Long-term performance of PEM fuel cells with dry cathode supply and anodic fuel recirculation

Sönke Gößling

ZBT GmbH
Carl-Benz-Straße 201
47057 Duisburg
Germany

Telefon: +49-203-7598 1171
Telefax: +49-203-7598 2222
www.zbt-duisburg.de
s.goessling@zbt-duisburg.de

Long-term performance of PEM fuel cells with dry cathode supply and anodic fuel recirculation

- the role/Importance of long-term tests
- long-term tests with dry cathode supply and anodic fuel recirculation
- basic structure of the test rig
- historical outline of the long-term tests at ZBT
- test rig improvements; learning the hard way
- latest last long-term test and improvements at ZBT

the role/Importance of long-term tests

- the fuel cell life time is an essential part on its way to a viable product
- the requested lifetime equals the operation time of its application
- the minimal requested lifetime is (no explicit definition/source found)
  - portable applications: 2000 h
  - mobile applications: 4000 h
  - domestic energy supply: 40000 h

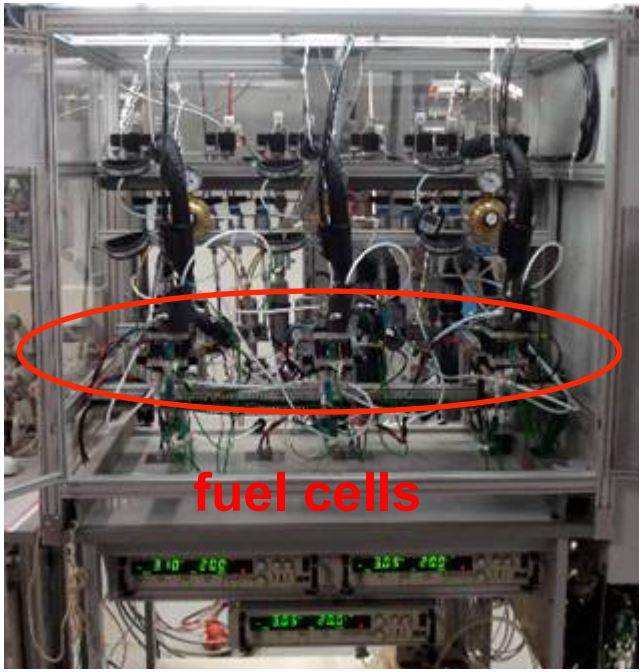
long-term tests with dry cathode supply and anodic fuel recirculation

- In scientific publications long-term performance of PEM fuel cell components is usually presented on the basis of highly sophisticated test environments
- real life applications usually try to reduce the balance of plant components and more often rationalize the humidifier
- for portable and mobile devices the anodic supply is usually realised with a recirculation or dead end and a purge

