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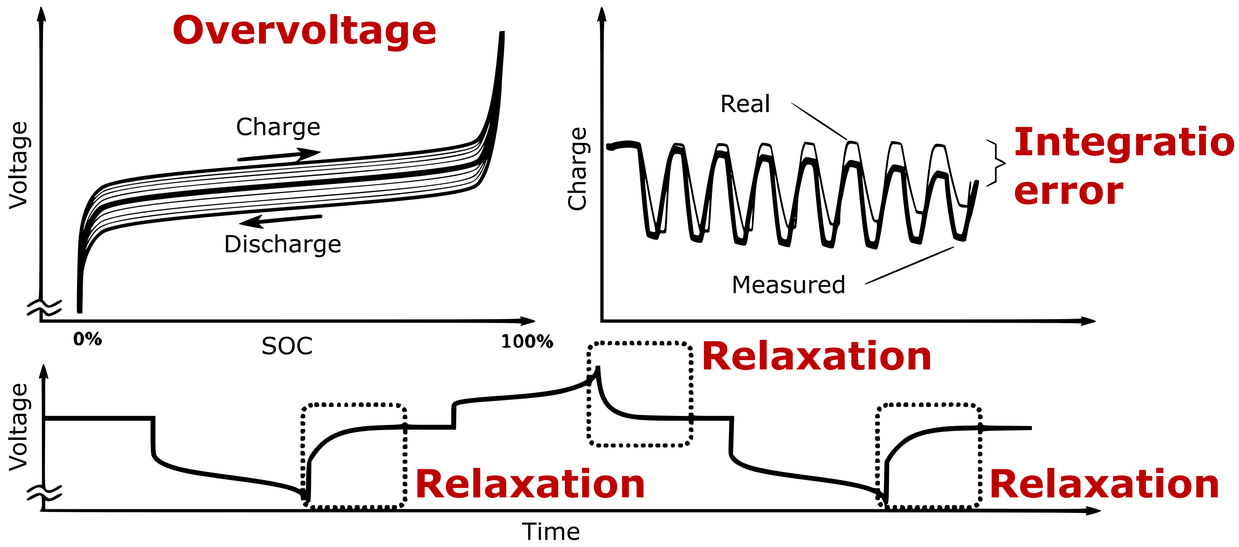
Fiber Optical Cell State Monitoring of Anode and Cathode

P1-46

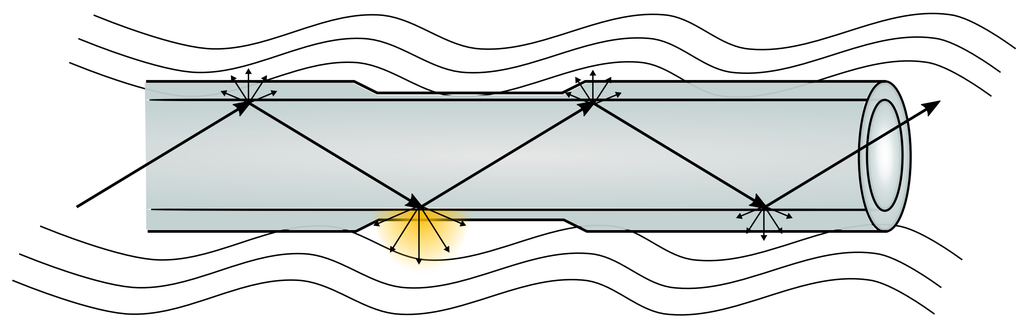
Introduction Current methods for state determination in lithioum ion batteries are based on electrical measurements. These methods to determine the state-of-charge (SOC) are either based on measuring the cell voltage or integration of the current to calaculated the transferred charge by Coulomb counting. Both methods show deviations from the true SOC because of overvoltage or integration errors. Therefore, other methods, independent from electrical data, are necessary. Here, optical methods have great potential, because they allow an observation of the electrode materials on a chemical level.

