Interaction with material surfaces

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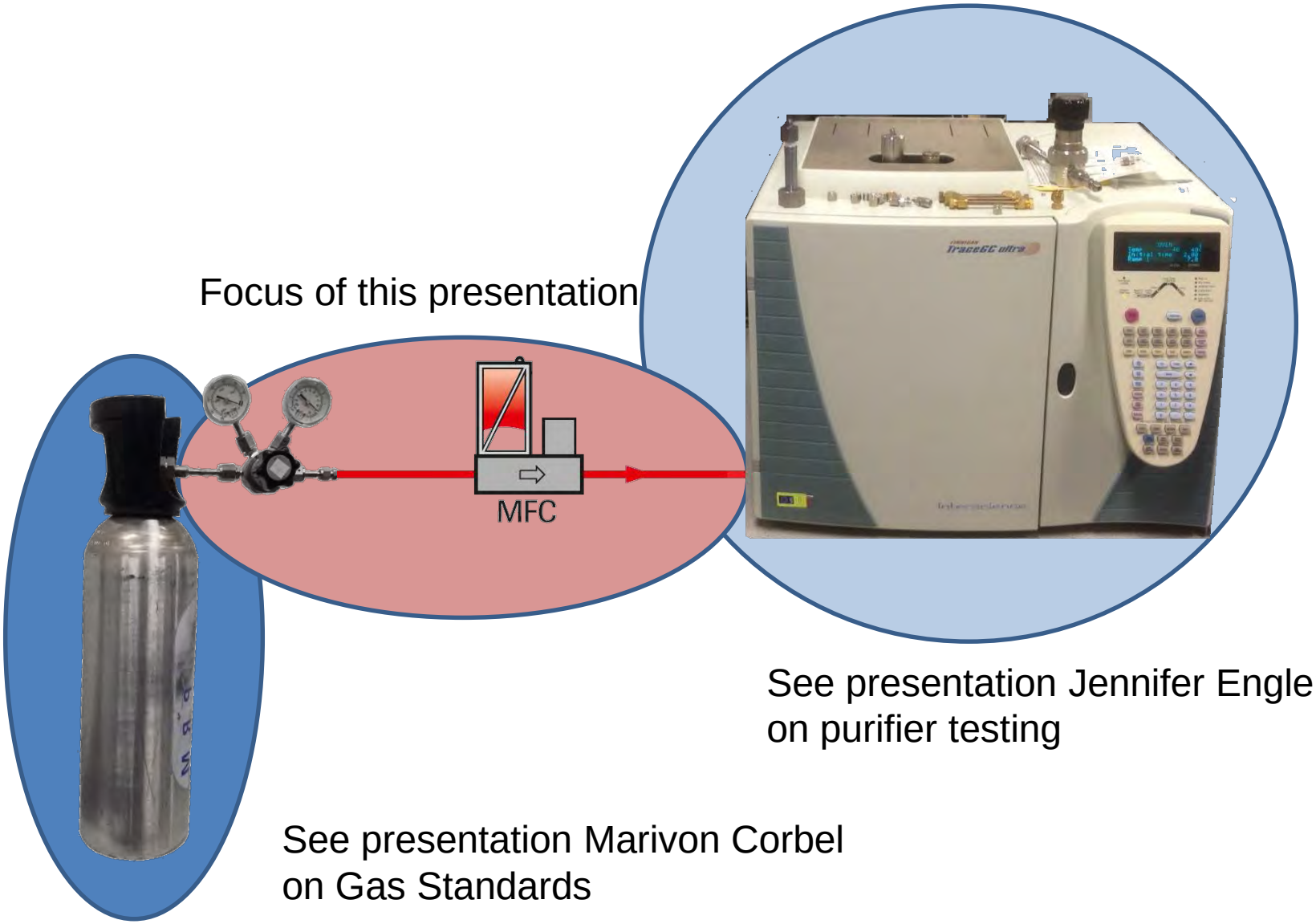
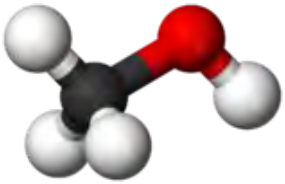
Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