➔ We do long-term tests with a dry cathode supply and anodic fuel recirculation

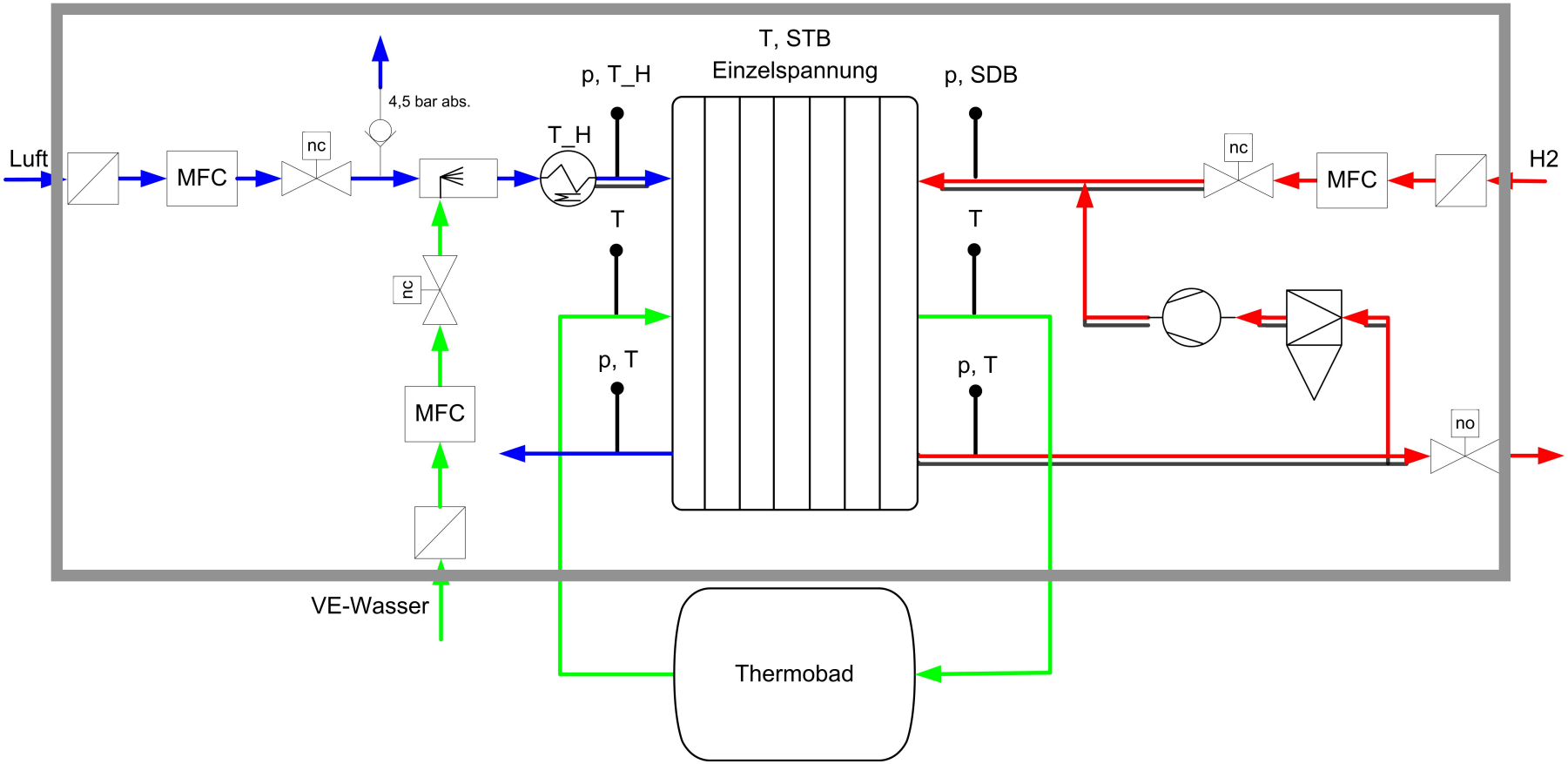
basic structure of the test rig

- long-term test with operating conditions typical for portable devices
- dry cathode supply / anodic recirculation
- weekly online electrochemical impedance spectroscopy
- short stacks of 5 cells
- three stacks with individual media supply
- verified results for long-term tests
- Task: comparing stack components (MEA, gaskets, bipolar plates) or operational topics like media supply independently from any outside influences



