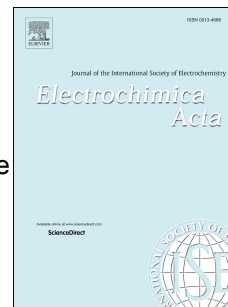


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Calendar-life versus Cycle-life aging of Lithium-ion Cells with Silicon-Graphite Composite Electrodes

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ABSTRACT

The use of blended silicon-graphite (Si-Gr) negative electrodes increases the energy density of lithium-ion cells over those containing only graphite (Gr) electrodes. However, volume changes in the Si particles that occur during cycling cause deterioration of the solid-electrolyte interphase (SEI) layer on the particles resulting in further electrolyte reduction that immobilizes Li⁺ ions and, therefore, capacity fade. Because the volume changes are not expected to occur during a potentiostatic hold (referred to as calendar-life aging), by comparison of cycle-life and calendar-life aged cells one can expect to assess the role of volume changes in the deterioration of cell performance. To this end, cells with Si-Gr and Gr negative electrodes (and Li_{1.03}(Ni_{0.5}Co_{0.2}Mn_{0.3})_{0.97}O₂ containing positive electrodes) were assembled, tested, and compared using cycle-life and calendar-life aging protocols. As expected, the capacity loss of the cycle-life aged cells was higher than that of the calendar-life aged cells. However, the measurable capacity loss for the calendar-life aged cells indicates continued immobilization of Li⁺ ions. Furthermore, electrolytes extracted from the calendar-life aged cells showed more LiPF₆ hydrolysis products than those extracted from the cycle-life aged cells. We discuss possible mechanistic causes for the observed aging behaviors in this article.

Keywords: NCM523, FEC, electrochemical performance, electrolyte NMR, reference electrode

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