Exploration of different means to create a defect in a pouch cell and operando monitoring of the subsequent aging

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Lithium-ion cell aging implies different phenomena that occur at various space scales: the active materials, the electrode and the cell as a whole. Scaling up involves taking into account the complexity of interactions between the materials, the electrolyte, and the design. Post-mortem studies have shown the non-uniform development of certain aging mechanisms. For instance, lithium plating is a major stake for aging comprehension though the appearance conditions of this phenomenon and its subsequent propagation are not fully understood. Artificially introducing the aging degradations that favor the development of lithium plating inside a pouch cell instrumented with a reference electrode allows to monitor, during cycling, the impact of the defect on the global behavior of the cell and of each electrode. Combining the operando monitoring of the cell with its post-mortem analysis allows gathering the parameters and the understanding of the aging mechanism [1] that will be used for the implementation of a multi-scale model.

Among the consequences of the aging phenomena that occur inside a cell during cycling, separator pore clogging, gas formation leading to a bubble inside the stack and material decohesion from the current collector can be further explored by artificially recreating those consequences on a fresh cell during the assembling. In our work, various experimental methods were explored to introduce a defect inside a pouch cell in order to simulate these aging consequences. Irradiation with a highly penetrating electron beam was also experimented for that purpose. Cycling at different C-rates and temperatures allowed aging the cell, which was instrumented with a reference electrode, and to monitor, in-situ, the cell behavior face to the defect propagation. Then, the post-mortem analysis of the cell revealed the pattern followed by the defect during its propagation. We will present aging results of pouch cells (NMC622 / Graphite SiOx) and we will discuss the local and global impact of these defects.

References

1. Li X., « Degradation mechanisms of high capacity 18650 cells containing Si-graphite anode and nickel-rich NMC cathode », *Electrochimica Acta* 297 (2019): 1109-20.

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