Errors of electrical methods

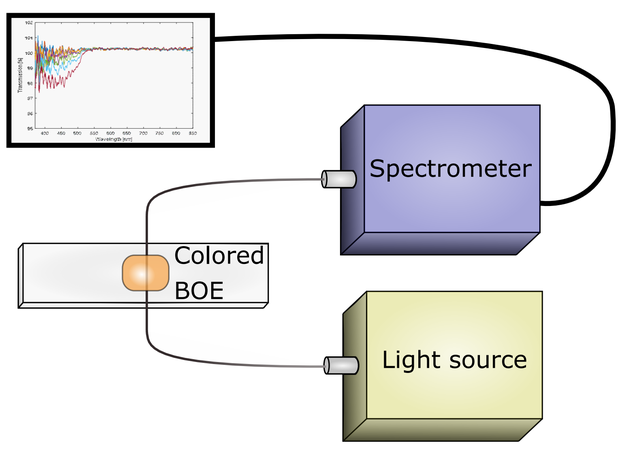


Fiber optic sensors with microcladding

Optical fibers with reduced cladding size act as evanescent wave sensors. Optical changes in the environment can be detected by a change in transmission

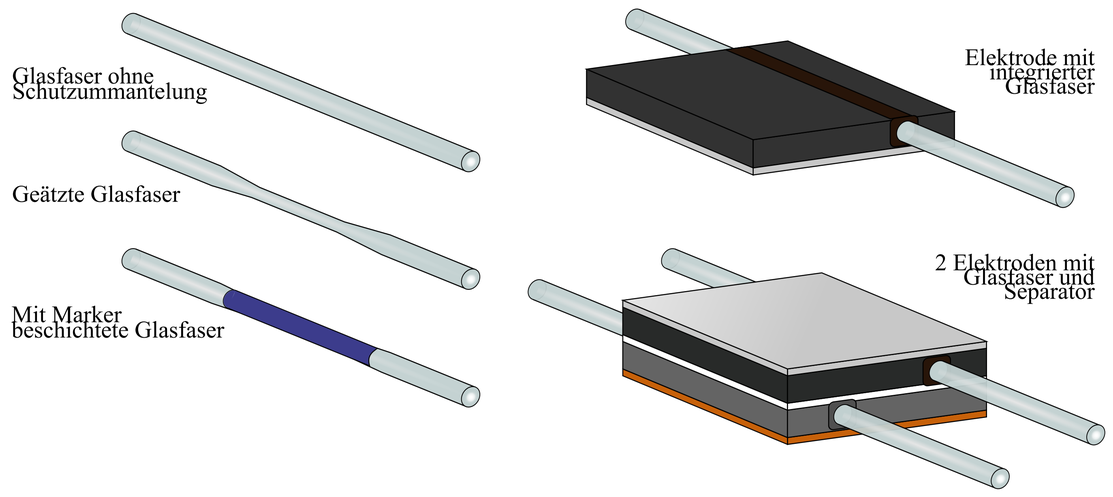


Sensor Preparation

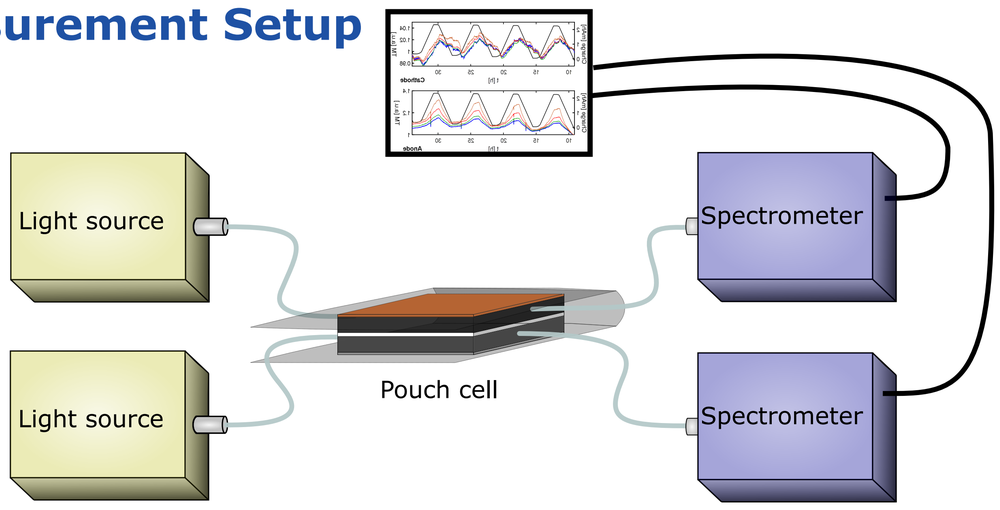


