Visualization of Internal Processes in a Fuel Cell Using a COMSOL Application

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Introduction: The scope of this work was to create a visualization application for the pupils laboratory of the Bielefeld University of Applied Sciences. The application serves as a supplement for a workshop about fuel cells. It should provide a better understanding of internal processes in a real fuel cell from an experimental kit for pupils (Fig. 1). The app enables the users to collect first experiences in simulation and to realize its benefits.

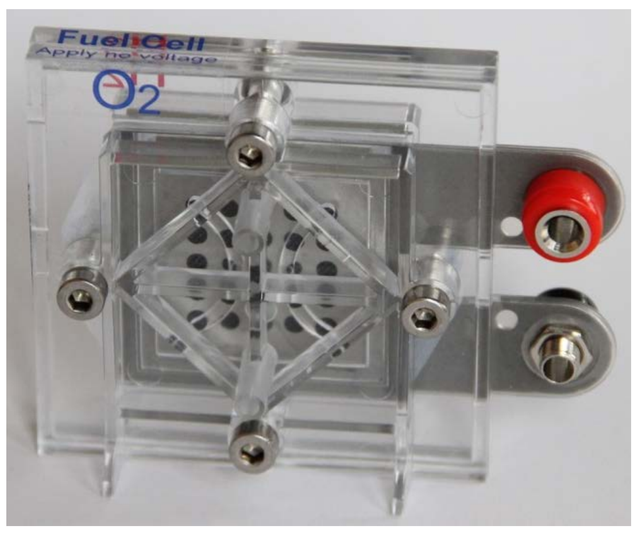

Figure 1. Fuel cell

Use of Comsol Multiphysics Software:
A PEM fuel cell was modeled with COMSOL Multiphysics (Fig. 2). Two physics interfaces were used: "Secondary Current Distribution" and "Reacting Flow in Porous Media".

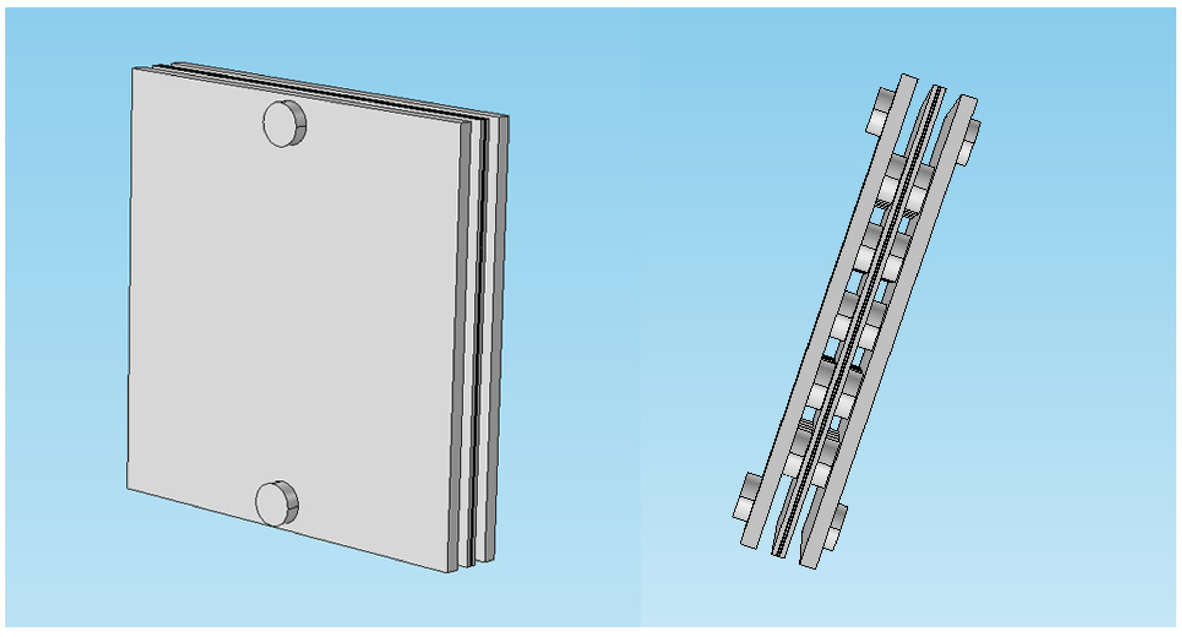

Figure 2. Model of the PEM fuel cell

Missing parameters for the simulation were determined by experiments with the real fuel cell. Important parameters are the inlet velocities of the gases for different voltages or currents, respectively.

The numerical results are in good agreement with the experimental measurements, so that the simulation model is validated.

An application (Fig. 3) was created with the help of the Application Builder of COMSOL Multiphysics.

