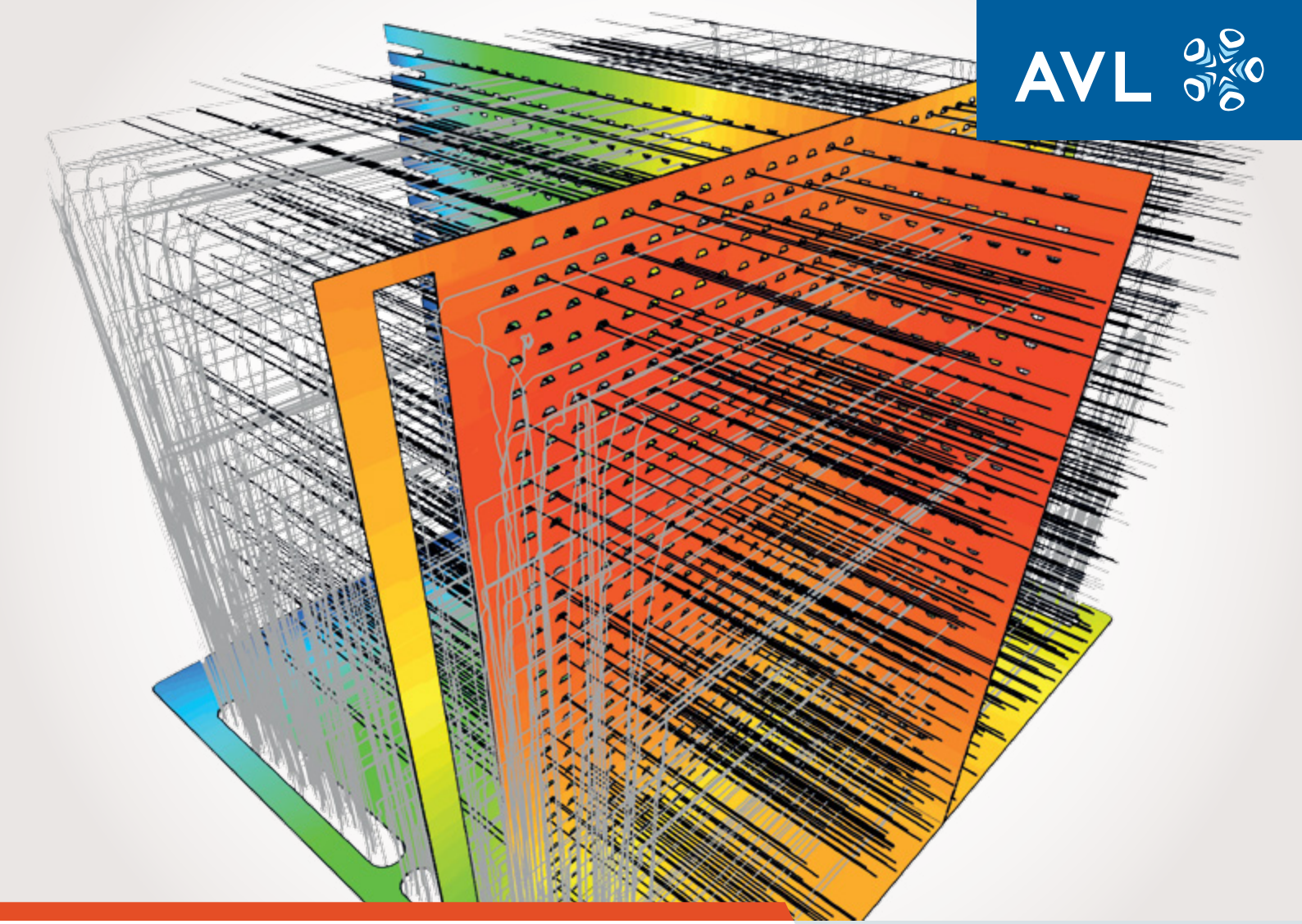


AVL FIRE™

Solid Oxide Fuel Cell Simulation

Adopting solid oxide or ceramic electrolytes, solid oxide fuel cells (SOFC) are used for the production of electricity from direct fuel oxidation. Due to their high operating temperature, solid oxide fuel cells do not require expensive catalyst materials and exhibit considerable fuel flexibility. The variety of applications of SOFC ranges from the use as auxiliary power units in land, sea and air transport to stationary power generation.

THE CHALLENGE

- Thermal material expansion requires a uniform and well-controlled heating process during startup.
- Performance and lifetime improvements demand a detailed insight into the impact of local cell internal conditions on the governing transport and conversion processes.

