Investigations on electrolyte distribution in Lithium Ion Batteries influenced by filling process

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The electrolyte filling and wetting process of a Lithium-Ion Battery (LIB) is a quality critical process step. In this context, the quality of a battery is influenced by the macroscopic electrolyte distribution between battery sheets and the soaking behaviour of the porous structures on microscopic scale. Less wetted areas on both scales influence the battery performance by increasing the electrolyte resistance [1]. As a result, the high current charging and discharging ability decreases. To avoid less wetted areas and to accelerate the electrolyte distribution, cells are filled under low pressure conditions in a vacuum chamber. Despite this potential to increase battery quality and also throughput there are only few research [2,3] activities in this field.

The goal of this study was to research the effect of time and pressure induced by filling process on the amount and average size of gas inclusions and the electrolyte distribution in Lithium Ion Batteries. Therefore, transparent cells were designed, manufactured and finally filled in a vacuum chamber. In order to produce transparent battery cases, a number of different polymer materials had to be tested. This due to the requirements that the polymer material needs to retain its high transparency even under contact with electrolyte. After designing and manufacturing a transparent cell an evaluation process for the optical characterization of the macroscopic electrolyte distribution in lithium-ion batteries was deducted. Therefore, a camera was placed inside a vacuum chamber and enclosed in a pressure protective case. The video material was analysed with MATLAB and its image processing toolbox. Histograms, different colormaps, edge detection and thresholding techniques were utilized for pre- and processing operations which allowed further investigation of the received footage, i.e. contrast adjustment to improve visual conditions. After that the effect of time (1s-60s) and pressure (0,5bar, 1bar) on the amount and average size of gas inclusions and the electrolyte distribution was examined.

The presented study shows the effect of time and pressure induced by filling process on the amount and average size of gas inclusions and the electrolyte distribution in Lithium Ion Batteries. The amount of gas inclusion as a result of the filling process increases and also the electrolyte distribution. As a result, this study provides the first steps for quality control during the filling process within Lithium Ion Battery production.

References:

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