Investigation of the expansion of battery cells with chromatic confocal distance sensors under varying mechanical stress

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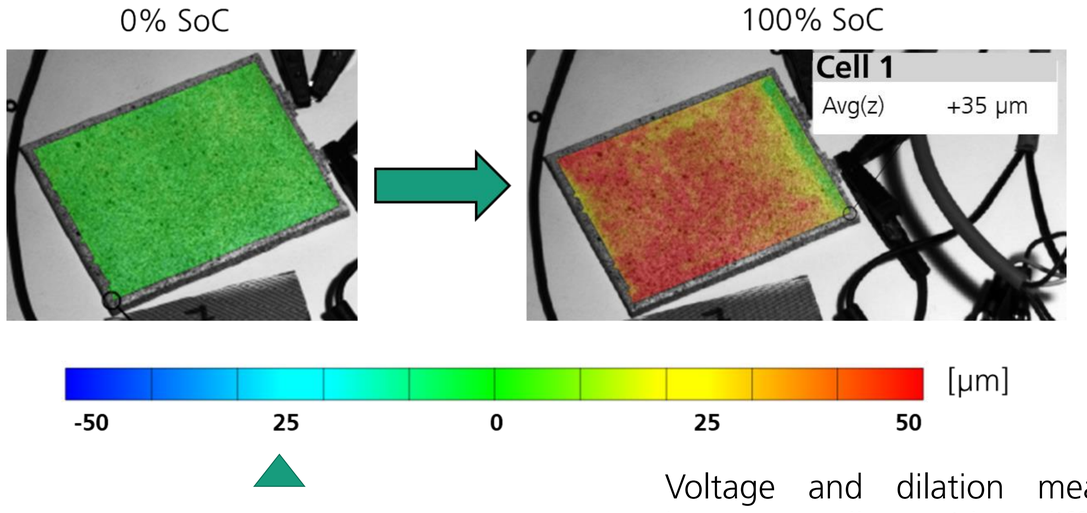
Abstract

Actual quality control in battery cell manufacturing includes measuring the electrical behavior of a produced cell [1,2]. Additional optical, non-contact measurements of the expansion behavior of cells performed simultaneously with the electrical measurements can provide deeper insights about the quality of the cells. To investigate the expansion behavior of 1 Ah NMC622 Li-ion pouch cells during cycling, measurements were made using digital image correlation technique on non-compressed cells, as well as measurements using chromatic confocal distance sensors on compressed cells.



3D distortion image taken with DIC system at the beginning of a charging cycle (left) and at the end of the charging cycle (right)