Dutch Metrology Institute

Challenges in measuring VOCs



Approaches to investigate VOC adsorption



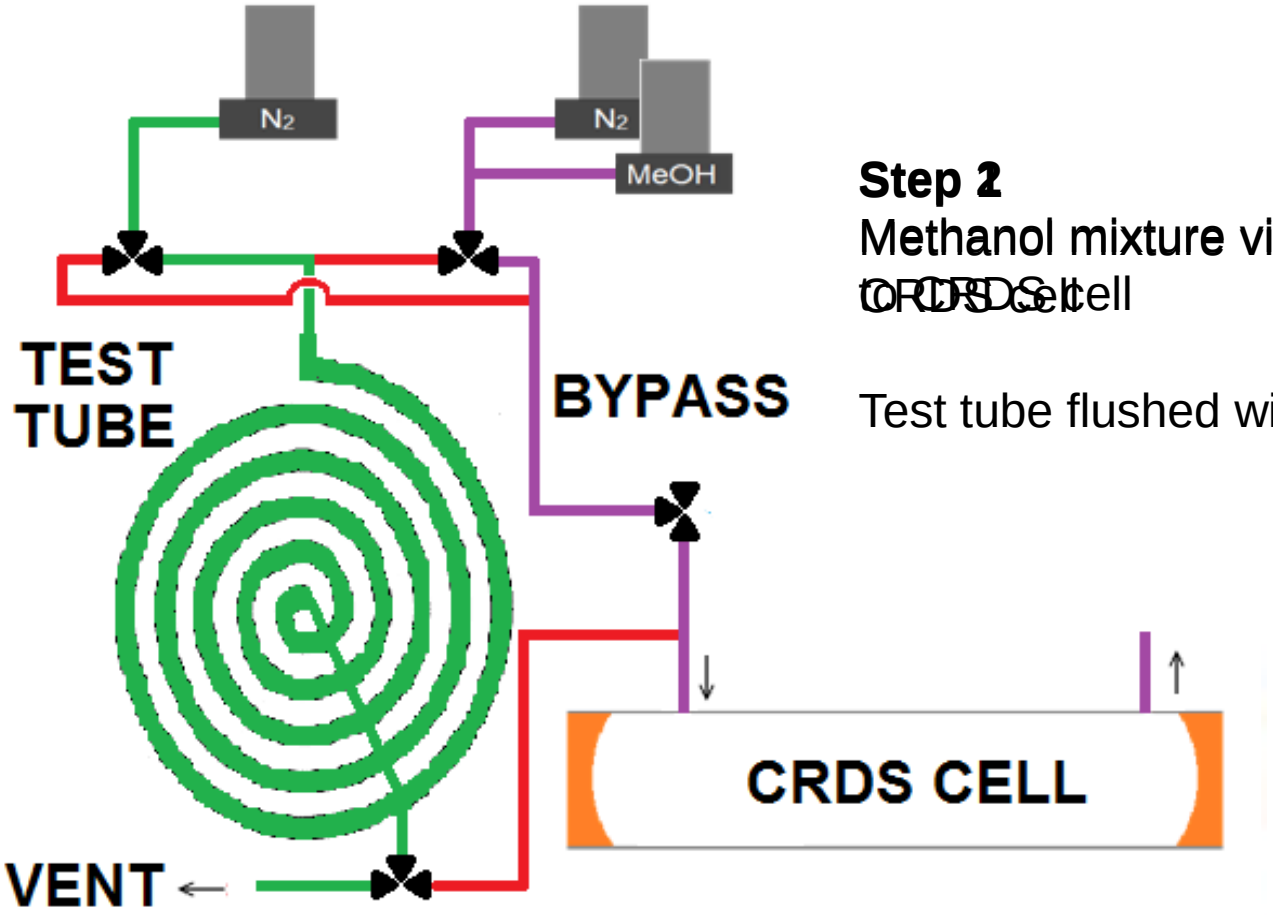
Project partners investigate the adsorption/desorption effect of VOC gas mixtures on various materials used for sampling and dynamic generation:

1) Study adsorption-desorption kinetics in step-change **methanol** concentration tests using GC (DWD) & CRDS (VSL)

2) Characterize chemical speciation on surfaces via x-rays (PTB)

3) Model the adsorption-desorption kinetics (POLITO)

Set-up for measuring the adsorption



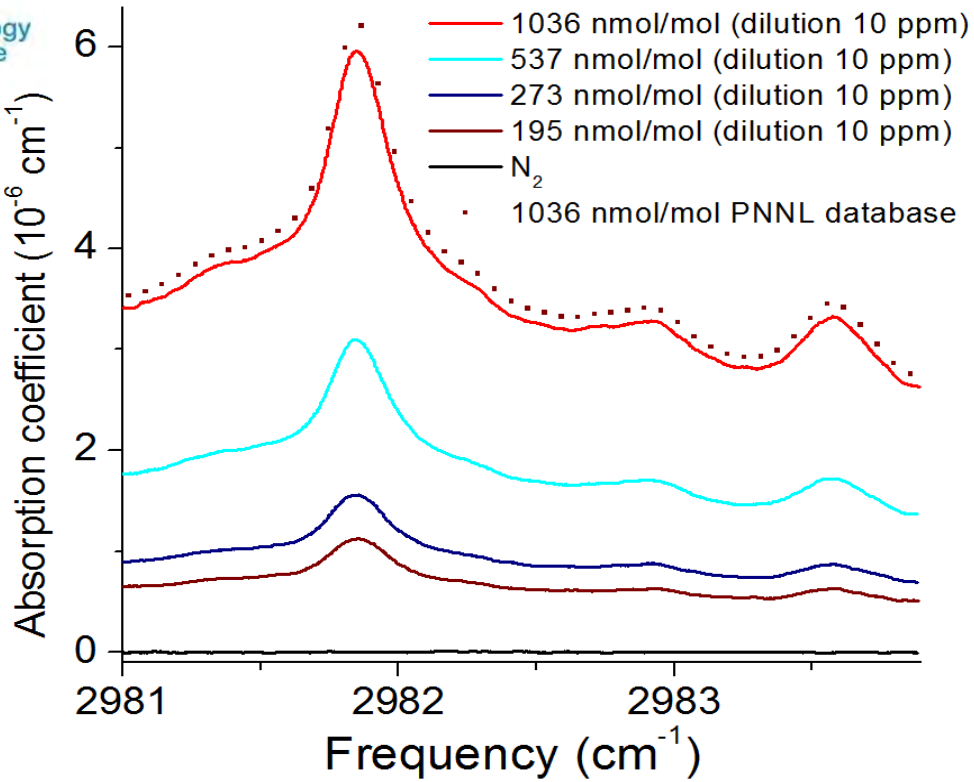
Step 1
Methanol mixture via bypass to CRDS cell