AVL APPROACH

The multi-physics 3D CFD tool AVL FIRE supports SOFC design and optimization on cell and stack level with respect to:

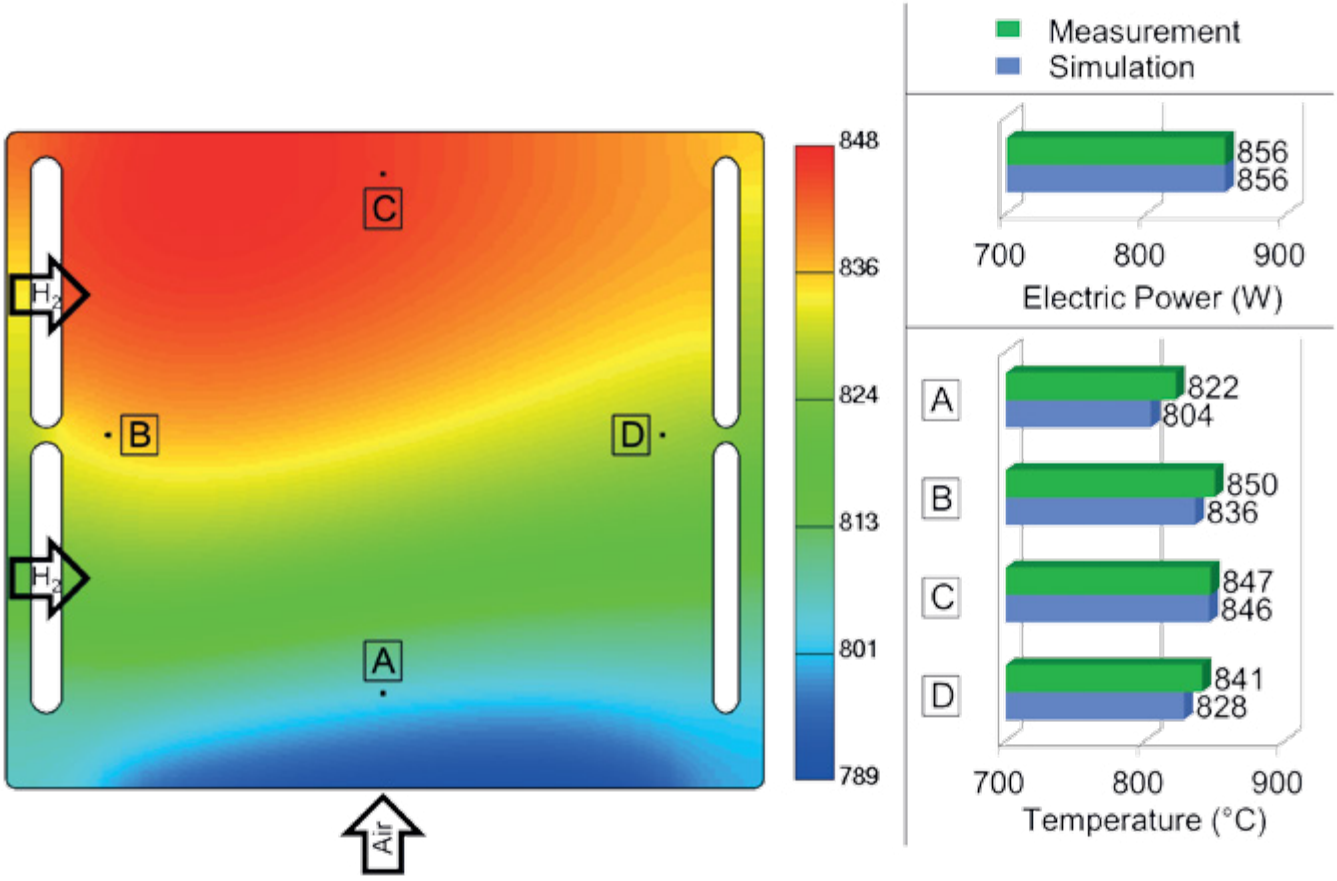
- Transient temperature distribution evolution during startup
- Identification of critical cell locations and operating modes
- Impact of material parameters on cell performance
- Efficiency and degradation critical parameters

THE SOLUTION

AVL FIRE™ offers comprehensive modeling functionalities for solid oxide fuel cell simulation in order to optimize the space and time resolved flow distribution, temperature profiles, gas concentrations and current density distribution etc. to ensure well controlled stack startup and steady operation.

BENEFITS AT A GLANCE

- Reaction kinetics analysis and startup optimization
- Performance evaluation/optimization with respect to design and combined thermal and electrochemical aspects
- Applicable to hydrogen fuelled cells/stacks
- Supporting hydrocarbon fuel operation by taking into account internal reformation and water-gas shift reactions



Temperature (°C) distribution in the middle interconnect and simulated vs. measured electric power (W) output and temperature (°C) in different monitoring locations of a solid oxide fuel cell

AVL OFFERS A COMPREHENSIVE PORTFOLIO OF ADVANCED SIMULATION TOOLS

AVL FIRE™

Multi-physics Solid Oxide Fuel Cell Simulation

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

In a number of research and customer projects AVL FIRE™ has proven to be an accurate and reliable numerical tool for gaining a detailed insight into the complex physical and electro-chemical processes in solid oxide fuel cells and stacks.

Due to its highly robust performance and fully graphical user interface (GUI) supported CFD workflow, AVL FIRE™ supports the SOFC 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, such as cell voltage, operating pressure, fuel composition etc., AVL FIRE™ provides 3D results in single cells and stacks for:

- Electrochemical, chemical and electrical quantities
- Gas species concentrations
- Fluid temperatures and temperatures in end plates, interconnects, electrodes and electrolyte
- Fuel and oxidizer stream velocities and pressure losses
- Transient thermal boundary conditions required to calculate residual stresses, deformation and the probability of cracking by means of structural analysis

FOR FURTHER INFORMATION PLEASE CONTACT:

AVL List GmbH, Hans-List-Platz 1, A-8020 Graz, Austria
T: +43 316 787 1222, Email: ASTMarketing@avl.com, www.avl.com/simulation