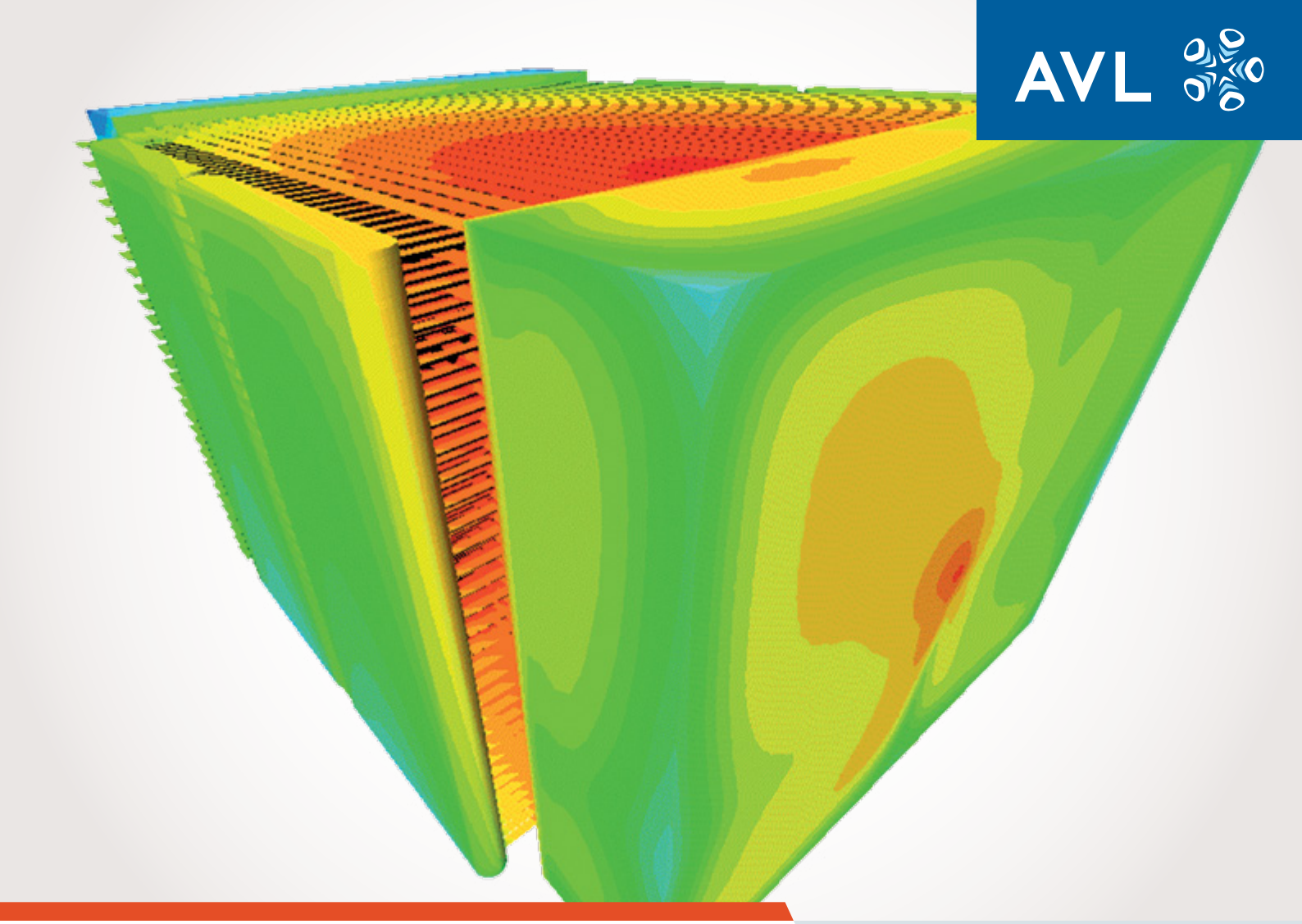


AVL FIRE™

Solid Oxide Electrolyzer Simulation

Solid oxide electrolyzers (SOE) are used for hydrogen production by electrolysis of water. Adopting a solid oxide or ceramic electrolyte, the SOE operates at temperature levels of typically 500 to 850°C. Based on its high efficiency and low required energy input, SOE based electrolysis is considered a promising technology for hydrogen production based on renewable energy sources.