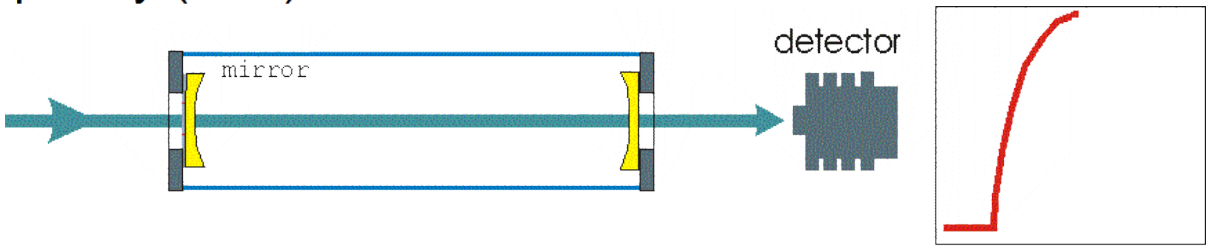
Step 2
Methanol mixture via test tube to CRDS cell

Test tube flushed with N_2

Methanol : ~100-500 nmol/mol
Flow : ~0.2 L/min
Temperature : 20 °C

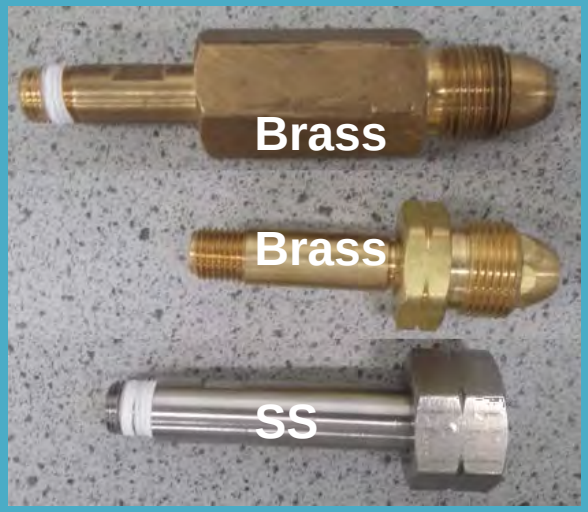
CRDS* spectrometer





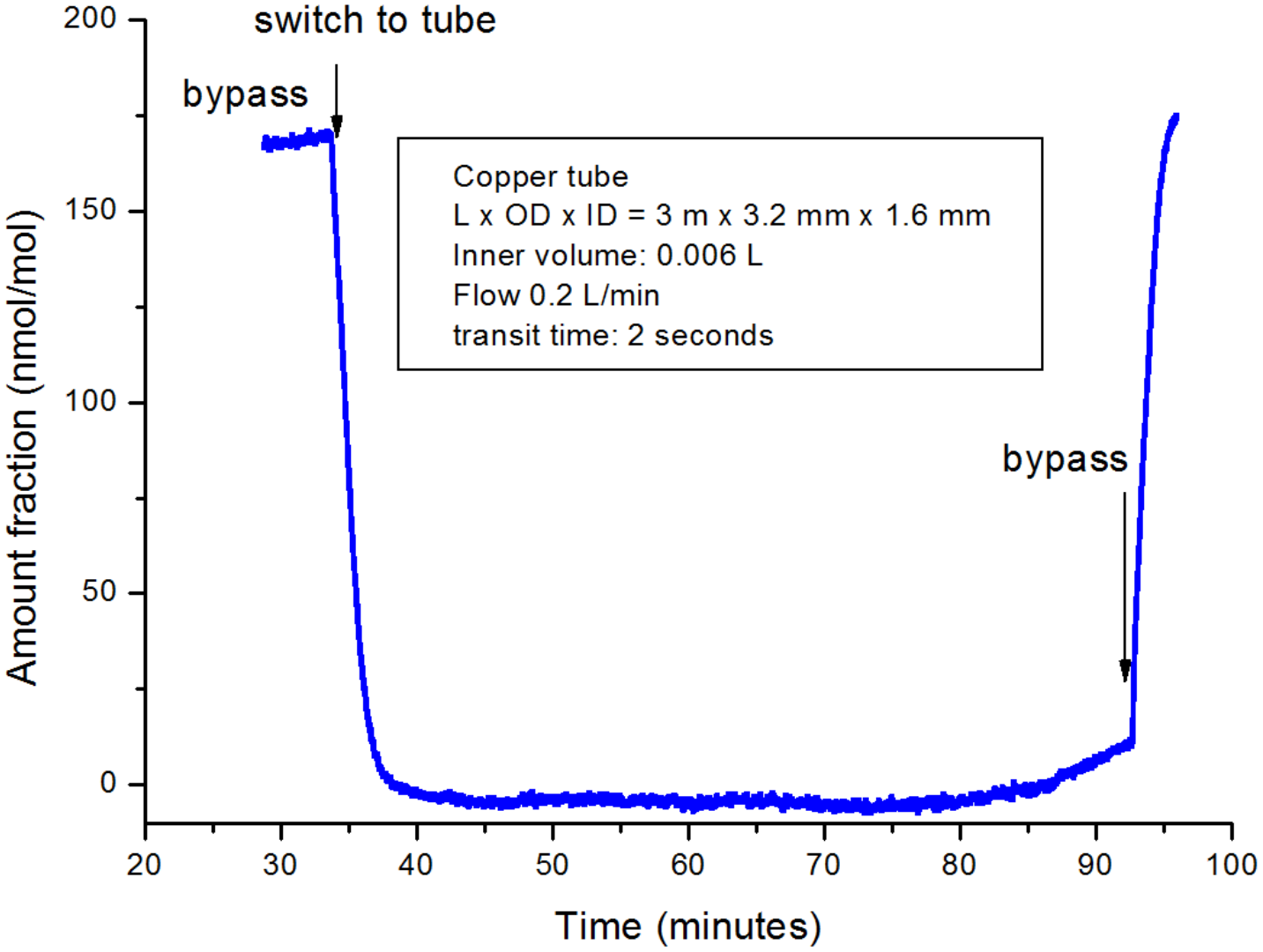
CRDS= Cavity Ring Down Spectroscopy

Tested materials

