Master Thesis / Vertieferpraktikum

Analysis of the ionic transport in porous battery electrodes by modified impedance spectroscopy

The field of battery research is growing faster than ever, especially in terms of new materials and systems, which aim to improve battery performance and sustainability. For the analysis of detailed electrochemical processes for different battery chemistries and cell setups electrochemical impedance spectroscopy (EIS) is a very strong method. It can separate different processes taking place in the battery and delivers detailed information on each of them. Hence, the difficulty lies in the correct post-processing of the information.

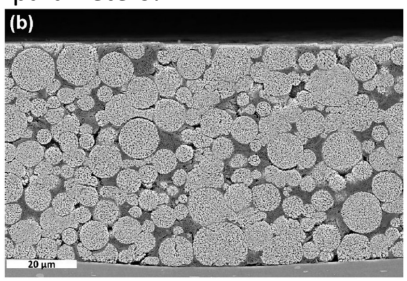
This work aims to develop a method for the electrochemical impedance spectroscopy that excludes chemical processes and analyses only structural properties of the battery electrodes. Therefore, a modified cell setup will be developed with the absence of reactive species, for which an analytical method will be developed. Furthermore, this method will be applied for state of the art battery electrodes and structural properties such as porosity, pore size distribution, etc. will be analysed for different electrode materials and production parameters.

Challenges:

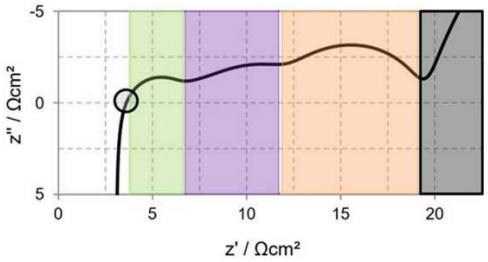
- Which materials to use for the new cell setup?
- What are reasonable analysis parameters? How to fit the results?
- What is the physical meaning of the results? How are they influenced by the used materials and production parameters?

Practical tasks:

- Casting of battery electrodes
- Characterization of the electrodes with Hg-porosimetry
- Assembling battery coin cells
- Impedance spectroscopy measurements and model fitting of the results



Cross-section of a battery electrode with porous nanostructured particles. [1]



Schematic impedanz spectra. [2]

Experience in electrochemistry is beneficial. Additionally, the ability to independently work out scientific questions and conduct experimental and analytical methods is necessary.
The start of this Master Thesis is flexible and set up for a length of six months. It can be done in English or German without any prioritization. Please take notice that it is done at **Campus North**.
If you are interested in this project, feel free to contact **Andreas Gyulai** (andreas.gyulai@kit.edu) or **Luca Schneider** (luca.schneider@kit.edu)

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[1] Müller, M. et al. ACS (2021)
[2] Dreizler, A. et al.
J. Electrochem. Soc. ***165****, (2018).*