basic structure of the test rig

•3x parallel

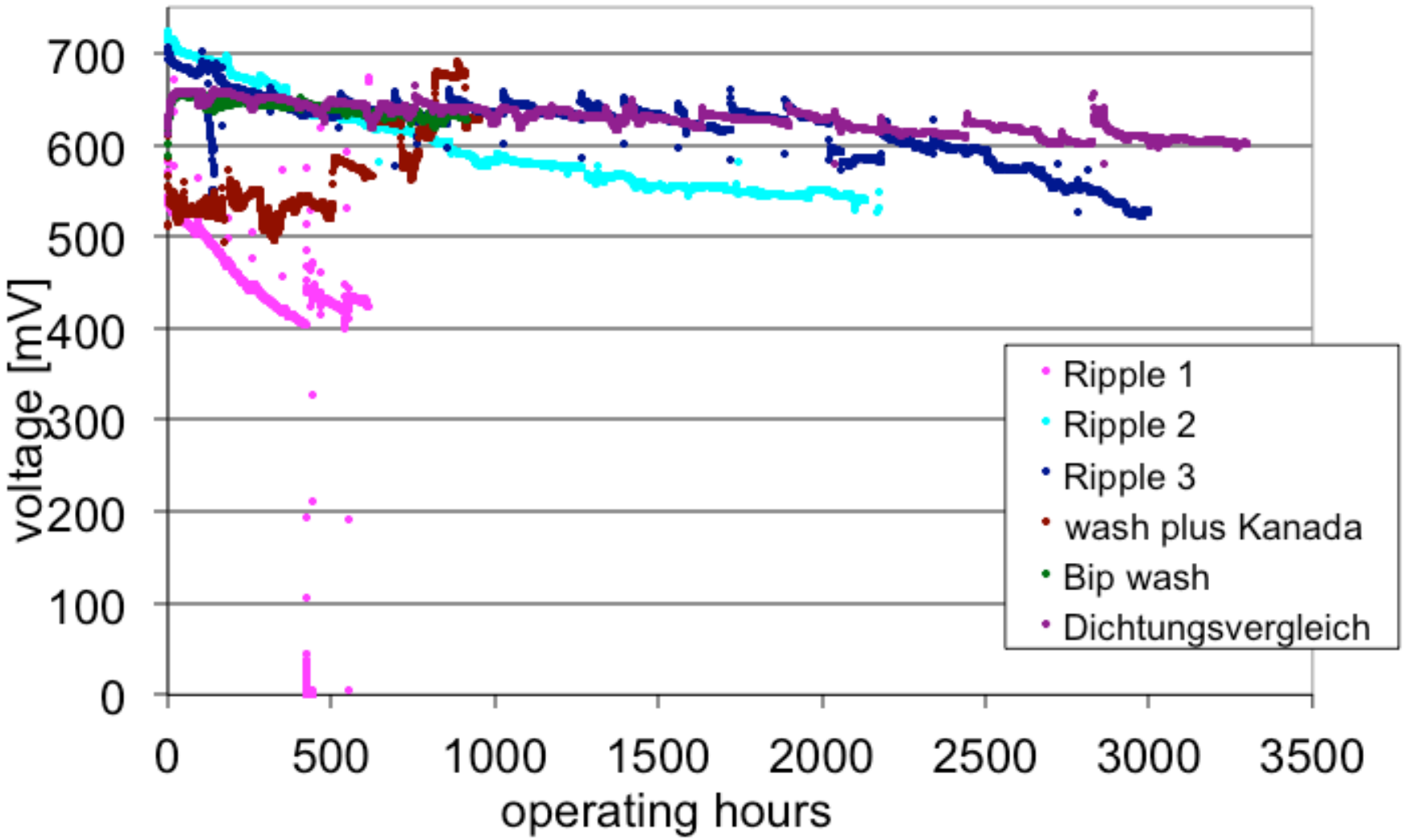


historical outline of the long-term tests at ZBT

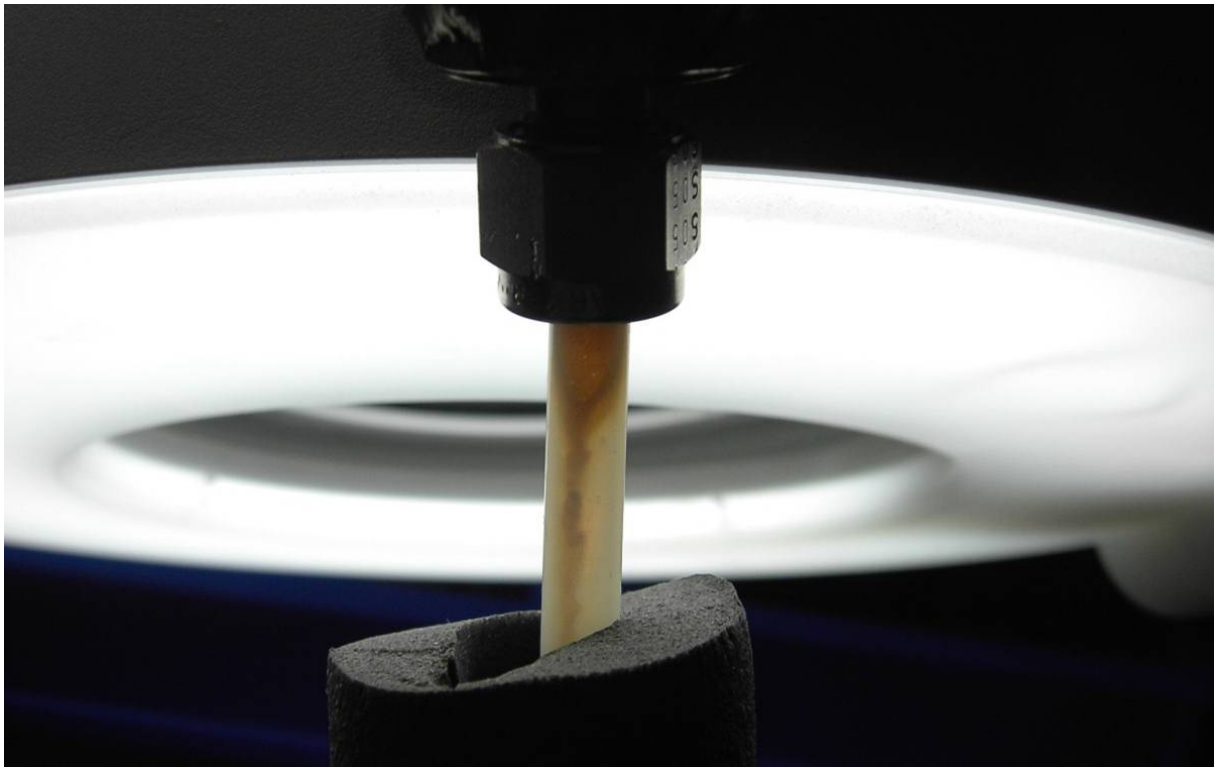
- first long-term test in 2007; the aim were current ripple purposes
- the degradation was to high and made any conclusion impossible
- attempt to reduce the degradation and increase current ripple effect in test #2 & #3
- after the current ripple project, the focus of the test rig changed to degradation of fuel cell and its components
- the parallel operation of three short stacks enables qualitative conclusions, even if the setup of the test rig and environmental conditions change

