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Investigating the ageing of multi-layer 5 Ah pouch cells with NCA cathodes and silicon anodes

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The demand for Li-ion batteries continues to grow each year, whether for industrial applications or electric vehicles, making the enhancement of battery performance a key focus of research. One approach to achieving higher capacities is transitioning to materials with superior properties. Silicon has attracted significant attention as an anode material due to its high specific capacity of 3579 mAh/g, which surpasses that of conventional graphite. However, pure silicon experiences significant volume expansion during lithiation, causing mechanical stress that can lead to battery failure.
In this study, the lithiation mechanism and aging behavior of silicon anodes and $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$ (NCA) cathodes were examined in multi-layer 5 Ah pouch cells using neutron diffraction and promt gamma activation analysis (PGAA). The batteries were manufactured on a research production line at the iwb to closely replicate the conditions of commercial cells. Fresh cells, following formation and stabilization, were compared to aged cells at a 60% state of health.
As the cells age, capacity decreases, which is reflected in the evolution of NCA's cell parameters. The c- and a-parameters of the aged cells show a smaller range of movement compared to the fresh cells. Additionally, the peak positions of NCA shift during the relaxation phase after charging, indicating changes in the NCA structure because of Li loss. With the PGAA measuremetns, the loss of Li could be identified on both electrode and confirm the results from electrochemical and diffraction analyis.

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