

Bachelor- / Semester- / Masterarbeit

(Simulativ)

Kinetic Degradation Modelling of Reversible Solid Oxide Cells in a 0D Python Model

Description

Reversible solid oxide cells (rSOC) can alternate between generating electricity as a fuel cell and converting electricity into chemical energy carriers as an electrolyser. This makes them well suited for flexibly coupling the power and gas grids. Their economic viability, however, depends critically on cell lifetime. In a collaborative project, the Chair of Energy Systems is working with an industrial partner to investigate the degradation of short stacks. The aim is a physically founded prediction of how stack performance develops over several years of operation.

In this thesis, degradation is not described as a lumped voltage loss but as a time-dependent change in physical model parameters. Examples include the decrease in triple-phase boundary length due to nickel coarsening, chromium poisoning of the air electrode, and the increase in ohmic resistance due to oxide scale growth. Each mechanism is described by a law that depends on the operating conditions (temperature, current density, gas composition, operating mode). Integrated into the chair's 0D model, it yields the evolution of cell voltage, area-specific resistance and impedance spectra over time.

Requirements

- Interest in electrochemistry and chemical reaction engineering
- Solid programming skills in Python
- Helpful: mathematical understanding of optimization

Work Packages

1. Literature review
2. Catalog of SOC degradation mechanisms
3. Implementation as a 0D Python model
4. Validation against literature data
5. Implementation of parameter estimation (Master's thesis)

Start date As of now
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