

Visualisation of the Internal Processes of a Fuel Cell with the Help of an Application Built with the COMSOL Multiphysics® Software

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Abstract

The fuel cell is a converter technology. It changes the chemical reaction energy into electrical energy and heat.

The scope of this work was to create a visualisation application for the pupil's lab of the University of Applied Sciences Bielefeld. The application serves as a supplement for a workshop about fuel cells. It should provide a better understanding of internal processes in a fuel cell, to visualize important influences and collect first experiences with a simulation. To achieve this objective, a model of the PEM-fuel cell was created (Figure 1). The visualization of the internal processes with the help of the results provided by the simulation allows an indication where problems can appear. An issue of real fuel cells is often an insufficient water removal.

A fuel cell from an experimental kit for pupils was modelled with COMSOL Multiphysics® software. Two physics interfaces were used: "Secondary Current Distribution" and "Reacting Flow in Porous Media". Missing parameters for the simulation were determined by experiments with the real fuel cell. Important parameters are the inlet velocities of the gases (hydrogen and oxygen) for different voltages or currents respectively. The numerical results are in good agreement with the experimental measurements, so that the simulation model is validated. Finally, an application was created with the help of the Application Builder of COMSOL Multiphysics® software.

The application shows different results of the mass fractions of hydrogen, oxygen and water, as well as the velocity distribution of the gas flows for different voltages (Figure 2). So the user gets an insight into the internal processes in a "real" fuel cell, which are not visible in experiments. In this context, the results make an analysis and optimization possible.

Figures used in the abstract

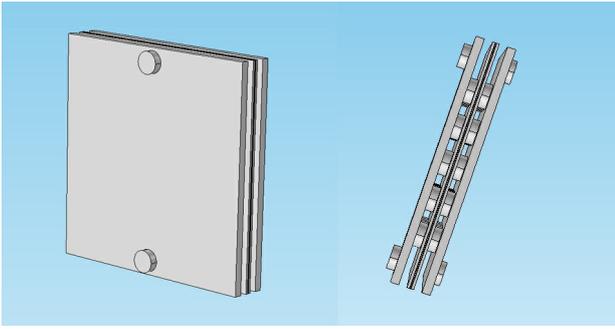


Figure 1

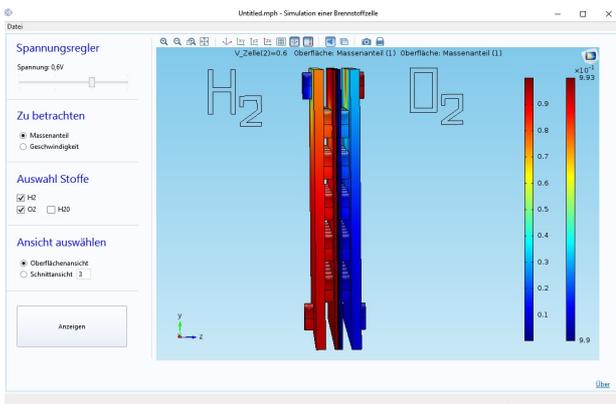


Figure 2