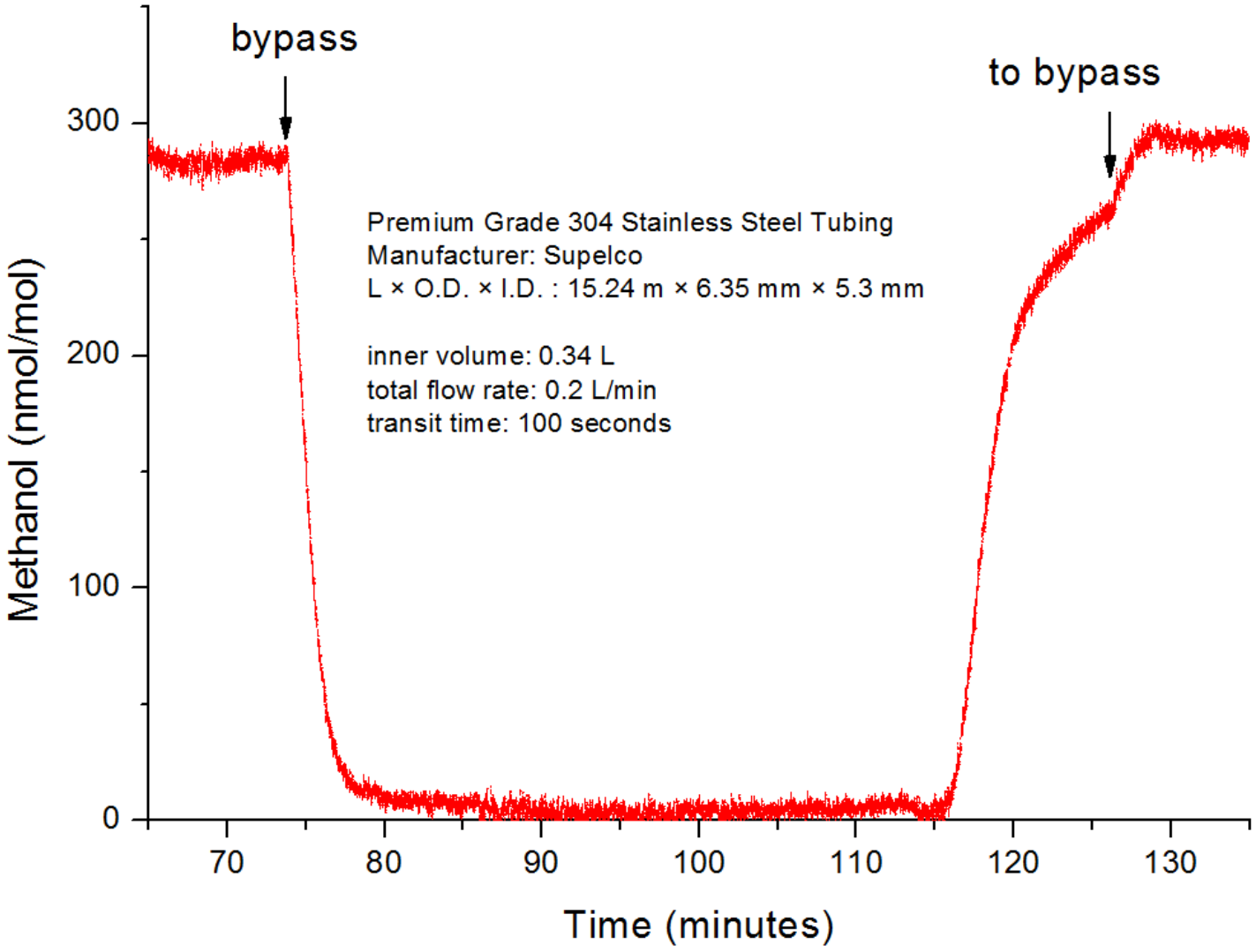


Stainless steel

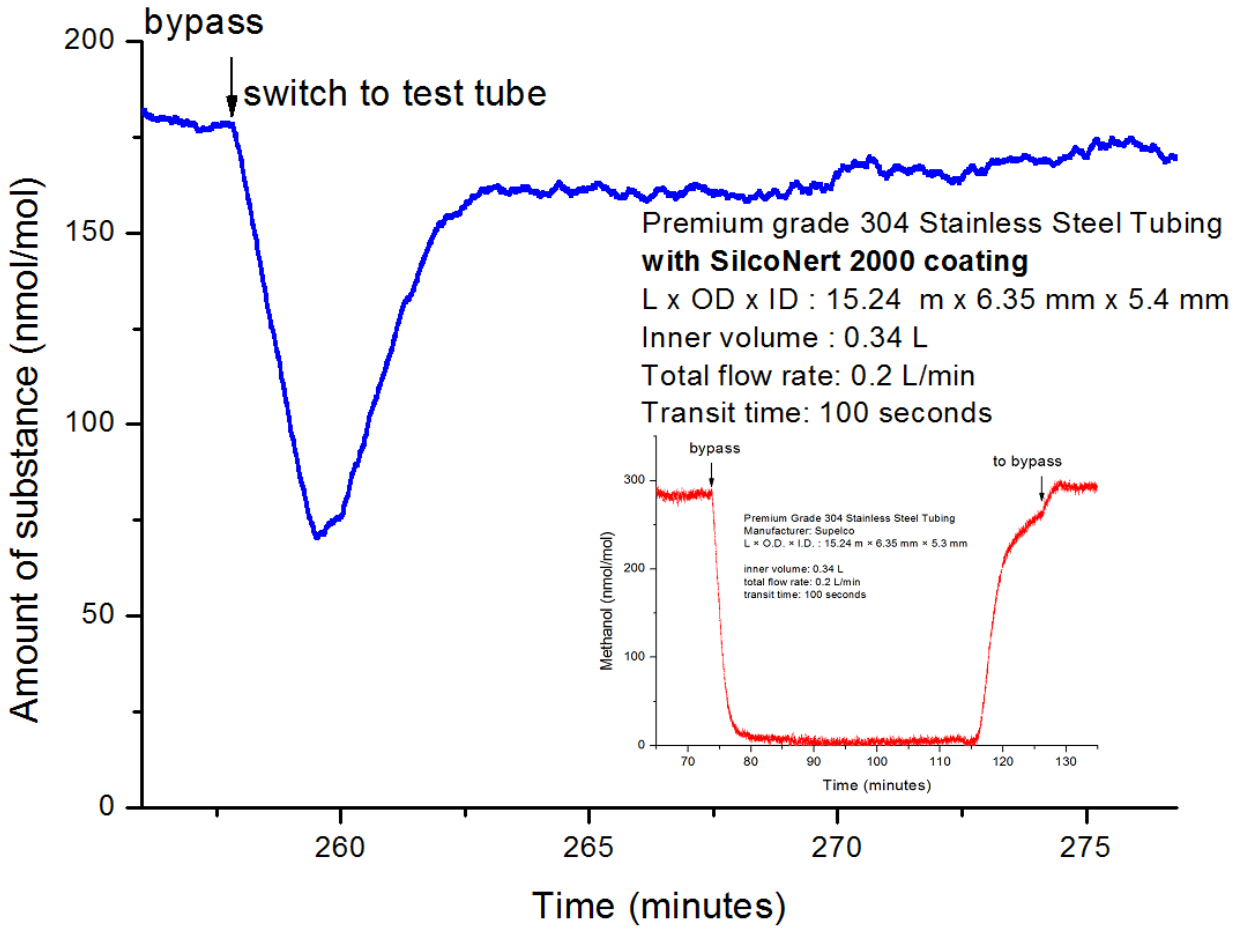
Result Copper



Result Stainless Steel tubing



Result SilcoNert coated Stainless Steel tubing



