Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

306

WHEC 2018 — 22nd World Hydrogen Energy Conference — Rio de Janeiro

Reversible Solid Oxide Cell and Co-Electrolysis Operation for Power-to-Gas and Energy Storage Application

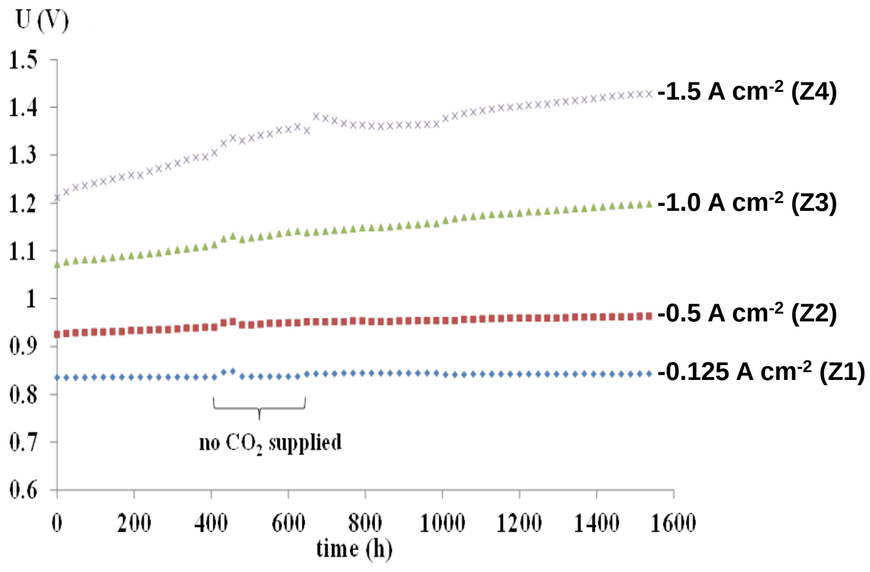
SCHILLER Günter, COSTA Rémi, LANG Michael
German Aerospace Center (DLR), Institute of Engineering Thermodynamics, D-70569 Stuttgart,Germany

Introduction

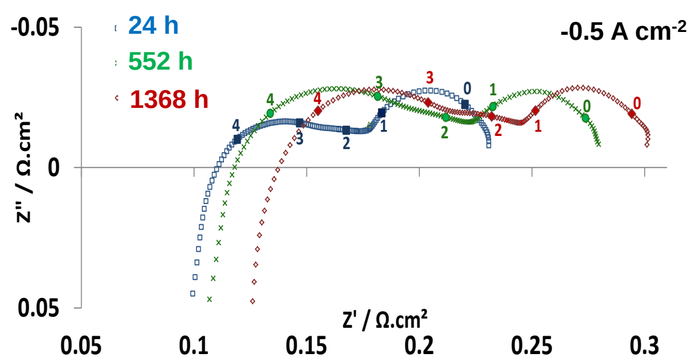
Solid oxide cells (SOC) exhibit the unique feature to be able to run in reversible operation and the capability to run with hydrocarbons. Due to the high temperature of the process, solid oxide cells exhibit very high efficiency in steam electrolysis and co-electrolysis (H_2O+CO_2) mode. This makes it very attractive for *Power-to-X*. At the German Aerospace Center, SOC are investigated from cell to stack level in order to characterize and understand the degradation behavior, identify an appropriate operation strategy and propose alternative materials to mitigate degradation issues.

Within a recently started project with AUDI AG, Germany, DLR works on the investigation of SOC stacks under near-system operating conditions in electrolysis as well as reversible operating mode. The electrochemical performance will be monitored during long-term tests to be compared with identical stacks implemented in an industrial reversible SOC system. The concept of the power-to-gas plant with 300 kW power is presented; experimental results will be published later.

