Development for Next Generation Fuel Cell and FC system with CAE Approach

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Solid oxide fuel cell (SOFC) is one of the best choices for energy production compared with heat engine. They are known for their high efficiency, low environmental pollution, and high power density. Highly efficient energy conversion from fuel to electricity leads to low carbon emission. And biogas -fueled SOFC[1] which can use carbon-neutral biomass fuel is focused as a low carbon emission system.

To take advantage of these SOFC potential, we should solve some problem caused by hydrocarbon fuel with some impurity. Chemical poisoning effects by sulfur, phosphorous, chlorine, etc. mixed in fuel are important to improve the cell durability[2]. Thermal stress fracture and carbon deposition[3] by hydrocarbon internal reforming are also severe problem which led to stop power generation.

In this study, focusing on the improvement of SOFC performance and durability, the influence of chemical poisoning, carbon deposition, and thermal stress is evaluated by CAE (computer aided engineering) approach, and developing higher durability cell structure and visualizing the cell poisoning mechanism is also evaluated by numerical analysis.

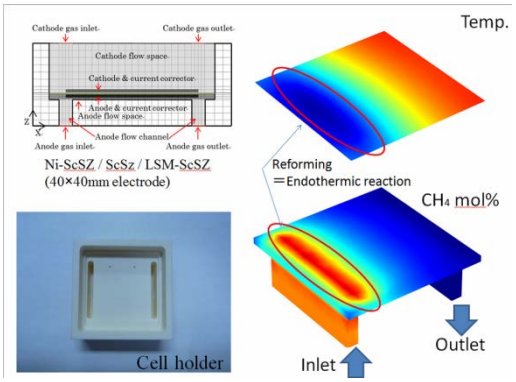

Fig.1 Cell schematic design and the distributions of temperature and methane mole fraction on direct internal reforming SOFC

References

1) "Internal reforming SOFC running on biogas", Y. Shiratori, et al., *International Journal of Hydrogen Energy*, **35**, 15, 7905–7912 (2010)

2) "Poisoning of SOFC anodes by various fuel impurities", K. Haga, et al., *Solid State Ionics*, **179**, 27–32, 1427–1431 (2008)

3) "Carbon deposition in CH4/CO2 operated SOFC: Simulation and experimentation studies", K. Girona, et al., *Journal of Power Sources*, **210**, 381–391 (2012)