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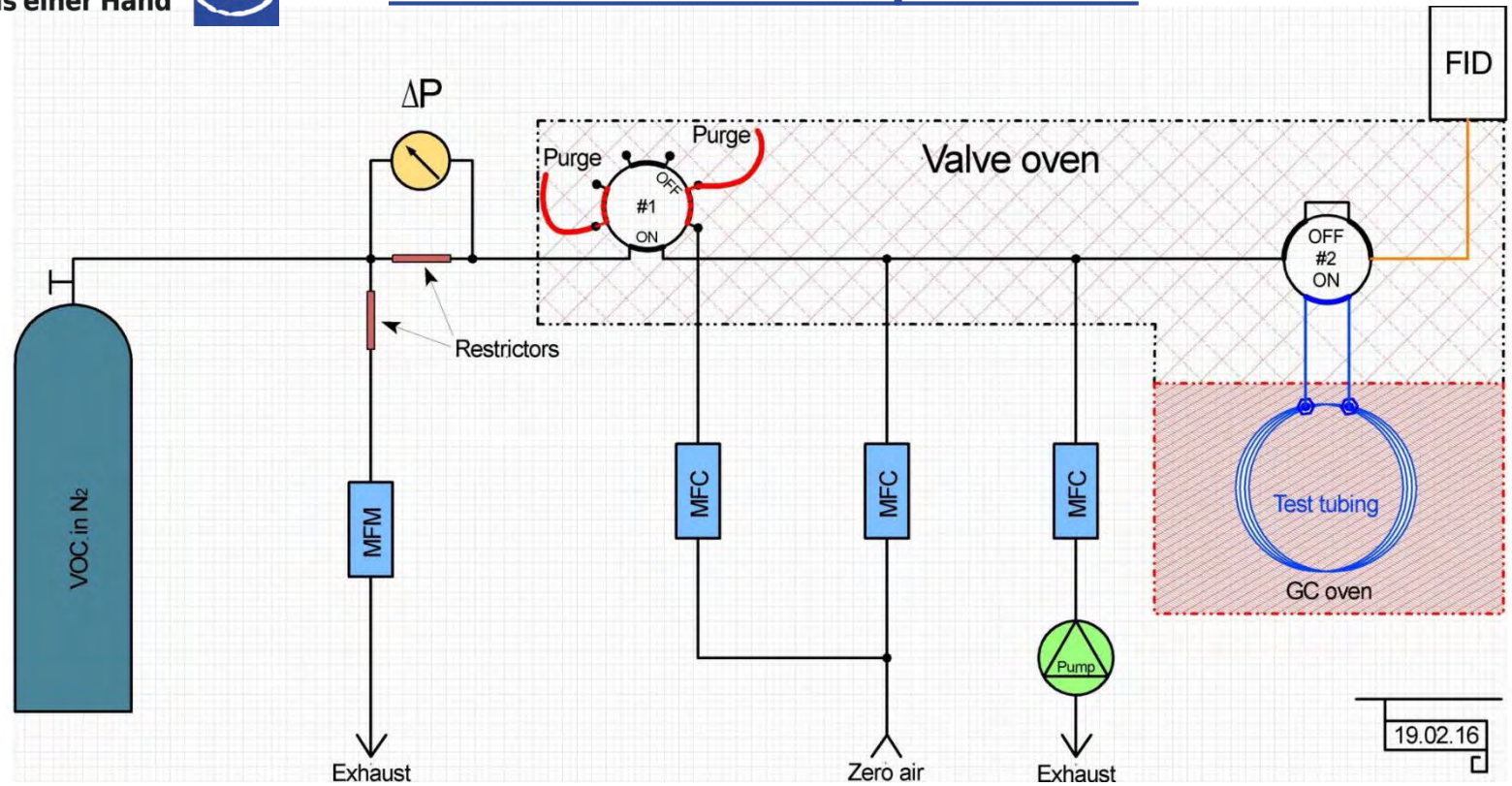
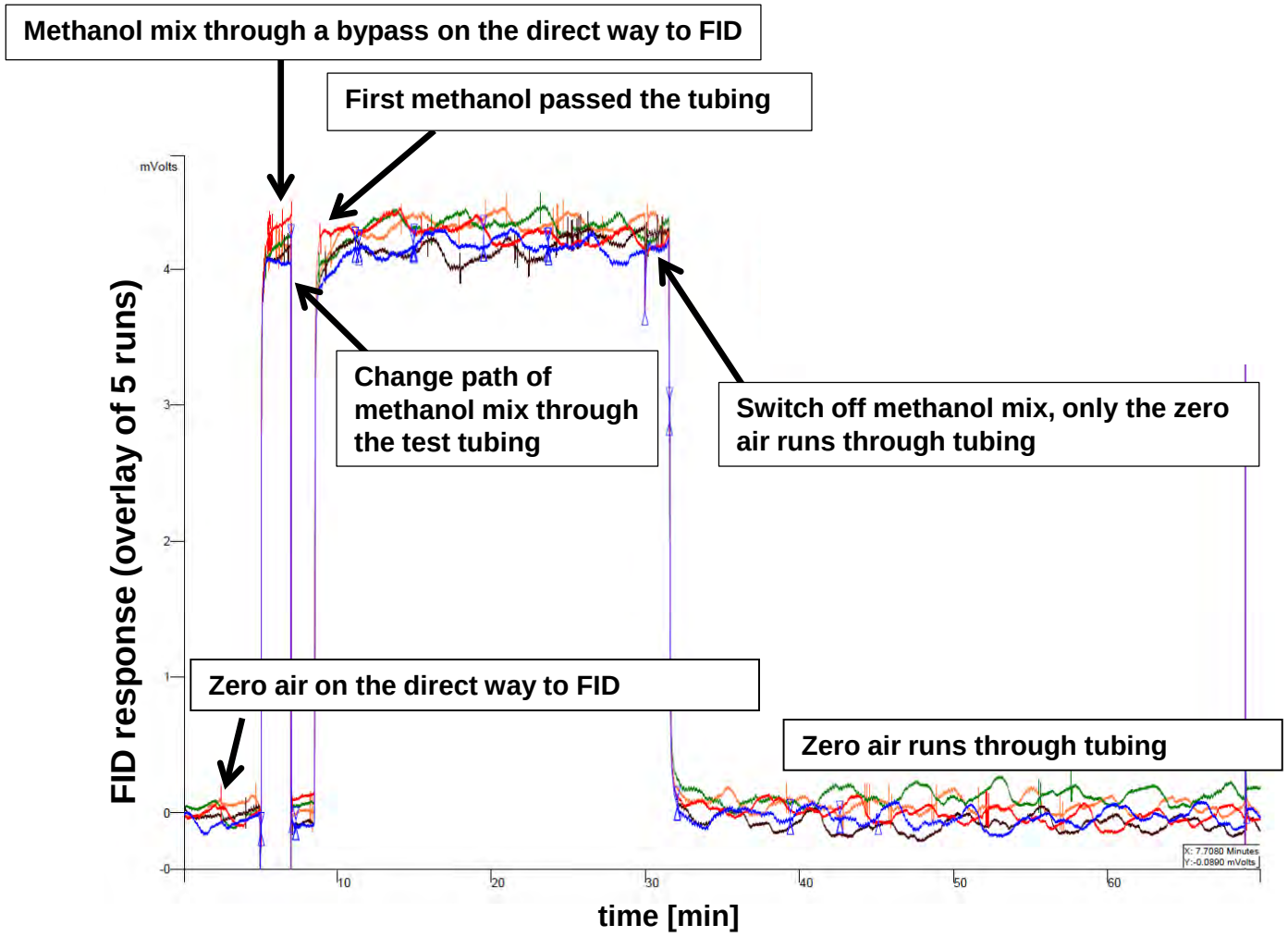
GC-based test set-up at DWD



