TWAICE

Master Thesis: Aging models for lithium-ion batteries using measurements at the beginning of life

Motivation

In today's world, lithium-ion batteries are ubiquitous in many applications. Their advantages in terms of power and energy density make them the most promising storage medium for electric mobility and stationary energy storage. At TWAICE, we develop digital twins to increase the lifetime, efficiency, and sustainability of lithium-ion batteries by providing an accurate virtual representation of any such systems. One of the cornerstones of these digital twins is the prediction of the battery capacitie's aging behavior. These aging models are typically parameterized from extenive laboratory measurements, where the cell is aged until the end of life. To cut down the time for these laboratory measurements, new methods of scaling an aging model with very few but very precise measurements at the beginning of life only are currently investigated.

Task

Within this Master Thesis, different options for scaling an aging model with laboratory measurements at the beginning of life should be investigated. The underlying idea for the scaling of an aging model is that the overall aging behavior of cells with similar chemistries behaves the same, while only the aging rate changes for different cell types. With this assumption, e.g. high precision coulometry (HPC) measurements at the beginning of life of a cell can theoretically be used to determine the cell-specific aging rate and parameterize an aging model accordingly. This assumption is to be validated within this Thesis. In detail, the tasks of this Thesis are:

- Literature review of the state-of-the-art on aging models, scaling of aging models and HPC
- Choice of a suitable cell-combination to investigate the applicability of the scaling of an aging model
- Development of a measurement procedure for aging rate characterization at the beginning of life
- Execution of aging rate characterization tests in the TWAICE laboratory
- Evaluation of aging rate characterization tests and development of a scaling method for the aging model – development is preferably carried out in MATLAB or Python
- Validation of the scaled aging model with additional aging tests on the same cell
- Documentation of the Thesis
- Preparation of a mid-term and a final presentation

Contact

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