Evaluation of Calendar Degraded 18650 Li-ion cells during Low Temperature Cycling

Omar S. Mendoza-Hernandez [a], Yoshitsugu Sone [a,b], Eiji Hosono [c], Daisuke Asakura [c], Hirofumi Matsuda [c], Minoru Umeda [d]

[a] *Japan Aerospace Exploration Agency, Institute of Space and Astronautical Science, 3-1-1 Yoshinodai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan*

[b] *The Graduate University of Advanced Studies, SOKENDAI, 3-1-1 Yoshinodai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan*

[c] *Institute for Energy Conservation, National Institute of Advanced Industrial Science and Technology, (AIST) 1-1-1 Umezono, Tsukuba, Ibaraki 305-8568, Japan*

[d] *Nagaoka University of Technology, Department of Materials Science and Technology, 1603-1 Kamitomioka, Nagaoka, Niigata 940-2188, Japan*

E-mail: *omar.mendoza@jaxa.jp*

Energy storage devices are very important for space exploration missions and Li-ion cells have become the first choice to power aerospace systems, such as spacecraft and satellites. These applications demand a long lifetime and high safety level. However, there are still some concerns to achieve such demands, especially when the cells are operated at low temperatures [1]. Here, we present a comparative analysis of fresh and calendar degraded Li-ion cells when they are cycled at low temperatures. Also, a method to estimate the state of health for Li-ion cells will be presented. This method is based on the analysis of the current decay behavior during constant-voltage (CV) charge.

Commercial available $LiFePO_4$-Graphite 18650 type Li-ion cells are evaluated. Some cells were subjected to calendar degradation by storing the cells at 100% state of charge and 60 °C for 4 weeks. Then, fresh and calendar degraded cells were cycled at low temperatures, between 0 and -5 °C. To monitor the capacity loss during the low temperature cycling, capacity check measurements were carried out at 25 °C.

Figure 1 (a) shows the current decay for the duration of the CV phase during the charging process obtained through the capacity check measurements. The current decay behavior fits the equation shown in Fig. 1 (a) and the exponential factor b can be obtained. As it is shown in Fig. 1(b), the factor is proportional to the cell capacity loss and can be used to analyze and quantify the state of health of Li-ion cells.

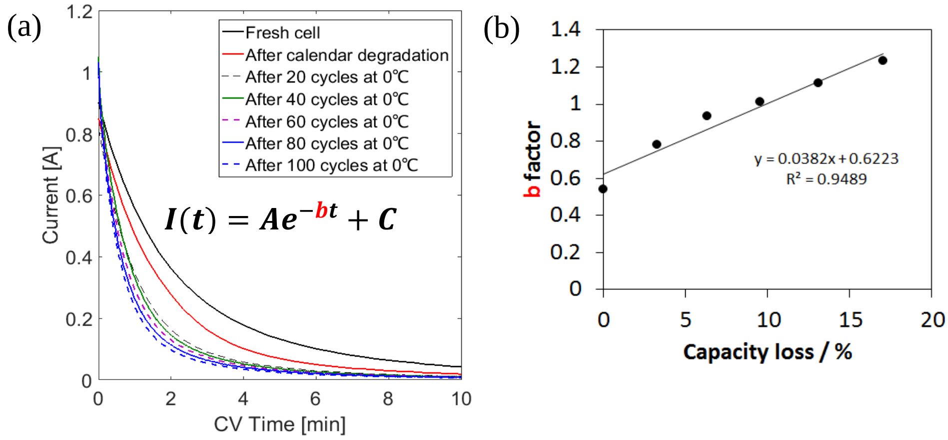

Fig. 1 Current decay for the duration of the constant-voltage phase during the charging process obtained through the capacity measurement (a). Factor b obtained from current decay curve fittings as a function of capacity loss

References:

[1] M. Petzl, M. Kasper, M. A. Danzer, J. Power Sources. 275 (2015) 799–807.