Oscillation of PEFC under Low Cathode Humidification: Effect of Gravitation and Bipolar Plate Design

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Oscillatory fluctuations of a single proton exchange membrane fuel cell appear upon operation with a dry cathode air supply and a fully humidified anode stream. Periodic transitions between a low- and high-current operation point of the oscillating state due to the balance of drying and wetting processes in combination with water transport have been observed previously[1-3]; however, several new aspects have been investigated in the present study, providing insight into the initiation processes.

Oscillations are present under both galvanostatic and potentiostatic conditions, and it is demonstrated that the transitions involve local membrane drying through the comparison of impedance data with current density distributions. The oscillations are caused by periodic flow type changes from one- to two-phase flow in the anodic channels[4] of the flow field.

It has been observed that cell orientation with respect to Earth's gravity field affects the liquid water distribution[5] in the anodic flow channels and, thus, also affects the oscillatory behavior of the cell performance.

When comparing cell performance oscillations with a five-channel serpentine flow field to a cell with a one-channel serpentine flow field, the oscillating performance behavior is observed to also be affected by the gas velocity within an anodic flow channel.

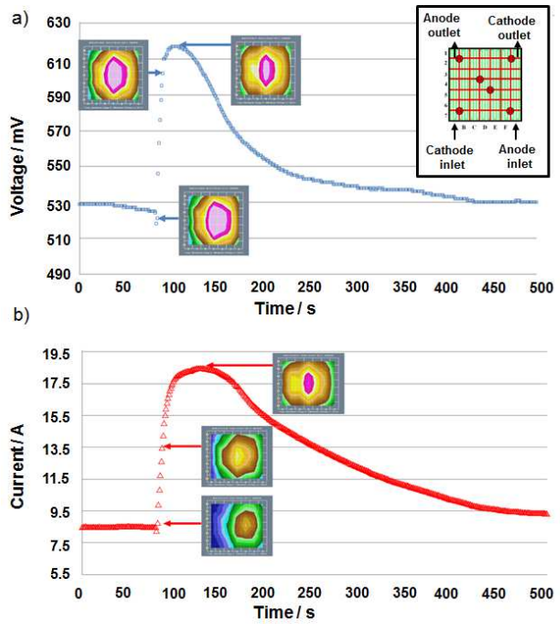

Figure 1 a) Galvanostatic operation at 20 A and b) potentiostatic operation at 600 mV and the corresponding current density distributions with the operation conditions; Relativity humidity: Anode (H2): 100% Cathode (Air): ca. 5%, Flows: Anode (H2): 209 ml/min, Cathode (Air): 664 ml/min, Cell temperatures :80 °C, Pressure: 1.5 bar.

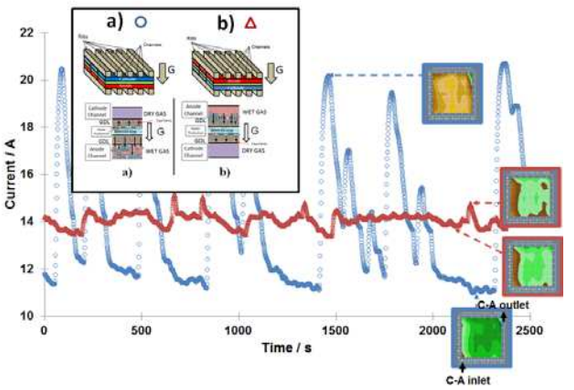

Figure 2 Cell orientation effect with MEAs parallel to the surface plane a) catothe on top (circles) vs. b) anode on top (triangles) under the conditions; Relativity humidity:Anode (H2): 100% Cathode (Air): ca. 5%, Flows:Anode (H2): 209 ml/min, Cathode (Air): 664 ml/min, Cell temperatures :80 °C, Pressure: 1.5 bar in potentiostatic mode: 600 mV.

References

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