#	current [mA]	runtime [h]	Degradation [µV/h]	cathod humidity [%]	cathode stochiometry
1	800	612	185.6/284.3	85	2,7
2	400	2133	78.3/75.5	85	5,4
3	400	2999	62.0/45.4	41	1,7
4	400	768	various operatin conditions		
5	400	913	29.7/27.8	0	2,2
6	400	3298	17,2/15,1	0	2,2

historical outline of the long-term tests at ZBT



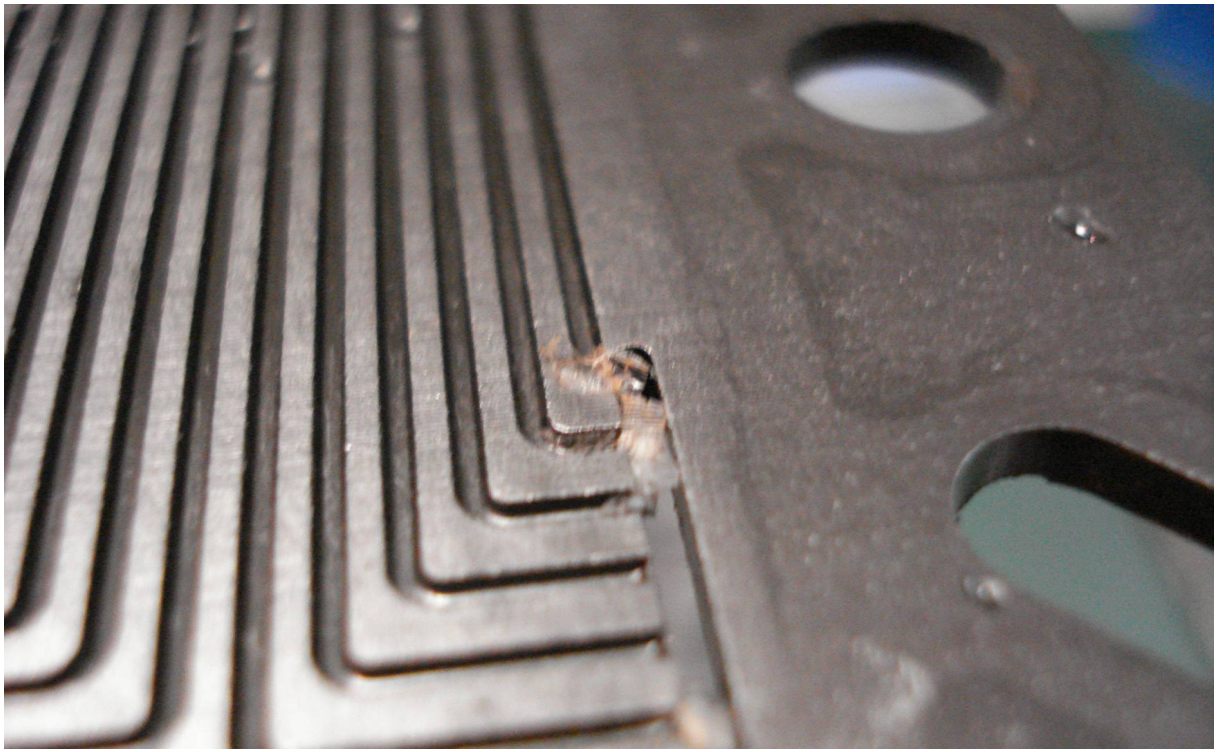
test rig improvements; learning the hard way