Micro-cladding fibers are prepared by monitoring the etching process with a dyed HF-solution.

Etched fibers are coated with electrode slurry and integrated into electrodes

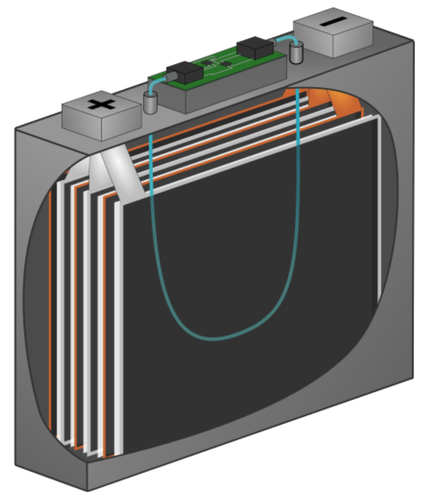


Measurement Setup



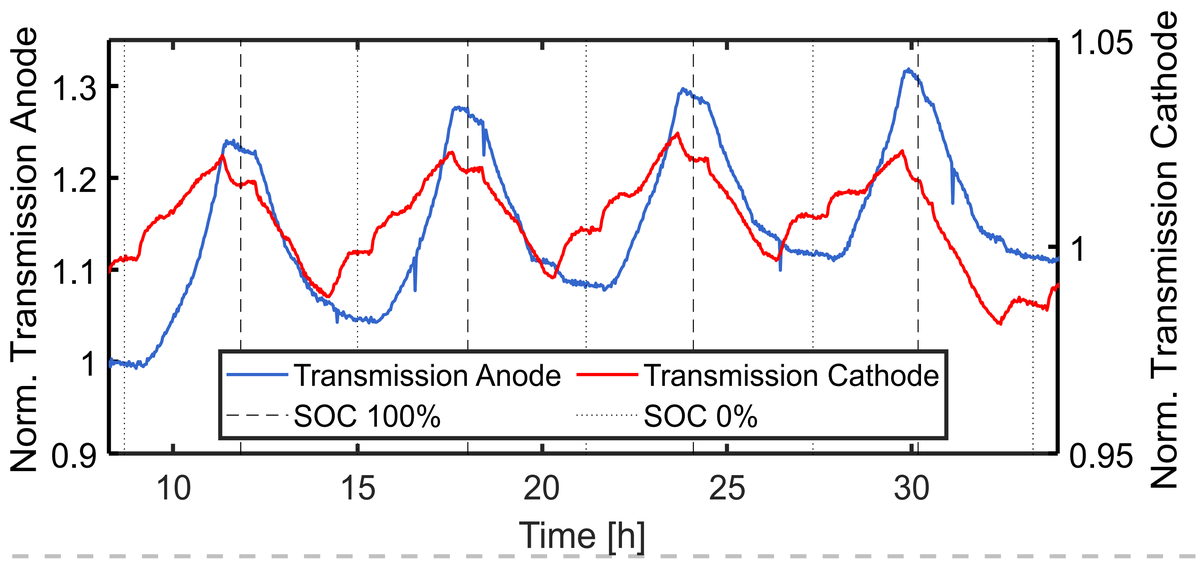
The electrodes equipped with fibers are sealed in a pouch. The fibers are connected to broadband lightsources and spectrometers to obtain wavelength dependent data

