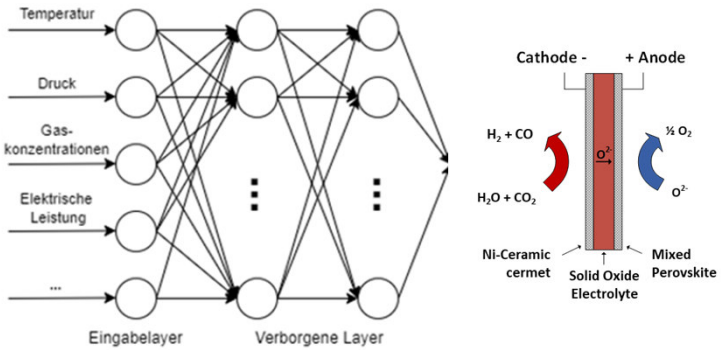
Development of a Machine Learning Model for Performance Prediction of High-Temperature Co-Electrolysers

Task description

High-temperature SOE (Solid Oxide Electrolysis) technology enables highly efficient green hydrogen production due to its operating temperature of 700-850 °C. In co-electrolysis mode, SOECs can also convert H_2O and CO_2 into syngas, an important feedstock for chemical synthesis and e-fuel production. Despite these advantages, broad deployment remains limited by high costs from low production volumes, severe degradation under non-ideal operating conditions and the lack of long-term, system-level studies

This work builds on an existing SOEC simulation framework in Matlab-Simulink®. The objective is to develop and implement a neural network surrogate model trained and validated using data generated from the electrochemical simulation model, in order to significantly reduce computational effort. The tasks include generating suitable datasets from the SOEC co-electrolysis model using a range of specified operating parameters, developing and implementing the neural network model (e.g. in Python), and validating the model accuracy against the electrochemical model. The final surrogate model should enable fast prediction of SOEC behaviour in co-electrolysis mode while retaining sufficient accuracy for system studies and optimisation.



Assignments

- Literature research: Introduction to SOE technology and review of existing electrochemical SOEC model and neural network modelling (3 weeks)
- Generation of data: Utilisation of the electrochemical SOEC simulation model to generate datasets for the surrogate model training (3 weeks)
- Model development and implementation: Definition of modelling approach and implementation of the neural network surrogate model (2 weeks)
- Model validation and testing: Verification and testing of the surrogate model with the electrochemical model (2 weeks)
- Results presentation and thesis writing (3 weeks)

Start: As of now

Duration: ca. 3 months

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