rust, caused by stainless steel

parts have been welded and the acid cleaning has been refrained

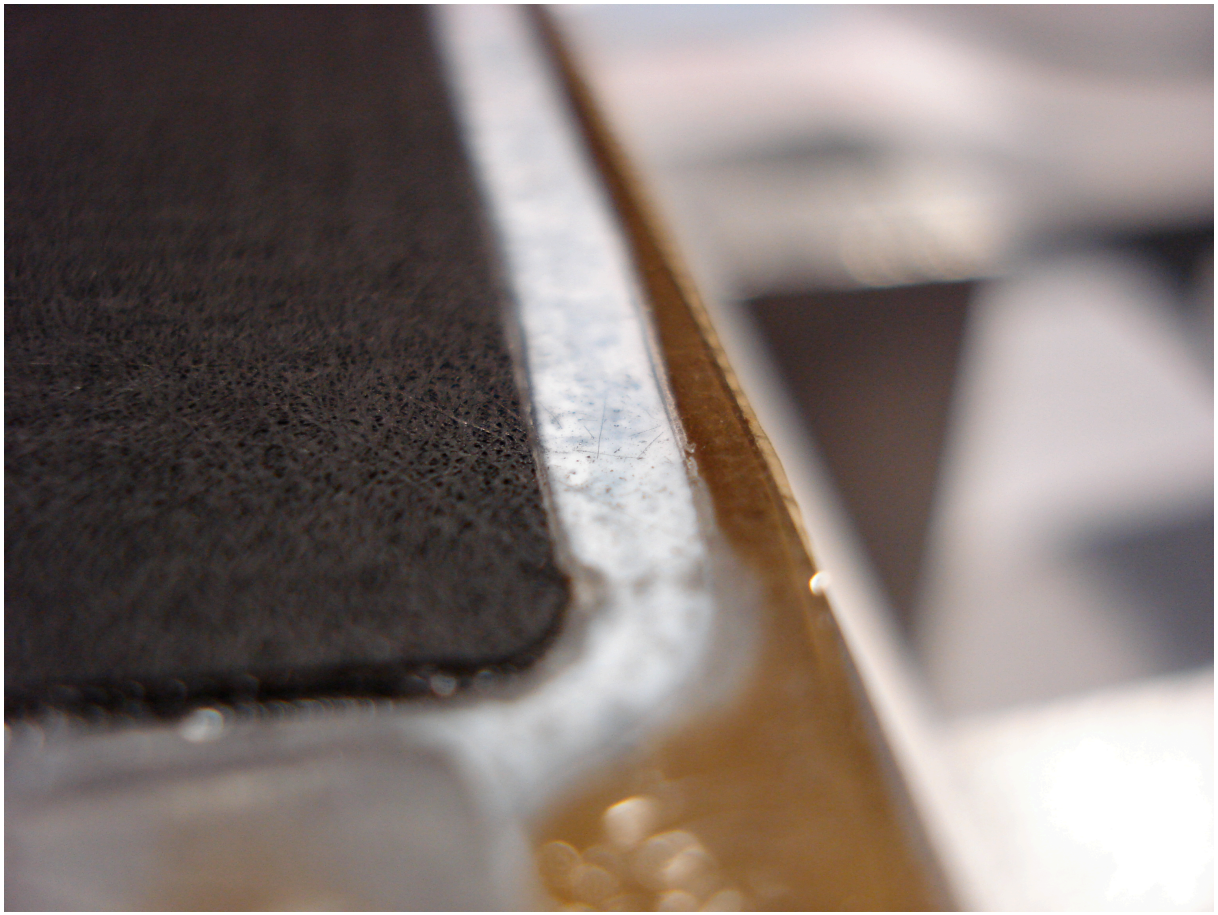
test rig improvements; learning the hard way



blocked flowfield channels

the combination of teflon tubes and quick-couplers cause small shred of teflon that can block single flowfield channels

