Micro-solid oxide fuel cells running on reformed hydrocarbon fuels

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Micro-solid oxide fuel cell (micro-SOFC) systems are predicted to have a high energy density and specific energy and are potential power sources for portable electronic devices. A micro-SOFC system is under development in the frame of the ONEBAT project *[1-3]*. In this presentation, we report on the fabrication and characterization of a sub-system assembly consisting of a startup heater and a micro-reformer bonded to a Si chip with electrochemically-active micro-SOFC membranes. A functional carrier including fluidic channels for gas feed and integrated heaters was bonded to a microreformer with an overall size of 12.7 mm x 12.7 mm x 1.9 mm *[4-7]*. As a catalyst, a foam-like material made of ceria-zirconia nanoparticles doped with rhodium was used to fill the 58.5 mm^3 reformer cavity. This micro-reformer allows for high methane and butane conversion of > 90 % with a hydrogen selectivity of > 80 % at 550 °C in the reformer *[7, 8]*. A silicon chip with 30 free-standing micro-SOFC membranes (390 µm x 390 µm) with a thickness of less than 500 nm was bonded to the carrier-reformer assembly described above. The micro-SOFC membrane consisted of an yttria-stabilized zirconia thin film electrolyte. Both Pt-based and ceramic-based electrode materials were tested regarding the thermal stability and carbon poisoning at temperatures below 600 °C. The functional-carrier mirco-reformer micro-SOFC assembly was electrochemically tested with hydrocarbon fuel between 300 °C and 600 °C. The fuel cell performance and the microstructural evolution of the anode are discussed as well.

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