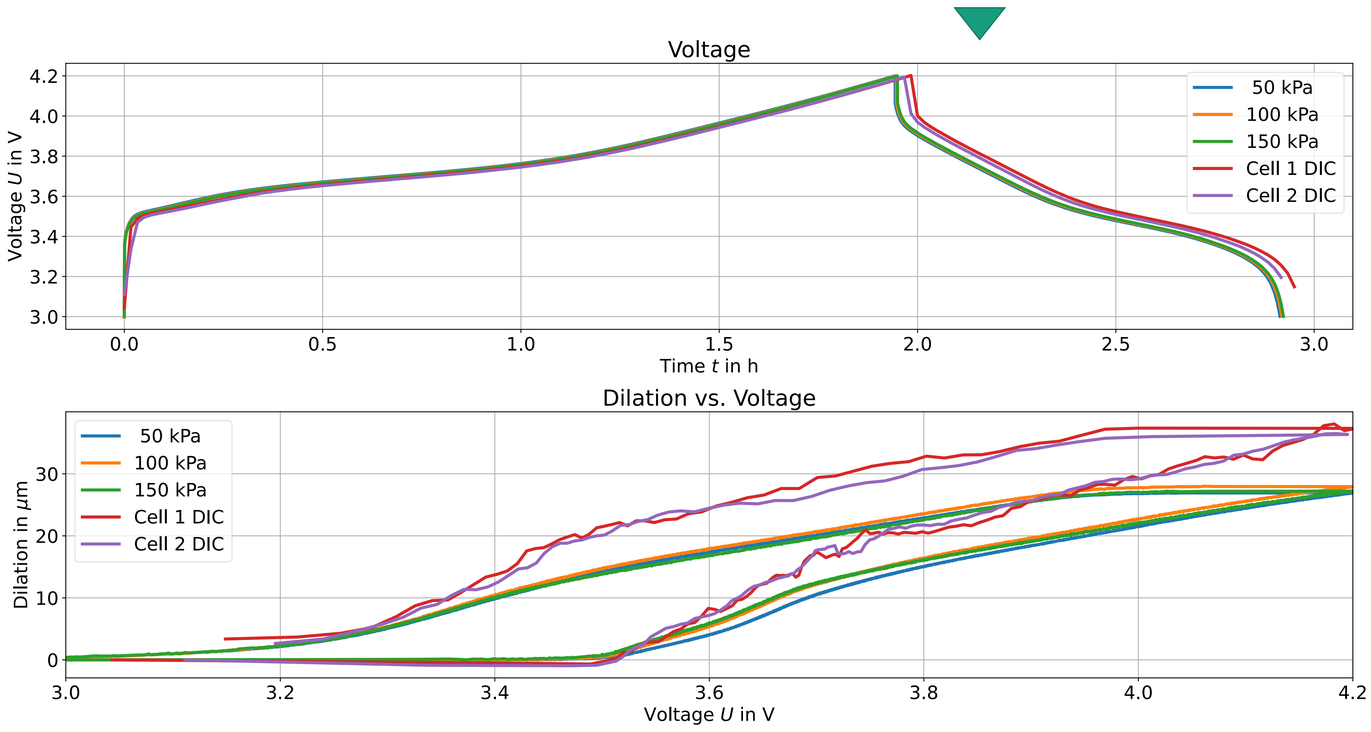
Experimental

Battery Cell
- 1 Ah NMC622 / Graphite
- 2 single sided / 8 double sided cathode sheets
- 2 single sided / 8 double sided anode sheets
- Size 66 x 51 x 3 mm^3 (L x W x H)

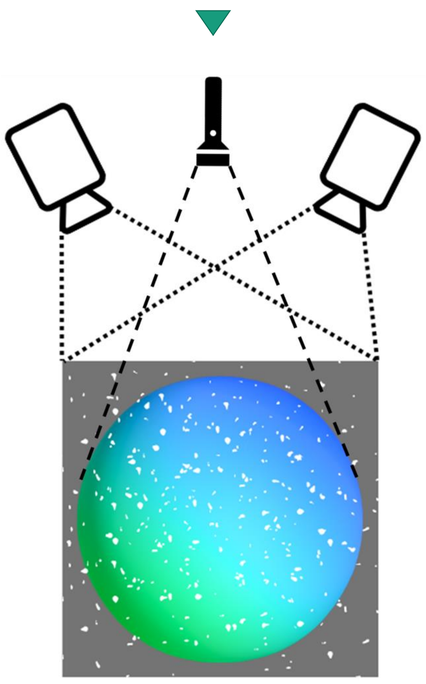
Digital Image Correlation (DIC)
- Two cameras with defined angle focus on same area of interest
- 3D deformation can be measured by recording stochastic pattern on a surface through a digital image sequence
- Image sequences are combined using the photogrammetric theories

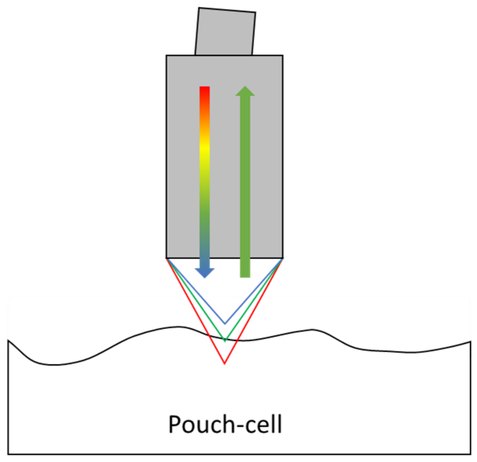
Chromatic confocal distance sensor
- White light source focused along a single propagation axis
- Light wavelength, which is focused on the surface, is reflected to sensor
- Distance to workpiece determines reflected wavelength intensities
- Contactless distance measurement

Voltage and dilation measurements of battery cells with different surface pressures. Top: Voltage curve of the individual measurements over time. Below: Dilation over voltage measured with chromatic confocal distance sensors with clamped cell surface and DIC with unclamped cells



Measuring principle of DIC [3]





Measuring principle of chromatic confocal distance sensor [4]

Conclusion and Outlook

- Compressed cells show results with lower deviation and less dilation than uncompressed cells
- Due to large file sizes of DIC, chromatic confocal distance sensors can have higher sampling rates
- DIC has higher potential to measure unclamped cells due to bigger region of interest
- Long-term data with chromatic confocal distance sensors should be recorded to detect irreversible expansion and aging behavior of battery cells
- Cells with defined defects should be measured in compressed condition for comparison with non-defect cells

Kontakt

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Project-Website

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