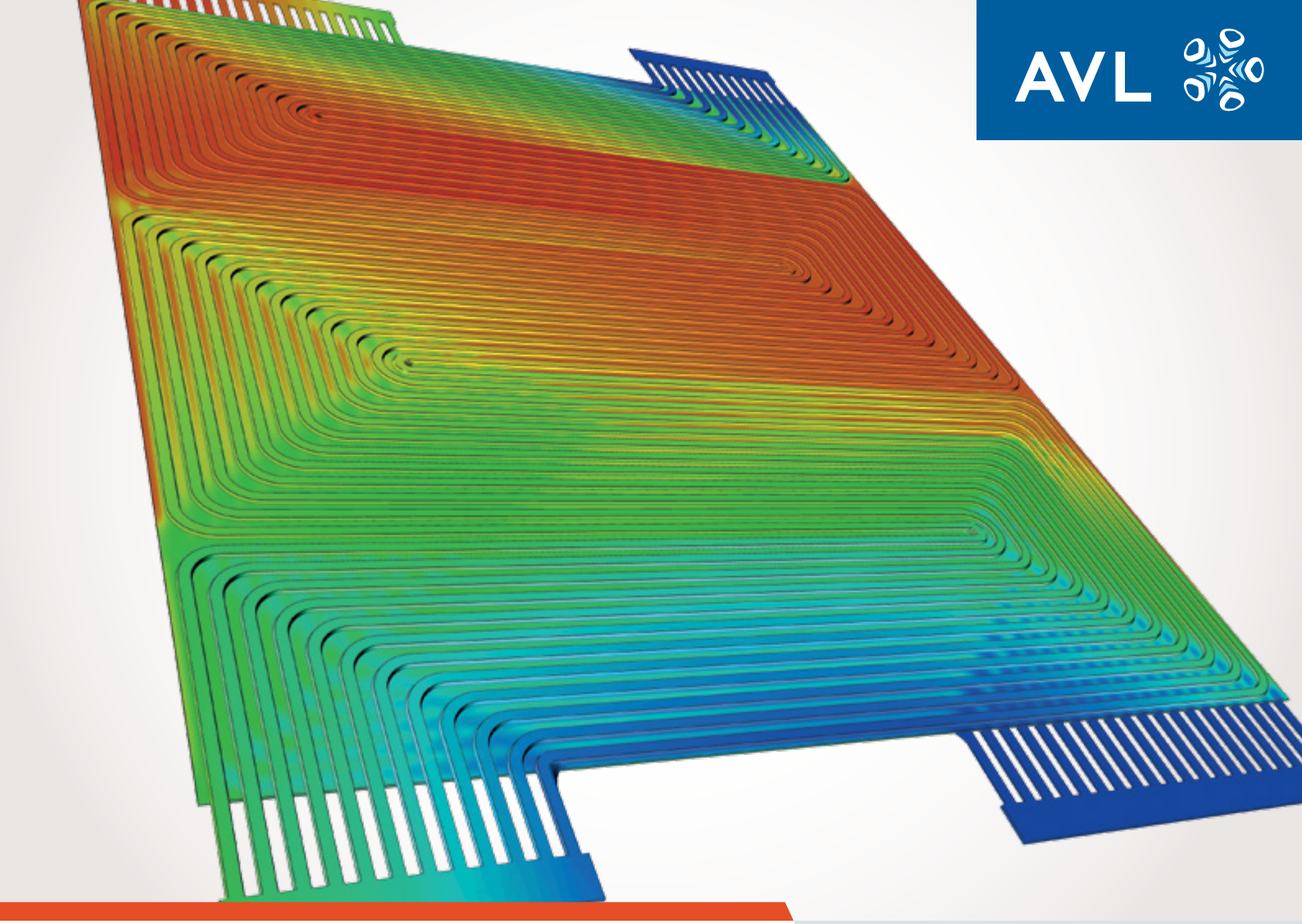


AVL FIRE™

PEM Fuel Cell Simulation

Proton exchange membrane (PEM) fuel cells are currently the most promising fuel cell technology for light duty vehicles. PEM fuel cells work with a polymer electrolyte in the form of a thin permeable sheet and are operated at temperatures about 80°C. Due to the relatively low temperatures these cells are operated on pure hydrogen.

THE CHALLENGE

Performance and lifetime optimization of PEM fuel cells require a detailed insight into the governing multiphase flow, chemical species transport and electrochemical processes.

AVL APPROACH

Multi-physics 3D-CFD tool AVL FIRE™ for PEMFC layout and optimization on cell/stack level accounting for:

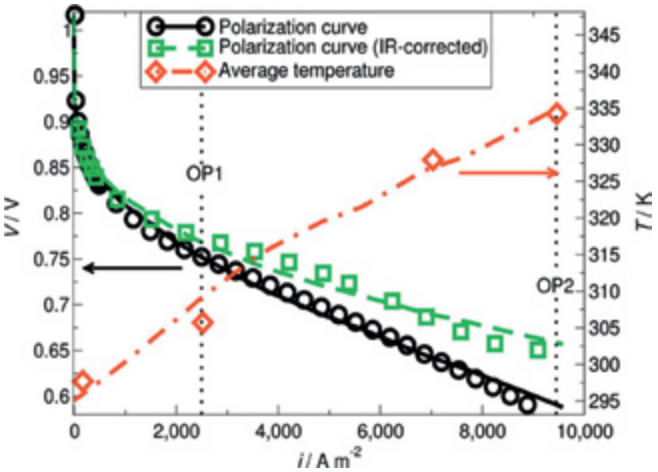
- Water transport, ionic/heat conduction and species cross-over in membrane
- Catalyst layer electrochemistry including parasitic reactions due to gas cross-over
- Membrane and catalyst layer degradation accounting for local operating parameters
- Species and liquid water transport, electron and heat conduction in GDL/MPL
- Gas species and liquid water transport in gas channels

