



Master thesis

Development of mixed electronic-ionic conducting perovskite for high-temperature electrolyzers

Research area

- Batteries
- Fuel cells and electrolysis
- Electrocatalysis

Alignment

- Experimental
- Electrical Characterization
- Material analysis
- Development of measurement technology
- Modeling
- Simulation
- Literature Research

Course of study

- Electrical engineering and IT
- Mechanical Engineering
- Chemical Engineering
- Chemistry
- Physics
- Material Science
- Techno mathematics
- Industrial Engineering

Language

- English
- German

Starting date

As soon as possible

Contact person

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Motivation

Our modern society faces a crisis of energy and environmental issues resulting from the rapid depletion of fossil fuels as well as global warming. The development of sustainable energy storage and conversion devices is urgently necessary in order to overcome these complications. In terms of energy conversion, solid oxide electrolyzer cells (SOECs) have proven to be the most efficient and environmentally friendly technology for producing green hydrogen.

In today's SOECs, nickel/yttrium stabilized zirconia ceramic-metal compounds (Ni/YSZ-cermet) with excellent electrochemical performance are widely used as fuel electrode. However, the performance of such electrodes degrades due to Ni agglomeration and migration, limiting the lifetime of the SOEC. This problem promotes the development of materials exhibiting higher stability as fuel electrodes in SOECs.

All ceramic fuel electrodes based on mixed ionic-electronic conductors (MIECs) can effectively improve the stability of the SOEC. In this thesis, a perovskite-type fuel electrode material will be developed and tested. The challenge is to find a composition that combines a sufficient electrochemical performance (conductivity and electrocatalytic activity) with high structural stability. The work comprises powder synthesis and characterization, the preparation of screen printing pastes and printing of electrodes, the sintering of the electrodes to produce cells, and an electrochemical characterization by means of impedance spectroscopy.

Finally, the results obtained from the investigated materials shall be compared to state-of-the-art fuel electrodes previously investigated at IAM-ET.

The following tasks are included in this project

- Literature study on perovskite-type fuel electrodes
- Familiarizing with defect chemistry of perovskites
- Selection of materials to be investigated
- Powder synthesis via solid-state reaction or wet chemical methods
- Material characterization (XRD, conductivity measurement, SEM)
- Preparation of electrodes and cells (paste preparation, screen printing, sintering)
- Cell testing, performance, and stability evaluation of prepared electrodes

About us

We offer a lively atmosphere and the opportunity to work in an interdisciplinary team on an innovative topic. Independent work and the motivation to work on current research topics are required. For further information, please contact Yousef Alizad Farzin. Interested candidates are asked to send a brief motivation letter, curriculum vitae, and grades to yousef.farzin@kit.edu.

The supervisors

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