MAGNUM® Fuel Cell your partner in FC technology

Online Diagnostics for Fuel Cells using Hardware-in-the-Loop capable Test Benches

Z. Lemeš[1], M. Wörbelauer[1], N. Nicoloso[1], I. Kundler[2], C. Henschel[2]
[1)]MAGNUM Automatisierungstechnik GmbH, Germany –[2)]BASF Fuel Cell GmbH, Germany

/// Introduction

A HIL set-up allows testing of (virtual) fuel cell systems where one or more components are replaced by their parameter sets. Real time simulation is achievable with an appropriate FC model and a HIL-interface (Figs. 1 and 2). For HT-PEFC studies we have modified our 1-D Model of the normal PEFC /1/ by readjusting the MATLAB-Simulink code of the membrane part.

The simulations are verified by matching with the performance data of the Celtec MEA from BASF Fuel Cell. The tool lends itself for FC diagnostics: deviations from the optimum behaviour of any component can be monitored and used for continuous control.

/// Results and Discussion

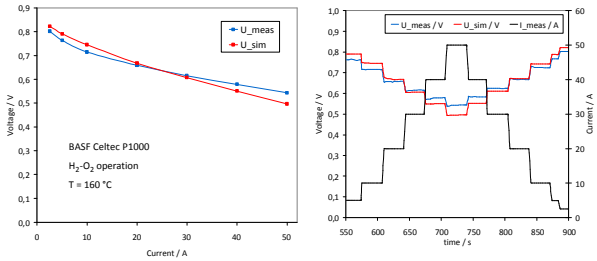

Fig. 3: Verification of Simulation Model: a) I-V curve and b) I,V –steps on load change of Celtec P 1000-MEA.

Modelling Fig. 3 presents the fuel cell characteristics of the PBI-H_3PO_4 cell from BASF Fuel Cell at T= 160 °C. There is good agreement with respect to the stationary (3a) and dynamic behaviour (3b) in spite of the simple yet non-optimized model. Evidently, the description of the electrochemical kinetics and of the IR-loss have to be further improved. Especially the kinetic parameters taken from the low temperature PEFC (T < 100 °C) are suitable to only a limited extent. Next step, a MATLAB-Simulink code for the CO tolerance will be included.

HIL-Facility The MAGNUM HIL facility can be used for online-diagnostics. The measured and control parameters will start to differ when a component runs out of its optimal state. Since a couple of components can be surveyed at the same time, even the impact of a component decline on its neighbours may be investigated.

/// Summary

Modelling and use of a HIL- capable test system is a unique tool for HT-PEFC performance control. Main advantages are the possibility to check the compatibility of components within a given system (important for system design) and to savely test a component or device under all conditions, notably, extreme ones that provide degradation and failure.

1-D Model

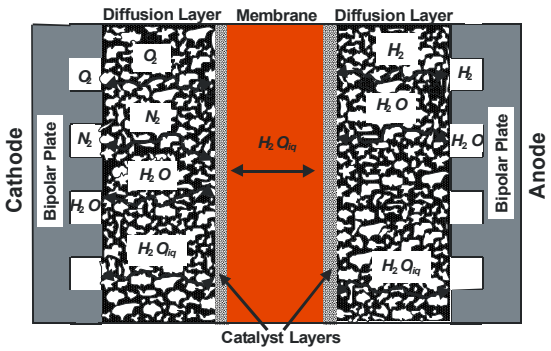

Fig. 1: 1-D Model of the HT-PEFC

/1/ A. Vath, N. Nicoloso, Z. Lemeš, H. Mäncher, M. Söhn, Th. Hartkopf: Dynamic modelling and hardware-in-the-loop testing of PEMFC, Journal of Power Sources, 2006, Volume 157, Issue 2

Hardware-in-the-Loop (HIL)

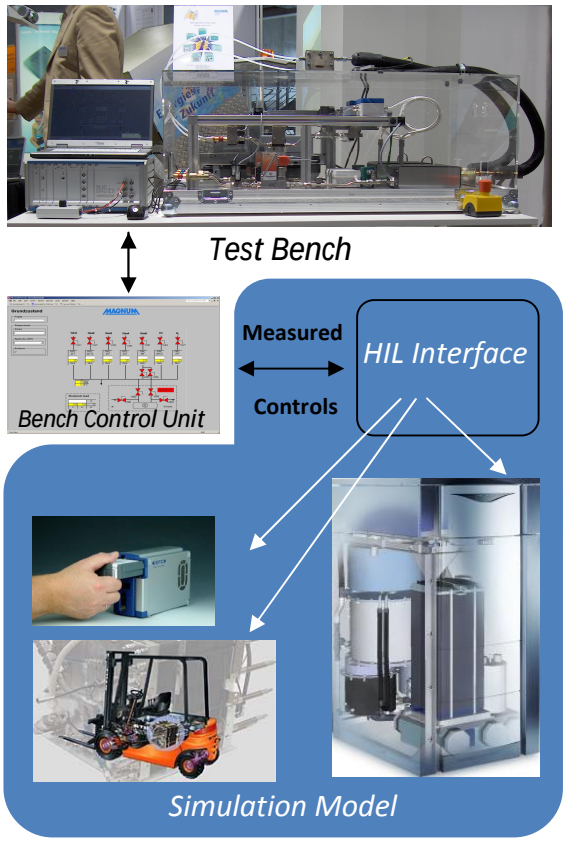

Fig. 2: HIL- Set up for Fuel Cells

MAGNUM® FUEL CELL