Evolution of the current density distribution in PEMFC during drying and wetting processes

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Introduction

- A reduction of PEMFC performance is observed with insufficient level of gas humidification; a drying front is formed under counter flow conditions which propagates until the cell is completely inactive[1].
- This work is aimed to show the influence of wetting and drying processes in cathode or anode side on the current density distributions.

Experimental

- Conditions: cell temperature: 80°C, pressure: 1500 mbar, flow at both sides: 400 ml/min.
- Membrane electrode assembly (MEA): membrane Nafion®-111-IP, Pt loading: 0.3 mg/cm², gas diffusion media (GDL): 35 BC Sigracet.
- A home-made DLR test bench with PLC control, a segmented bipolar plate based on printed circuit board (PCB) technology[2].

Results

Drying process

At time t=0, dry gases with RH of 0% are introduced. The same flow value is imposed for the anode and cathode. In these way, the water uptake of dry gasses is the same at both sides.

Current density evolution plots, figure 1, show the reduction of the local current density (blue line), starting at the cathode inlet.

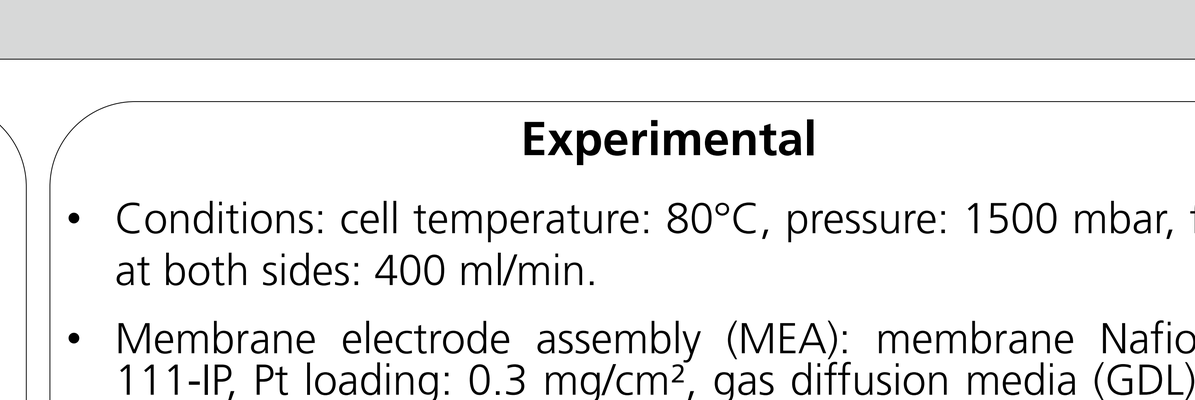
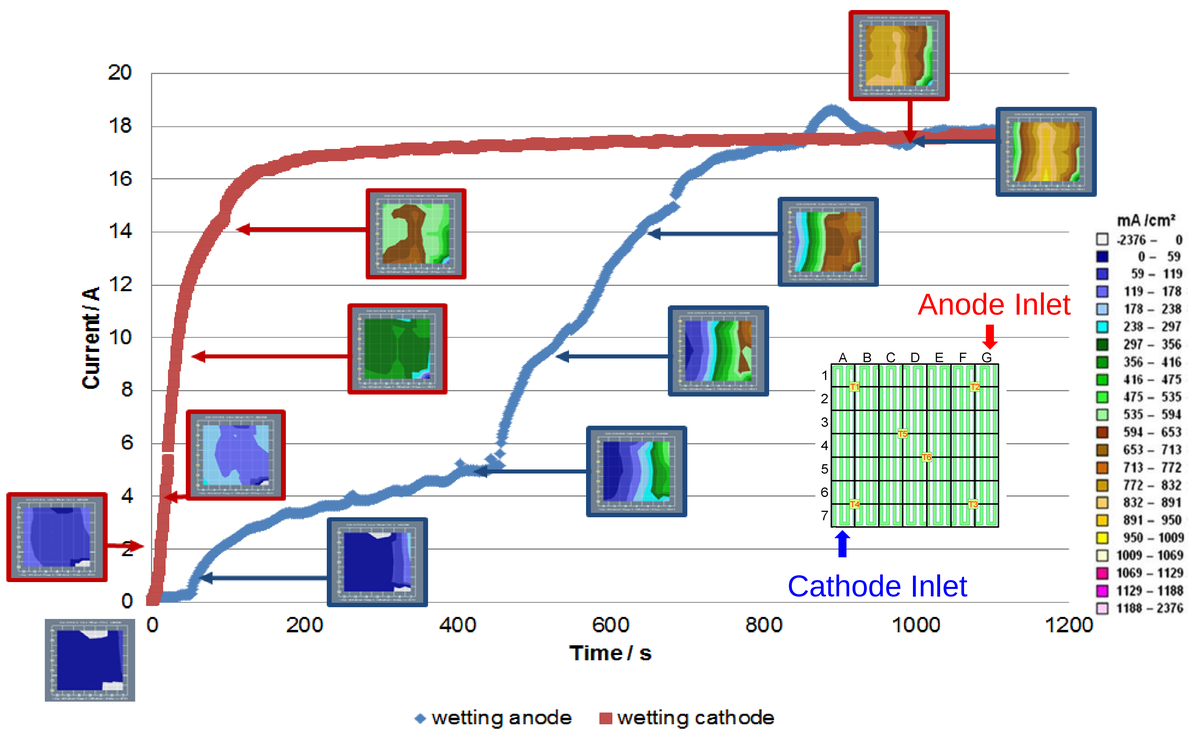


Figure 1: Current densitiy evolution during drying process, 9.5 A constant current.

Wetting process at anode or cathode side



Initial condition is a dry cell. At time t=0, the relative humidity at one of the side is changed to 100%.

There are some differences in the cell response depending on the hydration of the cell compartment cathode or anode. The hydration of the cathode involve a faster cell response and an uniform surface activation in the cell, red line in figure 2, while the hydration of the anode produces a slower response, and the activation surface shows an activation front starting at the anode inlet, blue line figure 2.

Figure 2: Current density evolution during wetting process, 600 mV voltage constant.

Conclusions

❖ Drying and wetting processes have a greater influence on the cathode side:

- ✓ Cathode side is more sensitive to the drying process; figure1 shows how the deactivation of the current density takes place at the cathode inlet.
- ✓ Cathode side has a faster response to wetting process, figure 2.

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References

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