu, (808) 956-2349

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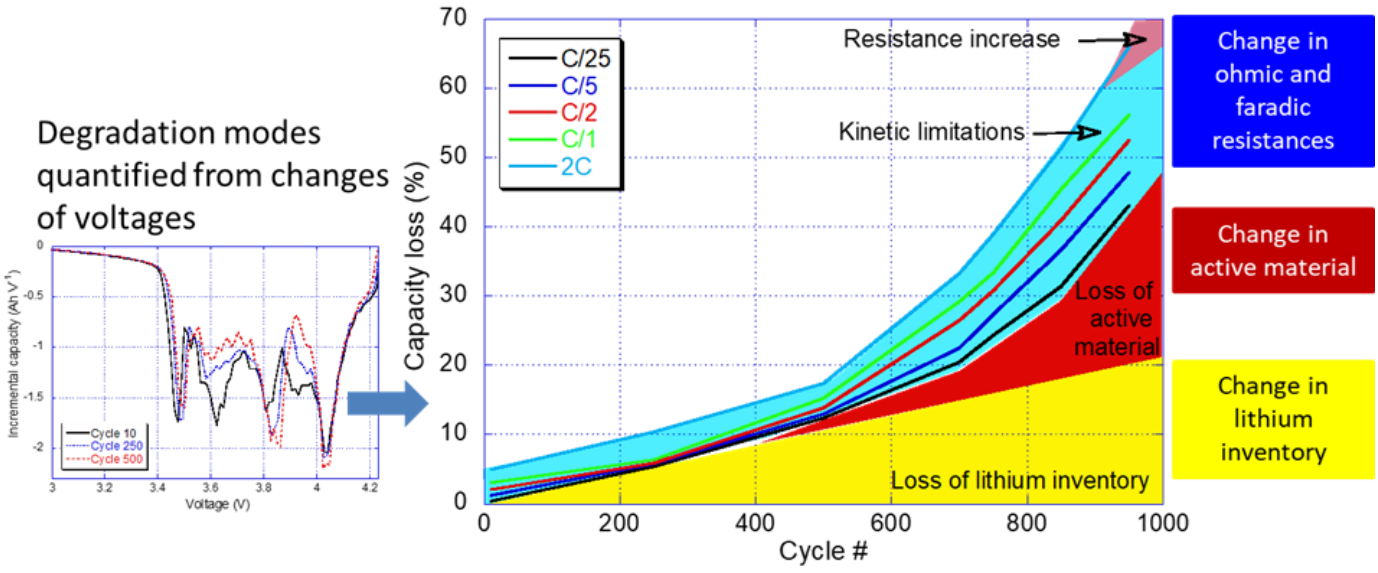

Hawai'i Natural Energy Institute | School of Ocean & Earth Science & Technology
University of Hawai'i at Mānoa, 1680 East-West Road, POST 109 • Honolulu, HI 96822
Phone: (808) 956-8890 • Fax: (808) 956-2336 • www.hnei.hawaii.edu

ADDITIONAL PROJECT RELATED LINKS

PAPERS AND PROCEEDINGS:

1. 2015, M. Dubarry, C. Truchot, A. Devie, B.Y. Liaw, K. Gering, S. Sazhin, D.Jamison, C. Michelbacher, **Evaluation of commercial lithium-ion cells based on composite positive electrode for plug-in hybrid electric vehicle (PHEV) applications. Part IV. Over-discharge phenomena**, Journal of The Electrochemical Society, Vol. 162, Issue 9, pp. A1787-A1792. (Open Access: **PDF**)
2. 2013, M. Dubarry, C. Truchot, B.Y. Liaw, K. Gering, S. Sazhin, D. Jamison, C. Michelbacher, **Evaluation of commercial lithium-ion cells based on composite positive electrode for plug-in hybrid electric vehicle applications. Part III. Effect of thermal excursions without prolonged thermal aging,** Journal of The Electrochemical Society, Vol. 160, Issue 2, pp. A191-A199.
3. 2011, M. Dubarry, C. Truchot, B.Y. Liaw, K.L. Gering, S. Sazhin, D. Jamison, C. Michelbacher, **Evaluation of commercial lithium-ion cells based on composite positive electrode for plug-in hybrid electric vehicle (PHEV) applications. Part II. Degradation mechanism under 2C cycle aging**, Journal of Power Sources, Vol. 196, Issue 23, pp. 10336-10343.
4. 2011, M. Dubarry, C. Truchot, M. Cugnet, B.Y. Liaw, K. Gering, S. Sazhin, D. Jamison, C. Michelbacher, **Evaluation of commercial lithium-ion cells based on composite positive electrode for plug-in hybrid electric vehicle (PHEV) applications. Part I. Initial characterizations**, Journal of Power Sources, Vol. 196, Issue 23, pp. 10328-10335.
5. 2011, K.L. Gering, S.V. Sazhin, D.K. Jamison, C.J. Michelbacher, B.Y. Liaw, M. Dubarry, M. Cugnet, **Investigation of path dependence in commercial lithium-ion cells chosen for plug-in hybrid vehicle duty cycle protocols**, Journal of Power Sources, Vol. 196, Issue 7, pp. 3395-3403.

LABORATORY: PAKALI BATTERY LABORATORY