Institut für Angewandte Materialien
Elektrochemische Technologien
Adenauerring 20 b
76131 Karlsruhe

Master thesis / HiWi

Membrane-less electrolyzer stack

Research area

- ☐ Batteries
- ☐ Fuel cells and electrolysis
- ☐ Electrocatalysis
- ☒ Water electrolysis

Assignment

- ☒ Experimental
- ☐ Electrical Characterization
- ☐ Material analysis
- ☐ Development of measurement technology
- ☐ Modelling
- ☐ Simulation
- ☒ Literature Research

Course of study

- ☒ Electrical engineering and IT
- ☒ Mechanical Engineering
- ☒ Chemical Engineering
- ☐ Physics
- ☐ Techno mathematics
- ☐ Industrial Engineering

Starting date

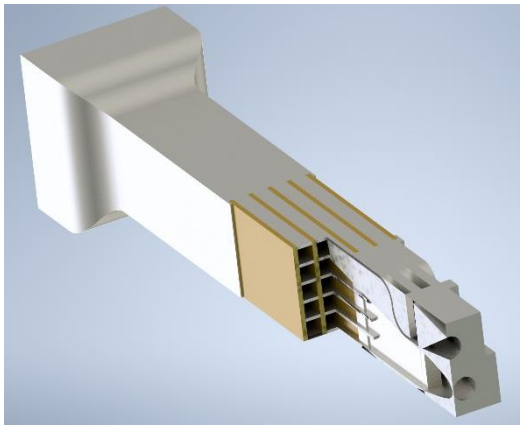
As soon as possible

Contact person

Pooria Hadikhani
IAM-ET
Adenauerring 20b
Building 50.40
E-Mail: pooria.hadikhani@kit.edu

http://www.iam.kit.edu/et/

Motivation



Hydrogen's high energy density and its potential for a green lifecycle are the main drivers behind the ongoing development of the hydrogen economy. Water electrolyzers are the primary method used for producing green hydrogen. However, improvements in efficiency and throughput are necessary before electrolyzers can be widely adopted. Membrane-less electrolyzers offer a promising approach to hydrogen production via water electrolysis without needing an expensive membrane separator. As demand grows for efficient, scalable hydrogen generation systems to support the transition to renewable energy, developing large stacks of membrane-less electrolyzer units is critical. Stacking enables modular, industrial-scale throughput, but requires overcoming challenges like gas/liquid distribution, preventing crossover, and current leakage. We seek a motivated master student to help design the next generation of high-performance, cost-effective membrane-less electrolyzer stacks for sustainable hydrogen production.

Building on the previous membrane-less electrolyzer cell design that produced high purity hydrogen, this project aims to validate a full stack featuring multiple cells in an array with series and parallel connections. The student will finalize the CAD models and 3D print the stack based on initial designs. Subsequent electrochemical testing will evaluate the uniformity of current distribution between cells, measure the purity of the product gases, and quantify the overall stack performance at varying electrolyte flow rates. This work demonstrates scalability of the membrane-less architecture from single cell to industrial levels.

The project is flexible and the student can bring her/his ideas. Basic knowledge in electrochemistry is preferred, while skills for CAD design, 3D printing, and electrochemical testing will be developed during the project.

Areas of responsibility:

- Refine the CAD model and 3D print a membrane-less electrolyzer stack
- Carry out experiments to characterize current, and flow rate effects on purity and efficiency of the stack
- Analyze experimental data and provide insights for design improvements

Application

Please send your CV and transcripts to Pooria.hadikhani@kit.edu.