Karlsruhe Institute of Technology

Seminar series of the Graduate School GRK 2078

Referee: **Dr.- Ing. André Weber**
Akademischer Oberrat
Institut für Angewandte Materialien – Elektrochemische Technologien (IAM-ET)

Date: Tuesday, April 18, 2023

Time: 14:00-15:00h

Location: Building 10.23, 3rd floor, seminar room 308.1
Please note that you can also participate in the event online

Title: **Multiphysics Modeling of Electrochemical Systems - Fuel Cells, Electrolyzers and Lithium Batteries**

Abstract

In the development process of electrochemical systems, physicochemical models of the envisaged cells support the analysis and development of cells and enable simulation studies on the stack/module and system level. At IAM-ET, models for fuel cells, electrolyzers and lithium batteries have been developed in the past 2 decades.
The models are based on electrochemical and microstructural characterization approaches. In a first step the cell is analyzed by means of electrochemical impedance spectroscopy. The impedance data analysis by the distribution of relaxation times provides information about the electrochemical processes in the cell and enables the construction of a physicochemical meaningful equivalent circuit model (ECM). By fitting this ECM to impedance spectra measured over a wide range of operating conditions, characteristic electrochemical parameters of the cell and their electrodes are gained. ECMs, as linearized small signal models, do not consider the highly nonlinear behavior of electrochemical cells and thus are not able to predict the cell performance.
In a second step more complex nonlinear multiphysics models are developed and parameterized using the information and parameters gained from the ECM. These 0-dimensional models represent the cell behavior considering internal states of the cell. They can be applied in 2 or 3 dimensional FEM-approaches representing larger cells, stacks or modules.

This presentation will focus on such impedance based model development. It will be shown how electrochemistry and microstructure are represented in multiphysical modeling approaches. Simulation studies revealing critical states in the cell will be presented and new approaches including chemo-mechanical interaction in the cell will be discussed.

You are cordially invited to take part in the event.

Prof. Dr.-Ing. Thomas Böhlke
(Spokesperson of GRK 2078)