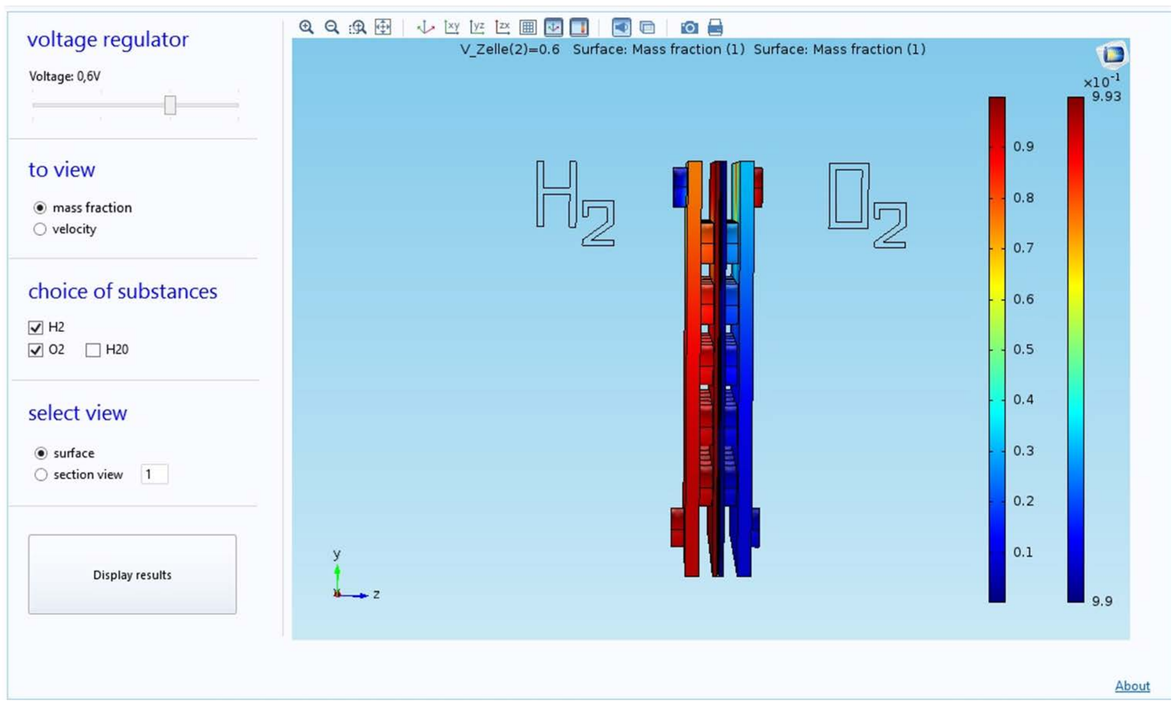

Figure 3. Visualization Application

Results: The application shows different results of the mass fractions of hydrogen, oxygen (Fig. 4) and water, as well as the velocity distribution of the gas flows for different voltages. 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.

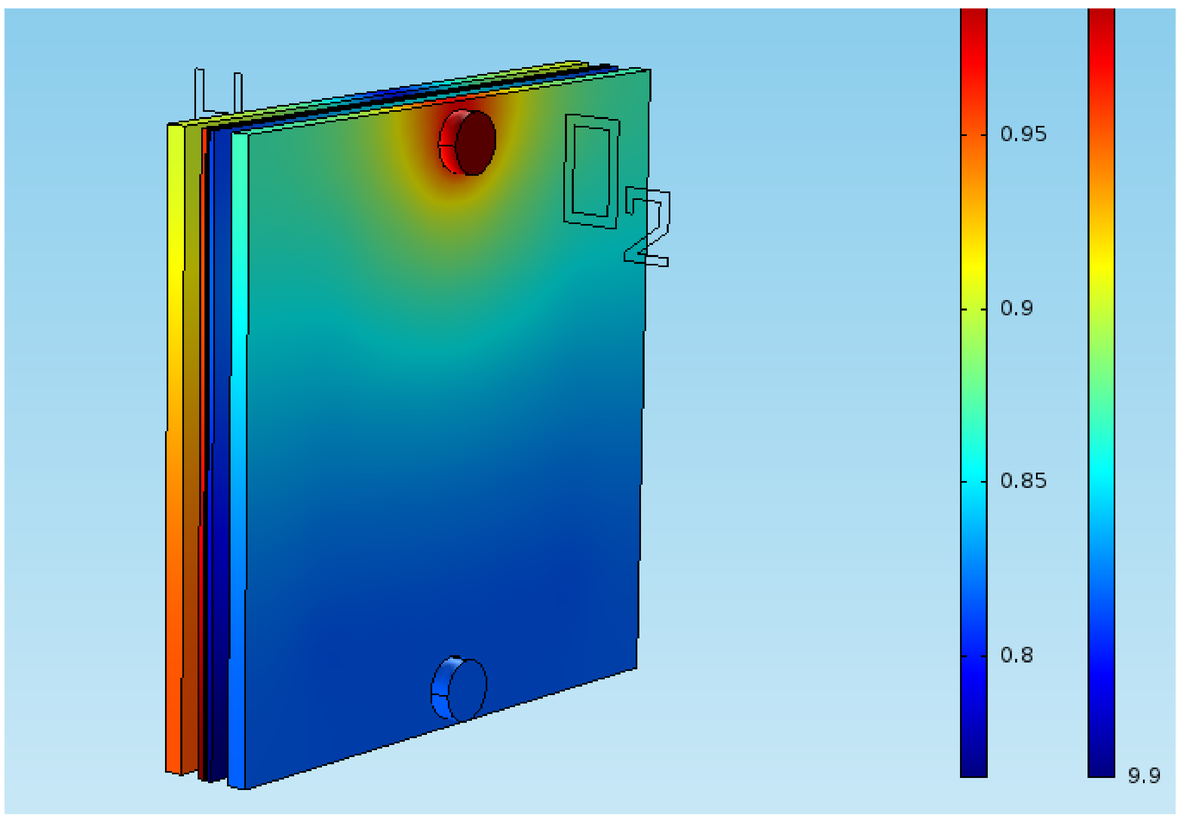

Figure 4. Mass fractions of H_2 and O_2