Test tubings (L=10 m):

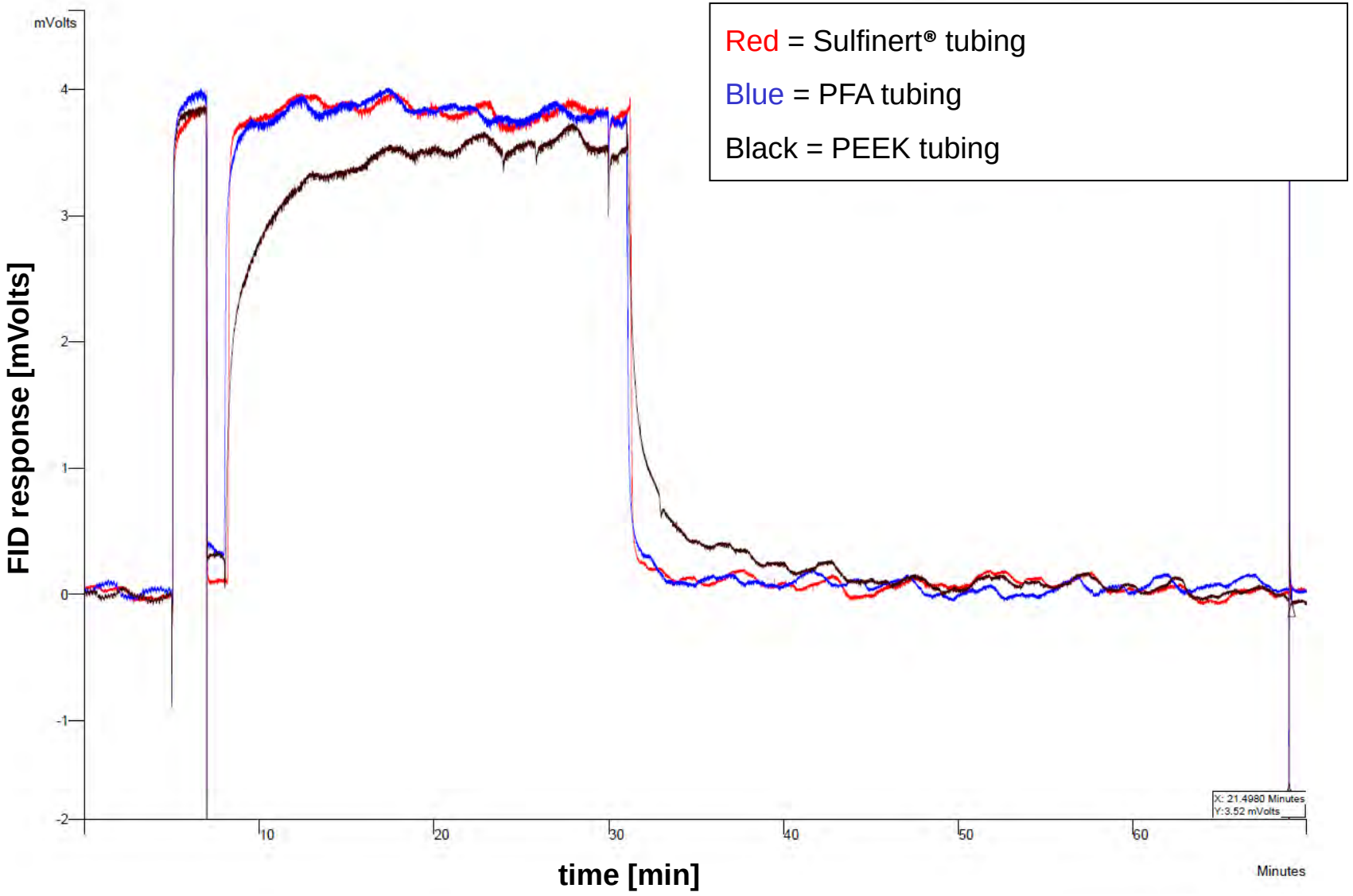
- **Stainless steel 321** (untreated), 1/8‘‘ ID 2 mm
- **Electropolished 316 stainless steel**, 1/8‘‘ ID 2.06 mm,
- **Sulfinert® passivated 304 stainless steel**, 1/8‘‘ ID 2.159 mm
- **Sulfinert® passivated 316 stainless steel**, 1/8‘‘ ID 2.1 mm
- **PFA** tubing, 1/8‘‘ ID 1.58 mm
- **PEEK** tubing, 1/8‘‘ ID 1.59 mm

