

SOFC Development and Characterisation at DLR Stuttgart

G. Schiller

German Aerospace Center (DLR)
Institute of Technical Thermodynamics,
Pfaffenwaldring 38-48, D-70569 Stuttgart, Germany

The concept of a metal supported SOFC where the functional cell layers – the membrane-electrode assembly – are deposited onto a porous metallic substrate support by either sintering processes or plasma spray technology is the presently most advanced approach in developing cells of 3rd generation. This cell type is particularly suited for the application of solid oxide fuel cells for on-board electricity supply in vehicles and trucks as so-called “auxiliary power unit” (APU). Based on advanced plasma deposition processes DLR Stuttgart has developed a concept of a planar SOFC with consecutive deposition of all cell layers onto a metallic substrate support. The high thermal conductivity of the metal support, such as a highly porous ferritic sintered plate, promises advantageous properties in terms of stability during thermal cycling conditions compared to ceramic support structures. Furthermore, welding and brazing techniques can be applied by using metallic components for sealing of the cells. The cell and stack design has been adapted to the needs of APU application to meet the very strict requirements of low volume and weight and providing an improved ability for rapid start-up and thermal cycling. Within an industrial consortium the DLR concept of a metal supported cell is presently further developed and transferred to an industrial state. The consortium partners combine their specific expertise in the area of porous sinter metals, sheet metal forming, stack assembly, plasma deposition technologies and electrochemical analysis. The presentation gives an overview about the current status of the SOFC development at DLR including the fabrication process, the stack technology, materials aspects and electrochemical performance.

In order to optimise the operational behaviour of fuel cells and minimise cell degradation it is very helpful to use in-situ and ex-situ analytical methods. The application of advanced diagnostic methods by monitoring cell characteristics under real operating conditions can provide valuable information to be used for the development of degradation mitigation strategies. DLR has developed spatially resolved diagnostic techniques with a segmented cell arrangement where different techniques such as IV characteristics, impedance spectroscopy, gas chromatography and temperature measurement are involved. The investigation by means of segmented cells aims at the determination of local effects and the identification of critical operating conditions during technically relevant SOFC operation. The approach of a combined experimental and modelling study of the spatial distribution of the electrochemical performance during technically relevant SOFC operation is described and results obtained are presented.