European Fuel Cell Car Workshop | March, 1st - 3rd 2017, Orléans, France

About fuel starvation: characterization of the mechanism of degradation and mitigation strategies

G. Maranzana, S. Abbou, J. Dillet, A. Lamibrac, T. Gaumont, S. Didierjean, O. Lottin
LEMTA, Université de Lorraine, 2, Avenue de la forêt de Haye, B.P. 160,
54504 Vandoeuvre-les-Nancy, France

gael.maranzana@univ-lorraine.fr

Keywords: fuel starvation, degradation, mitigation strategies

Fuel starvation occurs when the anode surface is not entirely fed by hydrogen. This situation can be the consequence of local flooding by liquid water or nitrogen [1] and is always encountered during the start-up (shut-down) procedure [2] when hydrogen (air) is flowing in an air (hydrogen) filled anodic compartment. This local lack of hydrogen allows a local increase of the oxygen concentration on the anode due to permeation through the membrane and a substantial increase of the local anodic potential. As a result, the local potential of the opposite cathode can reach values as high as 1.5V depending of cell potential. This phenomenon is thus responsible for carbon oxidation and catalyst dissolution of the cathode electrode.
This presentation is dedicated to the characterization of fuel starvation events using a segmented cell with reference electrodes along the active area [1,2]. An example of operation with a dead-end anode is shown in figure 1. Some mitigation strategies will be suggested.

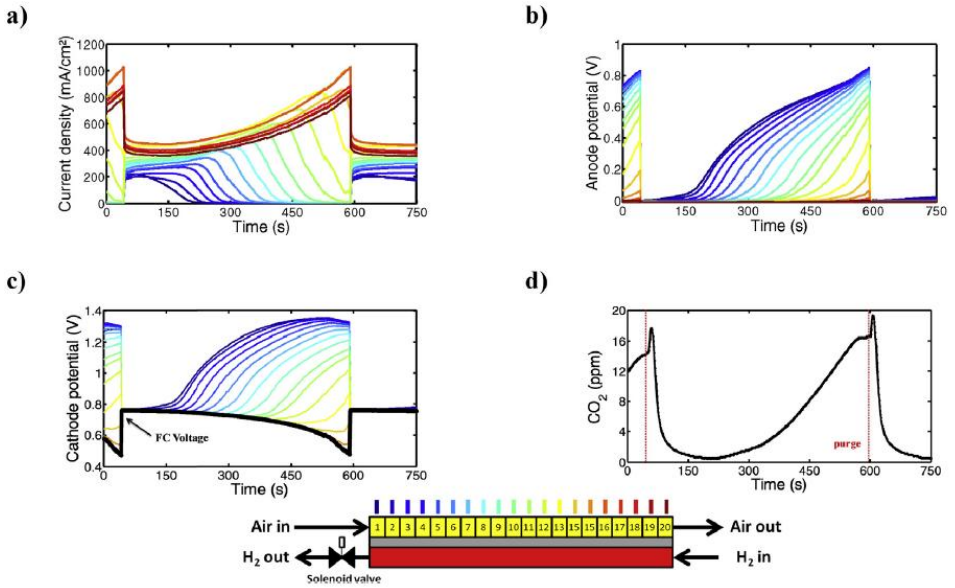

Figure 1: Time evolution of local current density (2.a, fuel cell average current density set to 0.33 A/cm2), local anode (2.b) and cathode (2.c) potentials and CO2 emissions (2.d) at the cathode exhaust between two successive purges. The cell was fed with dry hydrogen (at 1.3 bar) and the anode outlet remained closed as long as the fuel cell voltage was higher than 0.5 V. In Fig. 2(abc) the segments in blue are located near the hydrogen outlet (i.e., close to segment #1) and the red ones near the hydrogen inlet (i.e., close to segment #20).

REFERENCES

1. Abbou et al., High potential excursions during PEM fuel cell operation with dead-ended anode, *Journal of the Electrochemical Society* **162**,10 (2015)
2. Durst et al., Degradation heterogeneities induced by repetitive start/stop events in proton exchange membrane fuel cell: Inlet vs. outlet and channel vs. land, *Applied Catalysis B: Environmental*, 138-139 (2013)