THE SOLUTION

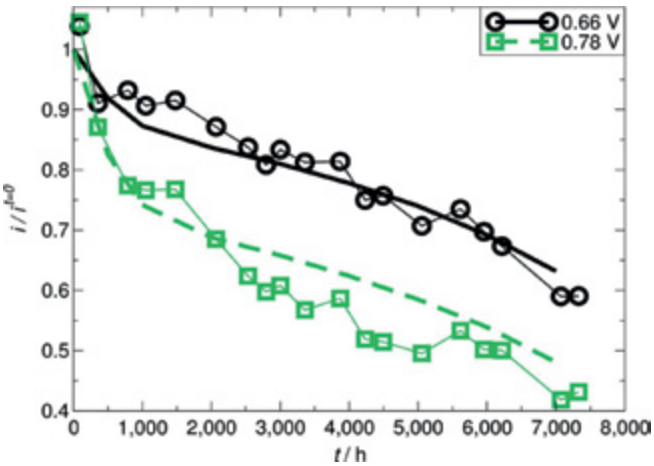
AVL FIRE™ offers comprehensive capabilities for simulation of PEM fuel cells in order to optimize the space and time resolved flow and temperature distributions, species concentrations and current density, etc. to ensure highest cell/stack performance and lifetime.

BENEFITS AT A GLANCE

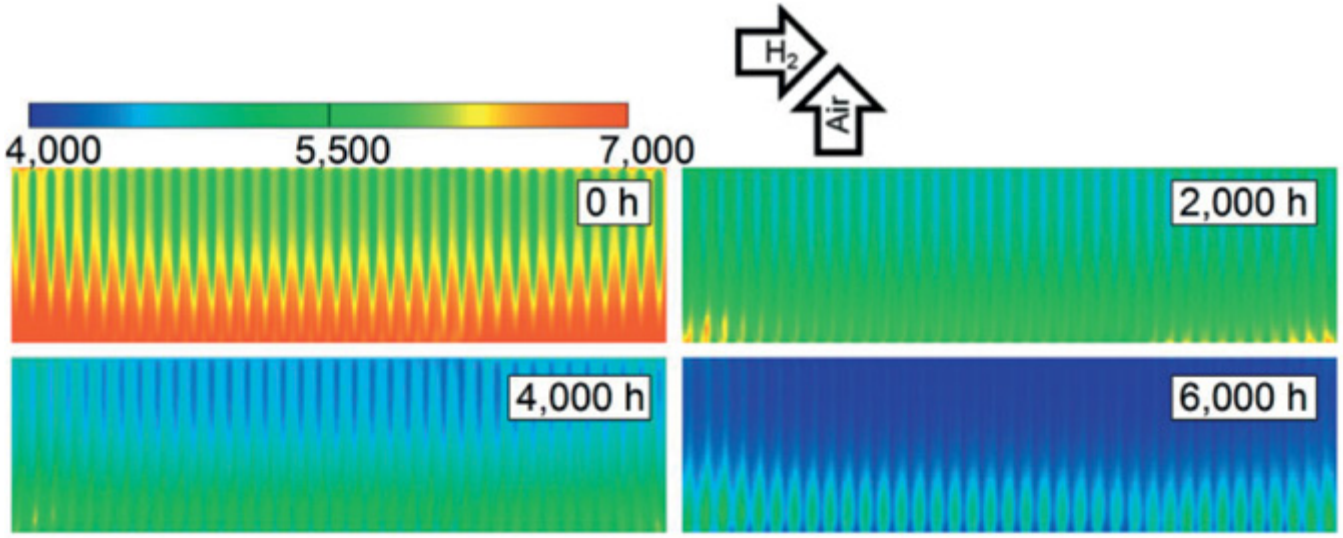
- Virtual flow field design for optimized media supply
- Identification of membrane drying and liquid water issues
- Seamless analysis of all fluid/structure elements' thermal conditions
- Fast and easy assessment of the impact of material parameters on cell performance
- Localization of degradation critical areas
- Identification of critical cell areas and operation modes



Simulated (solid lines) and measured (symbols) polarization curve and average temperature vs. current density



Simulated (solid lines) and measured (symbols) normalized current density vs. operating time for different cell voltages



Current density / A/m² at 0.66 V after 0h, 2.000h, 4.000h and 6.000h operating time

AVL OFFERS A COMPREHENSIVE PORTFOLIO OF ADVANCED SIMULATION TOOLS

AVL FIRE™

Multi-physics PEM Fuel Cell Simulation

AVL FIRE™ offers comprehensive fluid-flow, thermal and electrochemical simulation capabilities for analysis and optimization of PEM fuel cells.

With its robust and mature simulation capabilities and fully graphical user interface guided CFD workflow, AVL FIRE™ supports the PEMFC research and development engineer in the best possible way to achieve stack performance and lifetime targets.

Based on cell/stack geometry, material properties and operating conditions related information, AVL FIRE™ provides 3D distributions in single cells and stacks for

- Electrochemical, chemical and electrical quantities
- Gas species and liquid water concentrations
- Fluid temperature and temperatures in end plates, gas diffusion/microporous layer and membrane
- Fuel and oxidizer stream velocities and pressure losses

FOR FURTHER INFORMATION PLEASE CONTACT:

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