

## LONG-TERM TEST OF DK-SOFC CELLS

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A key technological requirement to SOFCs is long-term-stability. With expected lifetime requirements on the order of 40000 hr the tolerable degradation over practical time scales in cell development programs will be very small. This sets very strong demands to the test methodology and instrumentation.

Four Danish cells were tested at different conditions: 1) 0.5  $\text{Acm}^{-2}$  and 50%  $\text{H}_2\text{O}$ -50 %  $\text{H}_2$ ; 2) 0.5  $\text{Acm}^{-2}$  and 5%  $\text{H}_2\text{O}$ -95%  $\text{H}_2$ ; 3) 0.3  $\text{Acm}^{-2}$  and 5%  $\text{H}_2\text{O}$ -95%  $\text{H}_2$ ; 4) OCV and 5%  $\text{H}_2\text{O}$ -95%  $\text{H}_2$ . All cells were tested at 850 °C and were kept at the specified conditions for 1000 hr. or more.

The performance of the cells decreased between 0.7 and 4.7% over 1000 hr at constant conditions (see table I). The highest degradation was observed for the cell tested with the highest water vapor pressure and the highest current load. The performance decreased initially by 4% within approximately 100 hr and then the degradation rate leveled off (see Figure 1). After 1000 hr. under constant conditions, the cell performance had degraded by 4.7%. Microscopy revealed that Ni particles are coarsening during test and that there is a Ni depletion in the anode support. This may explain a part of the degradation, which is in accordance with literature (1,2). However, a part of the degradation may be in the auxiliary components of the test set-up.

In the used test set-up (3) the cell is sandwiched between two alumina blocks. Air and fuel gas is distributed to the cathode/anode through gas distributor plates (CCC and ACC respectively) placed on each side of the cell. The gas distributor plates are good conductors and are in contact with the current collector foils placed on the current and voltage probes. In-plane potential differences in the current collector foils are monitored during test. The in-plane potential difference changes significantly (see Figure 2) over the test but only at the anode side. This is a sign of changes in the current density distribution in the Pt-foil indicating a contact problem at the Pt/ACC interface. Post-test microscopy showed that Ni had partly disappeared from the ACC surface facing the Pt-foil for all tested cells. This is taken to be the explanation of the contact problem at the ACC/Pt interface.

In an an-going test voltage-probes, which have been mounted directly at the ACC and the Pt foil, measures the potential difference directly over the ACC/Pt-foil interface. The measurements reveal that the losses over this interface, after 600 hr. of operation are non-negligible ( $16 \text{ m}\Omega\text{cm}^2$ ) and that the cell voltage decreases simultaneously with the potential difference between ACC and Pt-foil (Figure 3).

It is therefore clear, that a part of the degradation reported in table I occurs at auxiliary components in the test set-up. It is necessary to pay special attention to this point when long-term tests are performed.

## REFERENCES

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**Table I.** Test conditions and performance change

Conditions	P [ $\text{W/cm}^2$ ]	$\Delta P$
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		0h	1000h	[%]
50% $\text{H}_2\text{O}$	0.5 $\text{A/cm}^2$	0.387	0.369	-4.7
5% $\text{H}_2\text{O}$	0.25 $\text{A/cm}^2$	0.274	0.271	-1.1
5% $\text{H}_2\text{O}$	OCV*	0.394	0.388	-1.5
5% $\text{H}_2\text{O}$	0.5 $\text{A/cm}^2$	0.411	0.408	-0.7

\* Performance was calculated from IV-curves at  $I = 0.47 \text{ A/cm}^2$

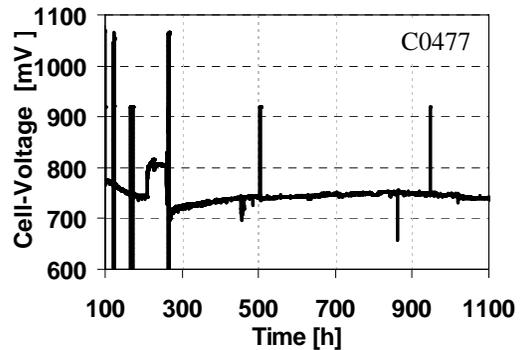


Fig.1. Cell Voltage of the cell tested at 50%  $\text{H}_2\text{O}$  and 0.5  $\text{Acm}^{-2}$  at 850 °C.

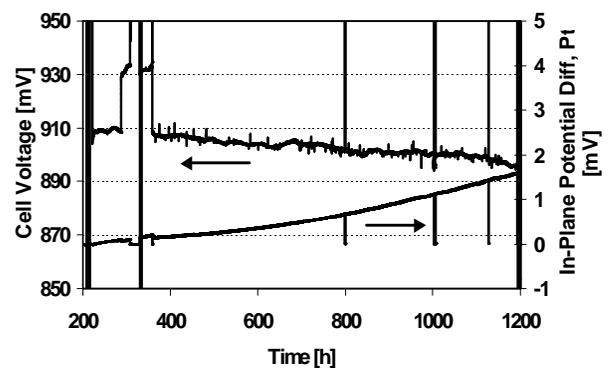


Fig. 2. Cell Voltage and In-plane Potential difference of a cell tested 850 °C, 0.5  $\text{Acm}^{-2}$  and 5%  $\text{H}_2\text{O}$ -95%  $\text{H}_2$  as fuel gas.

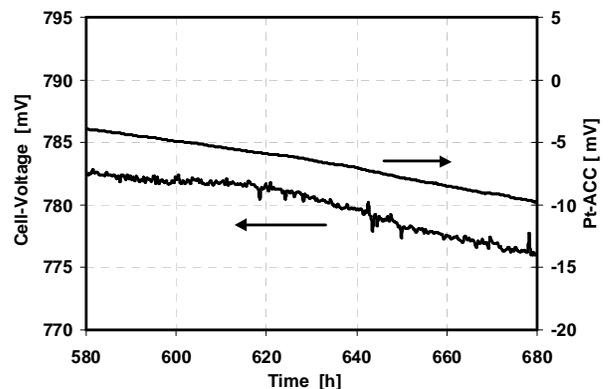


Fig. 3. Simultaneous change in cell-voltage and ACC-Pt potential difference