Co-electrolysis operation



1536 h Test	Z1	Z2	Z3	Z4
ΔV (mV/1000 h)	5.2	24.7	82	141
%/1000 h	0.6	2.7	7.7	11.7



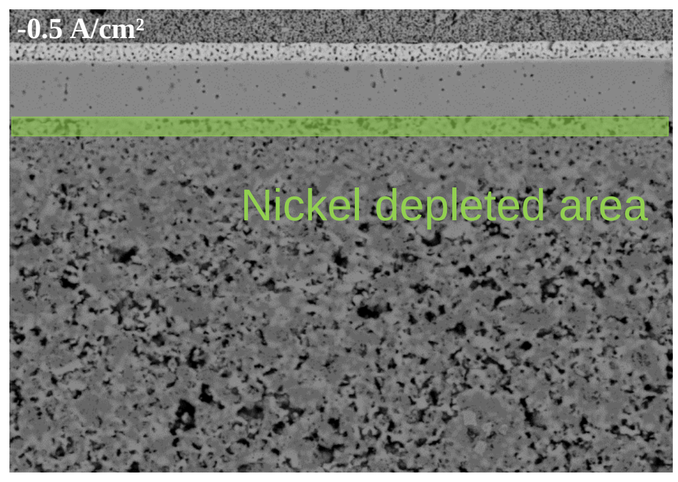
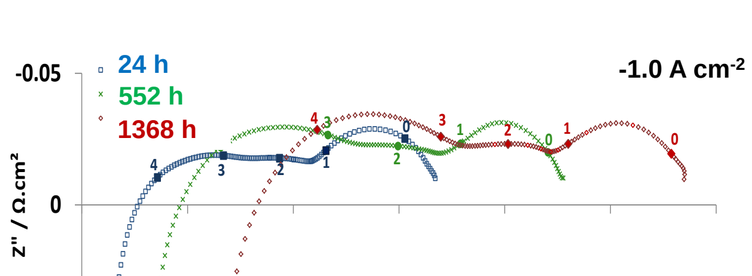


Fig.1: Long-term test run over 1500 h at 800 °C: life cycle at 4 current densities (-0.125,-0.5, -1.0, -1.5 Acm^{-2}); 57% H_2O, 36% CO_2, 7% H_2



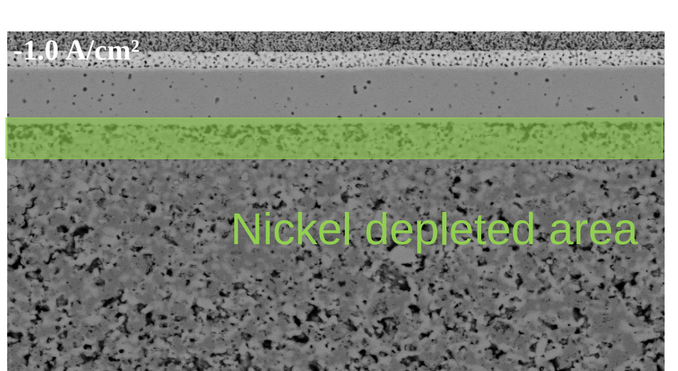


Fig.2: Impedance spectra at -0.5 and -1.0 Acm^{-2} after 24 h, 552 h and 1368 h and SEM images after operation at -0.5 and -1.0 Acm^{-2}

Reversible SOC for power-to-gas

Fig. 3: System layout of planned rSOC power-to-gas plant in Werlte, Germany

Fig. 4: Photo of existing Audi e-gas plant in Werlte, Germany

References

R. Costa, F. Han, M. Hoerlein, M. Lang, N. Sata, G. Schiller, K.A. Friedrich, ECS Transactions, 85, 1-11 (2018)

Acknowledgment

Financial support from the Federal Ministry of Education and Research (BMBF) in the project KOPERNIKUS and from the National Organisation for Hydrogen and Fuel Cells (NOW) is gratefully acknowledged.

Knowledge for Tomorrow

Wissen für Morgen