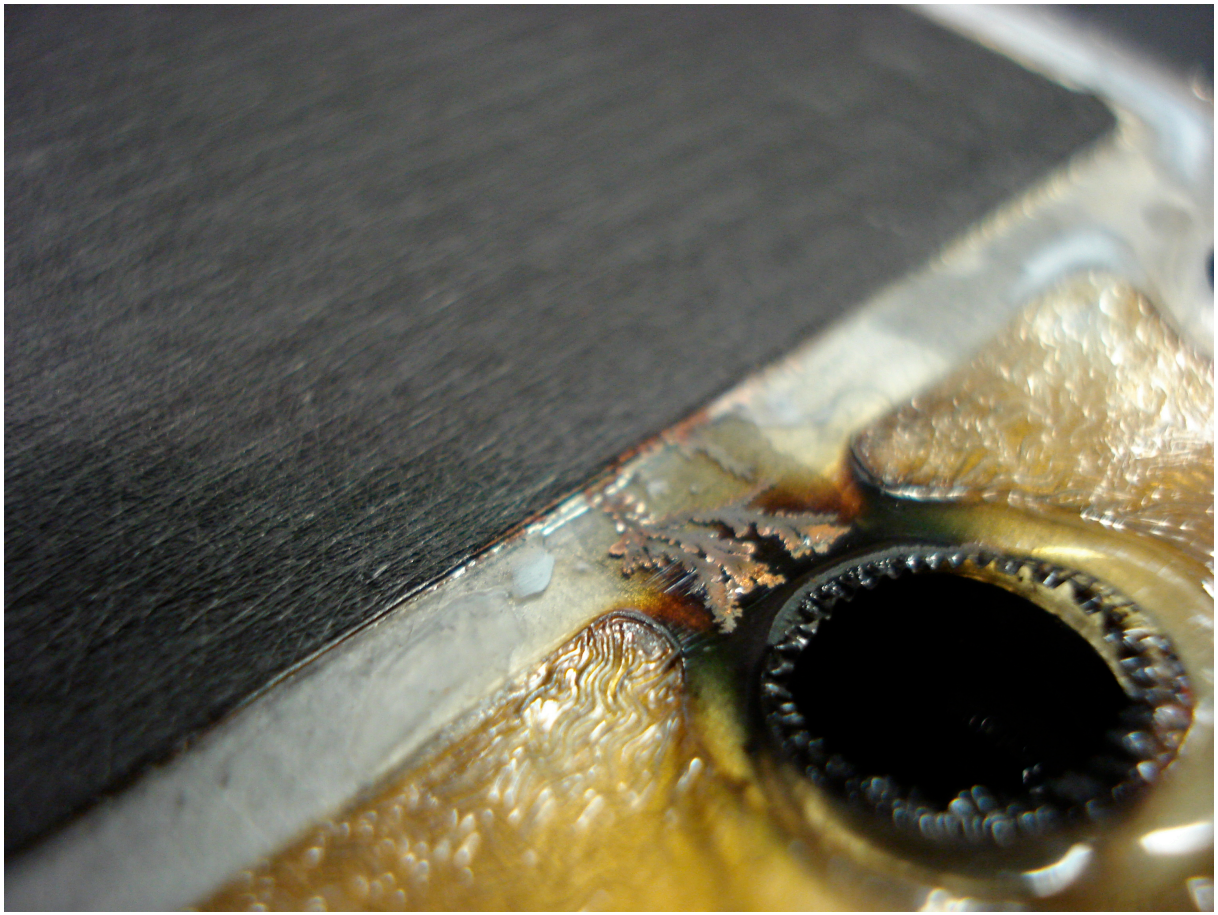
test rig improvements; learning the hard way



rust, caused by stainless steel

parts have been welded and the acid cleaning has been refrained

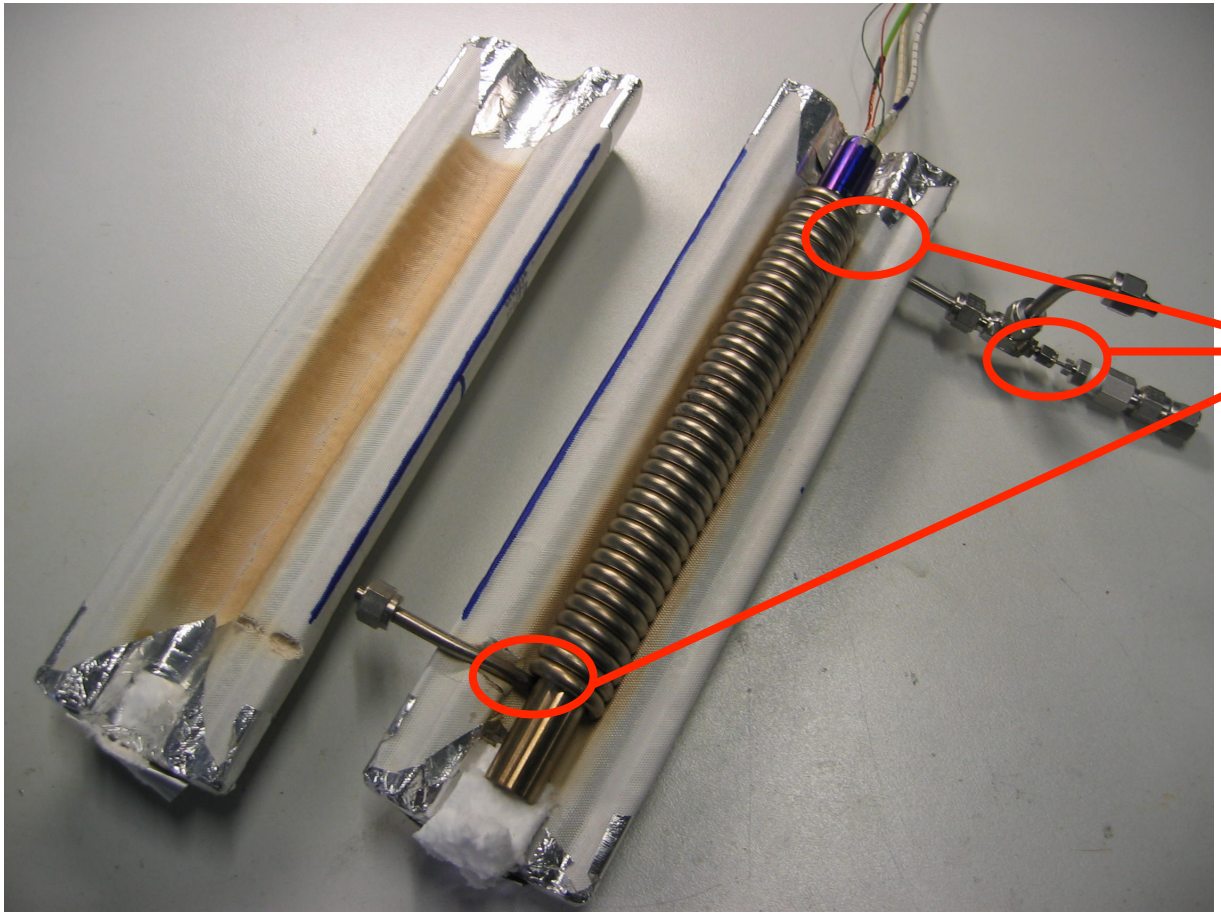
test rig improvements; learning the hard way



