**Institute of Engineering Thermodynamics**

**Influence of heat transfer on operation of a solid oxide fuel cell/gas turbine hybrid demonstrator**

Marc P. Heddrich, Mike Steilen, Marius Tomberg, K. Andreas Friedrich

German Aerospace Center (DLR) marc.heddrich@dlr.de

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**SOFC/GT hybrid demonstrator**
- Pressurized 30 kW_{el} SOFC with emulated gas turbine (GT)
- To be coupled with 3 kW_{el} GT investigated by Institute of Combustion Technology of DLR

**Challenges**
- Integration of components in and around pressure vessel
- Operation points and range thermal insulation dependent
- Experimental complexity due to component/controls restrictions

**Heat transfer influence on operation**
- Component heat losses affect not only efficiency, but operation strategy
- Adiabatic maximum power limited by mass flow restriction of compressor (cooling air)
- Non-adiabatic lower efficiency curve limited by min. cell voltage
- Largest heat losses from stack module, tubes and feedthroughs

**Commissioning results**
- Components working as designed and according to single component tests
- Automation control loops configured during commissioning (differential pressure, cathode gas inlet temp., …)
- Natural gas supply for cathode gas heater interrupt at \(T_{\text{stack}} \approx 350 \, ^{\circ}\text{C}\)
  - automated emergency shutdown worked as intended
- High temperature anode off-gas blower breakdown at \(T_{\text{stack}} \approx 550 \, ^{\circ}\text{C}\)
  - Failure due to unexpected thermal expansion of casing

**Outlook**
- Re-integration of recirculation blower for system start-up and final commissioning
- Characterization of SOFC system with emulated GT and optimization of the control loops
- Revision of hybrid power plant system design and system details
- Development of hybrid power plant interfaces and merge of control concepts and units
- Start-up of combined hybrid power plant with SOFC and gas turbine

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