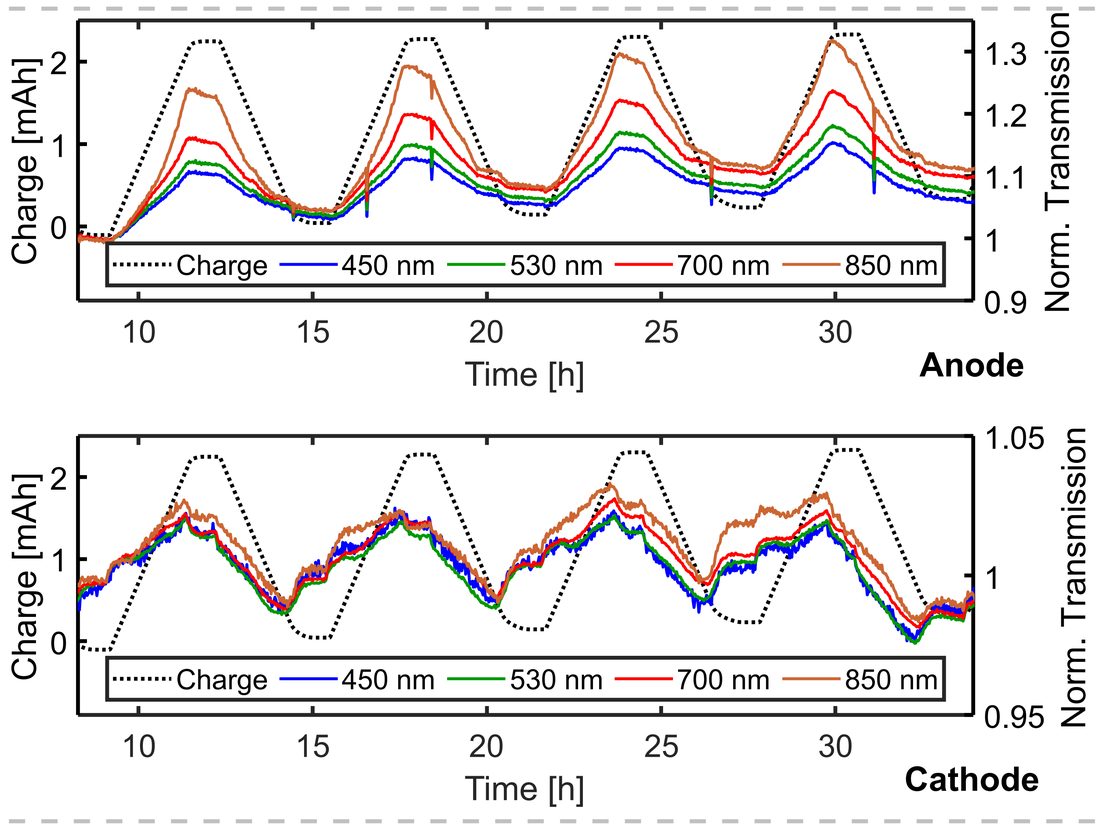
Future setup for the fiber setup in prismatic cells utilizing LED lightsources and simple photodetectors



Measurement Results

Results show a good correlation of charge and transmission of both electrodes. The anode shows a higher signal intensity and a wavelength dependecy. For the cathode relaxation effects of the material mix are notable.





Conclusion A method to detect optical changes in electrodes with micro-cladded optical fibers has been established. The optical signal is in good correlation with the SOC and can be utilized for state determination independent of electrical methods. For 'Optical in-situ observation of lithium-ion-battery electrodes for material characterization' see F. Rittweger at P1-28

[1] Ghannoum, A. et al., 'Development of Embedded Fiber-Optic Evanescent Wave Sensors for Optical Charaterization of Graphite-Ion Batteries', *ACS applied materials & interfaces*, Vol 9, No. 47, 2017.
[2] Modrzynski, Ch., Roscher, V., Rittweger, F., Ghannoum, A., Nieva, P., Riemschneider, K.-R., 'integrated Optical Fibers for Simultaneous Monitoring of the Anode and the Cathode in Lithium Ion Batteries', *IEEE Sensors Montreal*, 2019

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