rust, caused by stainless steel

parts have been welded and the acid cleaning has been refrained

test rig improvements; learning the hard way



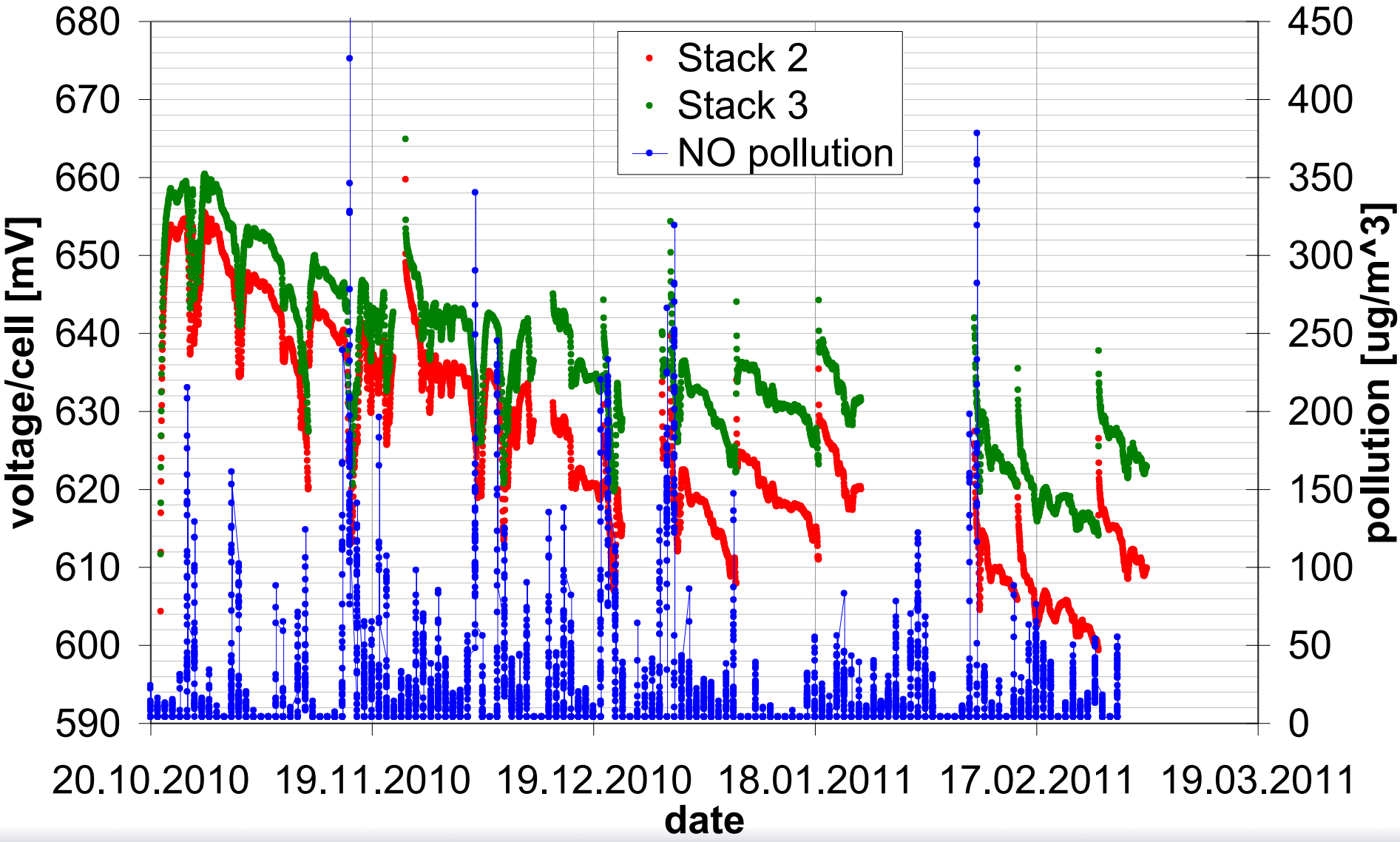
rust, caused by stainless steel

parts have been welded and the acid cleaning has been refrained

test rig improvements; learning the hard way

test rig improvements; learning the hard way

