LEHRSTUHL
LEE Energieverfahrenstechnik & Energiesysteme

UNIVERSITÄT DUISBURG ESSEN
Offen im Denken

Master-/ Bachelorarbeit

„3D Percolation Analysis and Performance Modeling of Porous Electrochemical Electrodes “

Allgemeines:

This thesis explores how the internal structure of porous electrodes affects the performance of fuel cells. In composite electrodes, electricity and ions must flow through separate, interconnected solid networks. If one path is blocked or poorly connected, the cell's efficiency drops drastically. Traditional engineering models often simplify these complex 3D structures into basic averages, missing crucial bottlenecks. This project aims to build a 3D (for a bachelor thesis 2D) computational percolation model to simulate random porous electrode structures and identify the exact point where continuous pathways form. By linking particle-scale connectivity to effective material conductivities, the resulting parameters will be plugged into a continuum engineering model to generate realistic current-voltage curves.

Aufgabenstellung:

- Define why porous electrodes are critical for electrochemical cells and where traditional macro-models fail.
- Fundamentals of Percolation Theory: Explain how random material networks form continuous pathways for ion and electron transport.
- Build a 3D digital electrode grid in Python and identify connected transport paths.
- Calculates material conductivities and plugs them into a 1D model to generate IV curves.
- Evaluate how varying material ratios and conductivity imbalances impact cell performance.
- Summarize key electrode design rules and outlines future model expansions.

Bei Interesse wenden Sie sich per Mail (inkl. Lebenslauf und Notenspiegel) an:

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