THE CHALLENGE

- High temperature induced mechanical compatibility issues require a uniform and well-controlled heating process during startup.
- Performance and lifetime optimization demand a detailed understanding of the impact of local cell conditions on the governing species transport and electrochemical processes.

AVL APPROACH

The multi-physics 3D-CFD tool AVL FIRE™ supports SOE design and optimization of operation strategies with respect to:

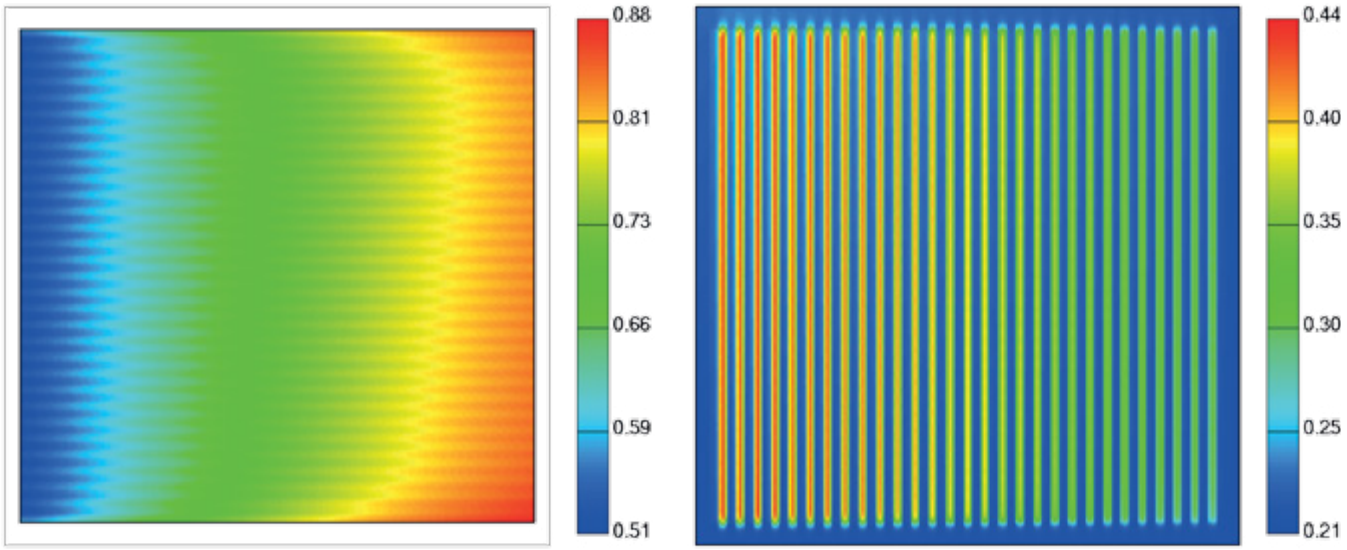
- transient temperature field evolution in fluid and solid domains during startup
- avoidance of critical cell locations/conditions
- impact of material parameters on conversion efficiency
- Performance and degradation critical parameters

THE SOLUTION

AVL FIRE™ offers comprehensive multi-physics modeling capabilities in the field of solid oxide electrolyzer simulation in order to optimize the space and time resolved flow distribution, temperature profiles, gas concentrations etc. to ensure well controlled stack startup and steady operation.

BENEFITS AT A GLANCE

- Startup optimization and reaction kinetics analysis
- Performance evaluation/optimization with respect to design and joint thermal and electrochemical aspects
- Hydrogen/oxygen production from water electrolysis
- Syngas production by electrolysis of water vapor and carbon dioxide



H_2 and O_2 mole fraction in the middle cathode and anode reaction layers of a Solid Oxide Electrolyzer

AVL OFFERS A COMPREHENSIVE PORTFOLIO OF ADVANCED SIMULATION TOOLS

AVL FIRE™

Multi-physics Solid Electrolyser Simulation

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

In a number of research and development 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 electrolyzers.

Due to its highly robust performance and fully graphical user interface (GUI) supported CFD workflow, AVL FIRE™ supports the SOE research and development engineer in the best possible way to fulfil given stack performance and lifetime targets.

Based on cell/stack geometry, material properties and operating conditions related information, such as media supply rate, operating pressure etc., AVL FIRE™ provides 3D distributions in single cells and stacks for:

- Electrochemical, chemical and electrical quantities
- Gas species concentrations
- Hydrogen/syngas production rates
- Fluid temperatures and temperatures in end plates, interconnects, electrodes and electrolyte
- 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:

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