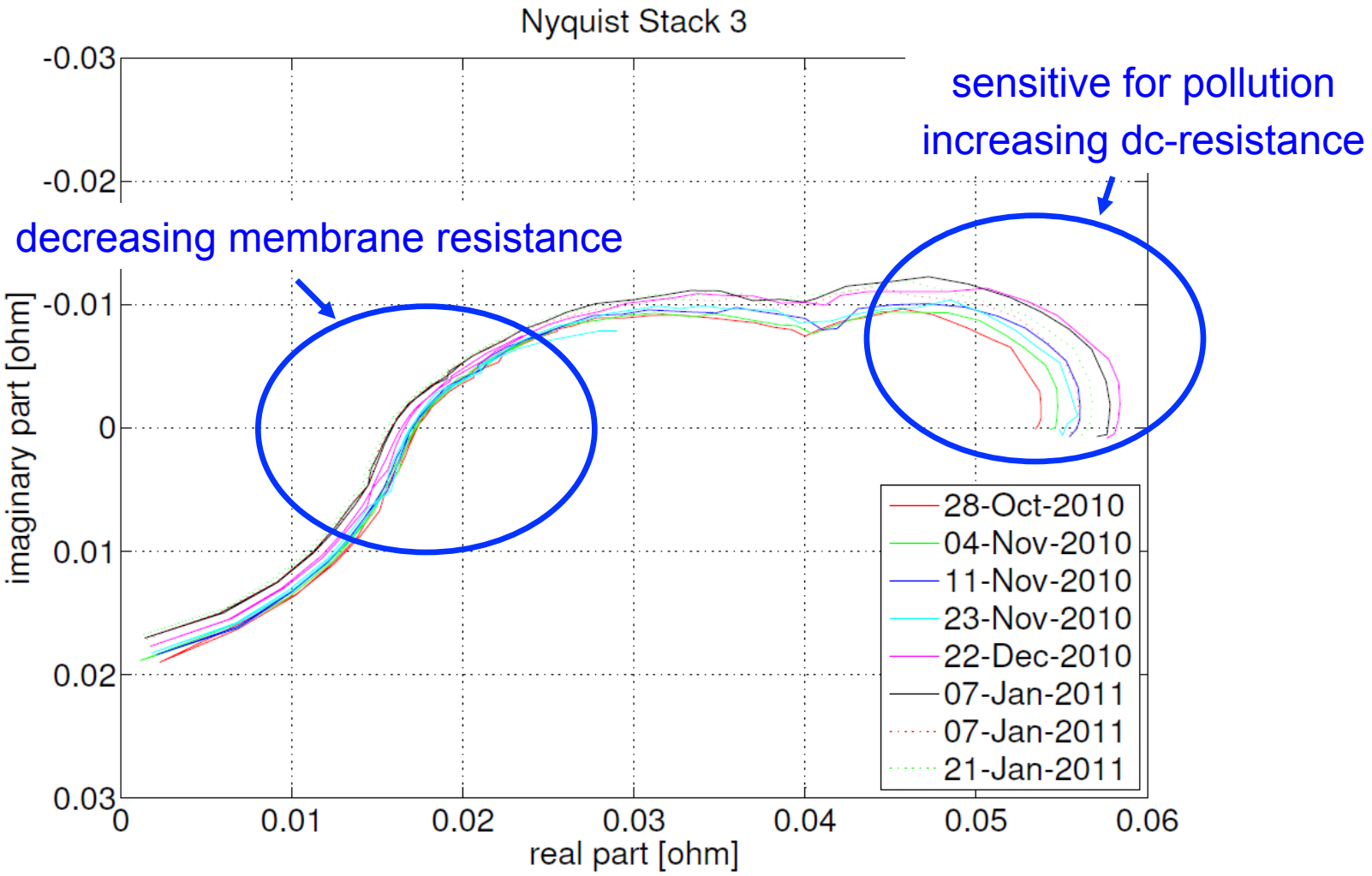
results – the long-term test



latest last long-term test and improvements at ZBT

- Online EIS

latest last long-term test and improvements at ZBT



thank you for your attention

Sönke Gößling

ZBT GmbH
Carl-Benz-Straße 201
47057 Duisburg
Germany

Telefon: +49-203-7598 1171
Telefax: +49-203-7598 2222
www.zbt-duisburg.de
s.goessling@zbt-duisburg.de