GC method



Sulfinert® passivated stainless steel

Example results at 50°C tubing temperature



Results of PFA at 50°C and 100°C

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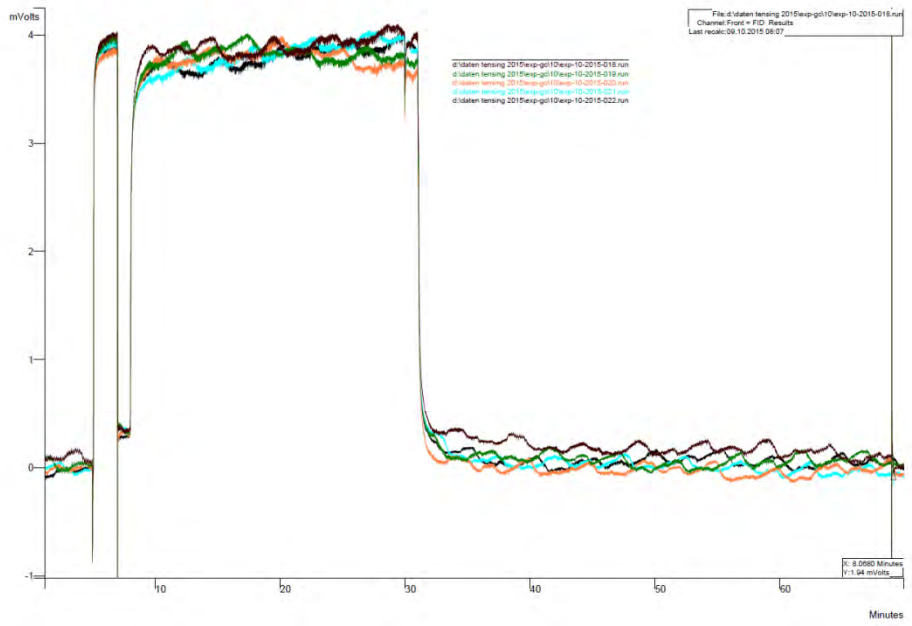
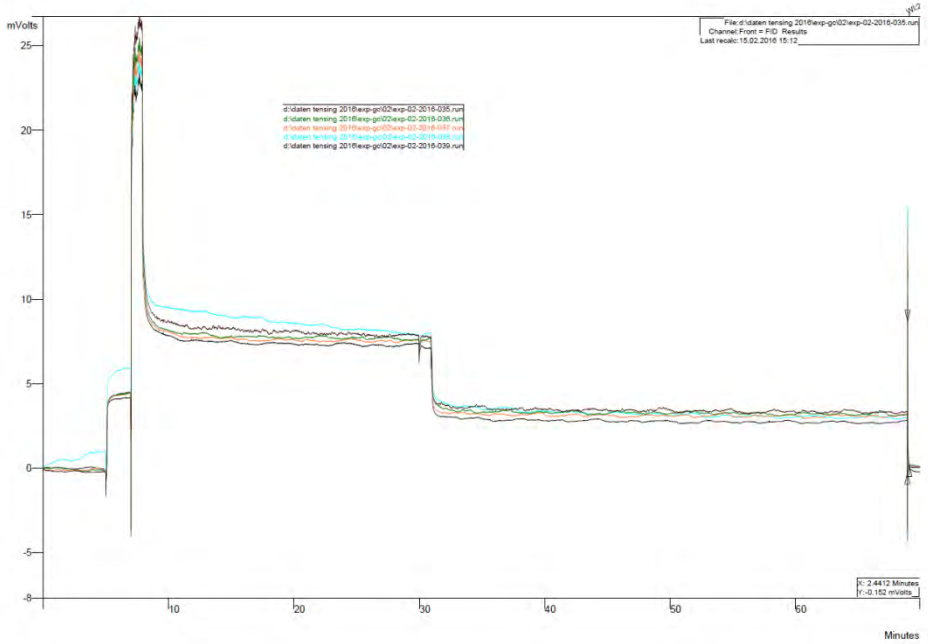
50°C



100°C



Summary results for tubing at 50°C and 100°C

Mole fraction of 3 µmol/mol, flow rate 15 ml/min

Tubings (1/8 inch OD)	50°C results	100°C results
Stainless steel 321 (untreated)	strong adsorption/desorption	no methanol detectable, destruction on the hot surface?
Electropolished stainless steel 316	strong adsorption/desorption	slightly better
Sulfinert® passivated stainless steel 304	no adsorption/desorption	no adsorption/desorption
Sulfinert® passivated stainless steel 316	no adsorption/desorption	no adsorption/desorption
PFA tubing	acceptable, but intensive flushing required	high outgassing of VOCs
PEEK tubing	some adsorption/desorption	some adsorption/desorption, slight outgassing of VOCs