State Estimation of Lithium-Ion Batteries in Aerospace

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Lithium-ion batteries are the technology of choice for a broad range of applications due to their performance and long-term stability. The performance and durability of lithium-ion batteries is heavily impacted by various degradation mechanisms. These include the growth of the solid electrolyte interphase (SEI) and the deposition of metallic lithium on the surface of the negative electrode, also referred to as lithium plating. Long-term SEI growth is the biggest contributor to capacity fade in lithium-ion batteries. Lithium plating, which occurs in low temperature or high current charging, can result in capacity fade or even thermal runaway.

Our group has described a model for SEI growth [1]. Furthermore we have done the simulation of lithium plating in the 3D microstructure of a battery as described in [2]. This model is based on the work in [3].

By comparing electrochemical simulations with experimental measurements using impedance spectroscopy and features in the cell voltage curves, we now want to perform state estimation of lithium-ion batteries in order to improve the characterization and management of the battery, e.g. for the battery of the REIMEI satellite [4]. Our goal is to understand the degradation processes and to observe and detect them while the battery is in operation. As a result this will prolong battery life by reducing capacity fade and improve safety.

References:

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