

Insights of Aging Mechanisms: An Electrochemical Survey of LiMn_2O_4 vs $\text{Li}_4\text{Ti}_5\text{O}_{12}$ Cells & Post Mortem Analysis

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One key challenge towards cycling stability and high efficiency for lithium ion batteries (LIB) is the understanding of failure mechanisms within the cell and its different components. A detailed investigation of aging phenomena of LIBs consisting of LiMn_2O_4 (LMO) as cathode active material and $\text{Li}_4\text{Ti}_5\text{O}_{12}$ (LTO) as anode are presented in this work.

The cells with a design capacity of 29.5 Ah were tested with different C-rate conditions and at different temperatures (e.g. Figure 1).

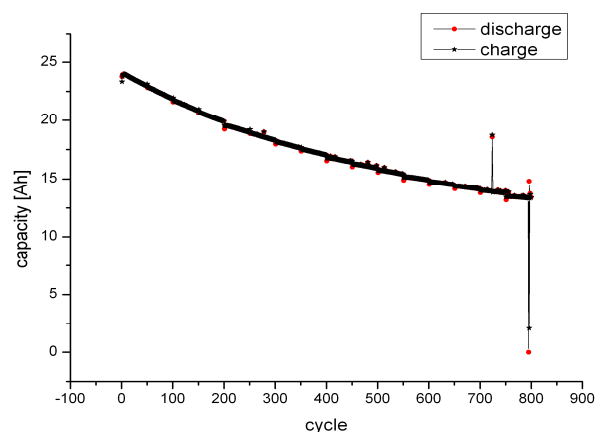


Figure 1: Cycling behavior of LMO vs LTO cell with 1C and at 23°C. The figure shows the capacity of the individual charge and discharge cycles up to 800 cycles.

Moreover, electrochemical impedance measurements were carried out to investigate changes within the cell towards increasing cycle numbers (see Figure 2).

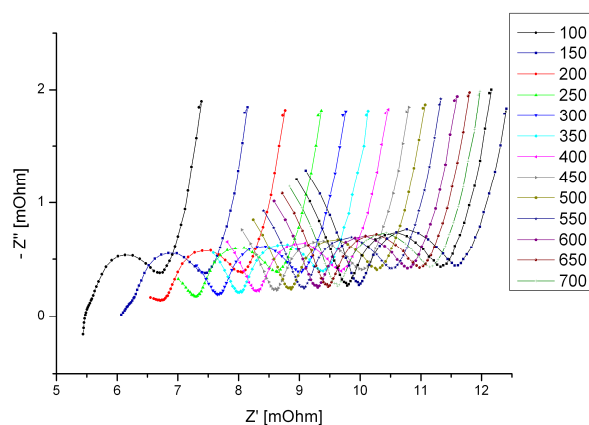


Figure 2: Impedance measurements and overview after every 50th cycle of an LMO vs LTO cell cycled with 1C at 23°C.

Within the spinel phase of the cathode material an exfoliation of active material was observed and connected to the Jahn-Teller distortion that appears at certain voltage steps [1].

In addition, the dependence of the exfoliation of active material on the workload of the different testing procedures are investigated and occupied by *ex-situ* measurements (see Figure 3) [2].

Moreover, the gas within the cells which is expected to evolve from electrolyte decomposition during cyclization was examined via GC-MS measurements.

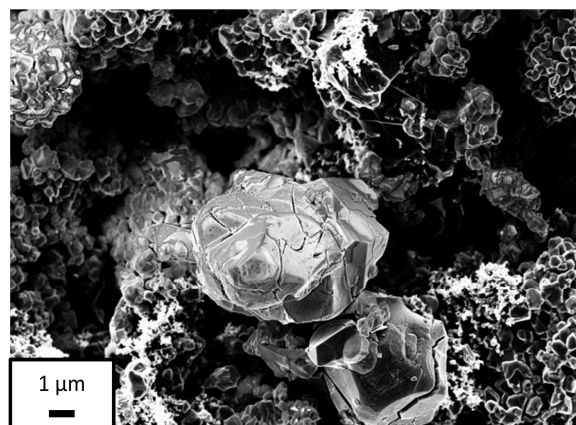


Figure 3: SEM picture of aged LTO anode with MnO particle deposition due to Jahn-Teller distortion on the cathode site.

References

- [1] M. M. Thackeray et al. *Electrochemical and Solid-State Letters*, 1 (1998) 7–9
- [2] K.Y. Chung, K. Kim, *Electrochim. Acta* 49 (2004) 3327–3337