Adsorption of ammonia on metal and polymer surfaces
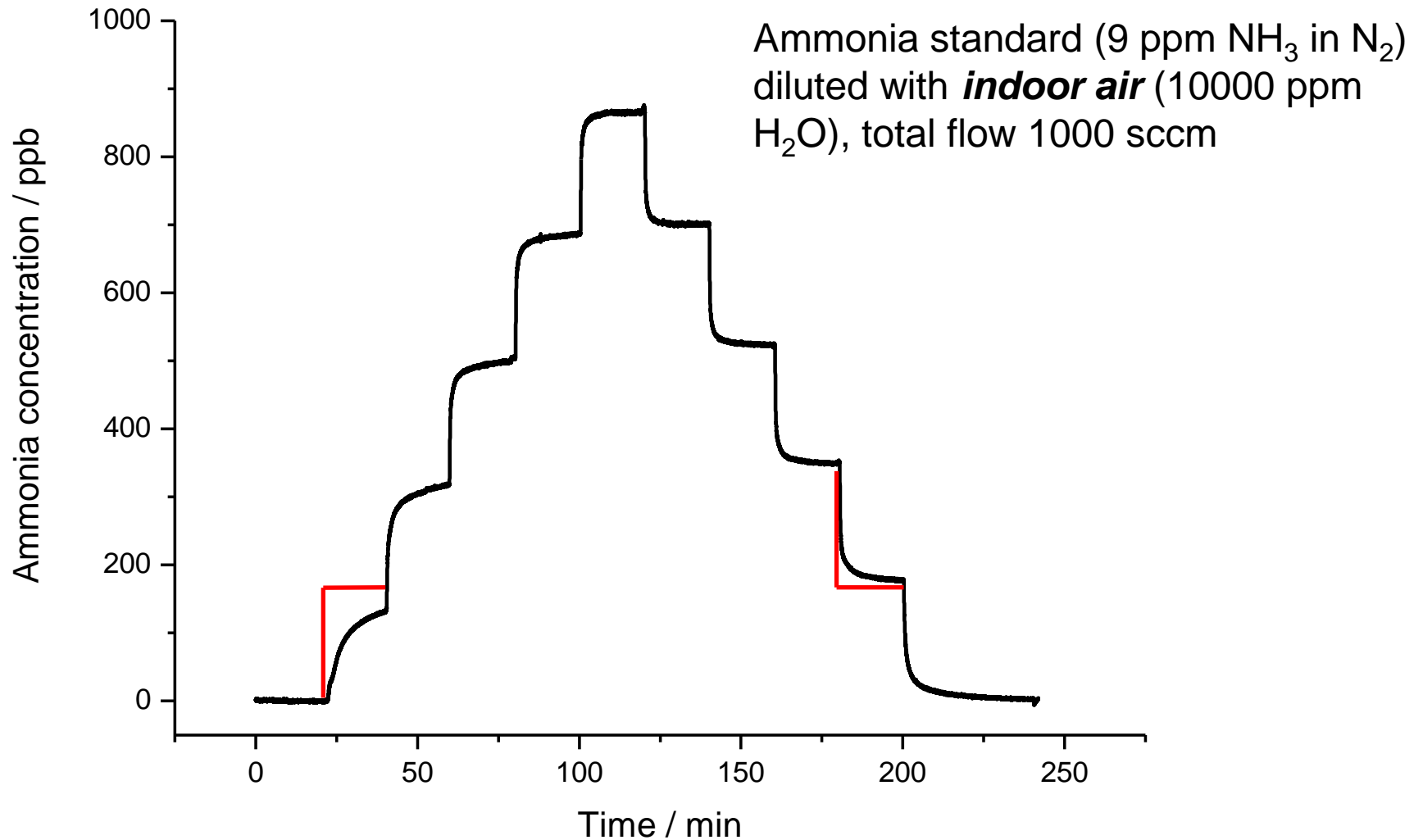
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Ammonia standard (9 ppm NH_3 in N_2) diluted with *indoor air* (10000 ppm H_2O), total flow 1000 sccm

Variables

Test tube coating: stainless steel 316L, electro-polished SS 316L, SilcoNert 1000, SilcoNert 2000, Dursan, PFA, FEP, PTFE, PELD, PVDF

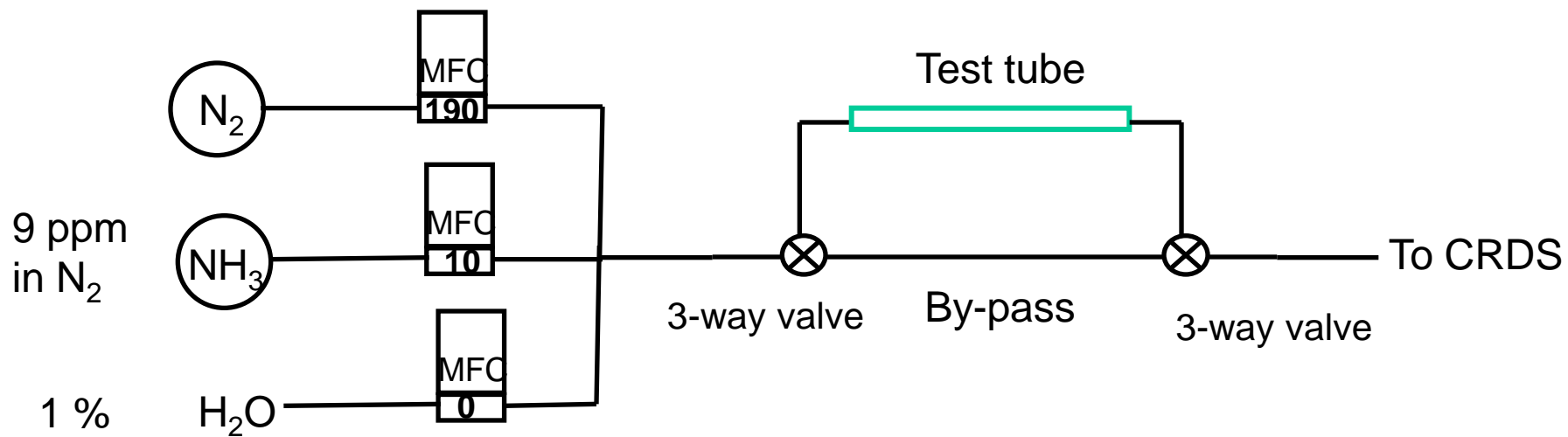**NH$_3$ concentration:** 10 ppb – 9 ppm (400 or 9000 ppb)

Flow rate: 0 – 2000 sccm (200 or 1000 sccm)

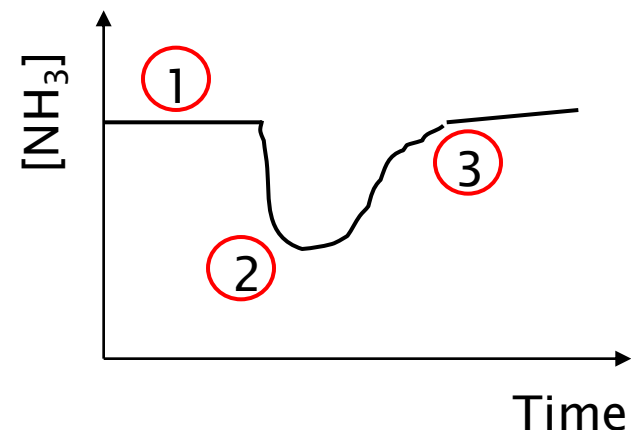**Temperature:** 295 – 333 K (295 K)
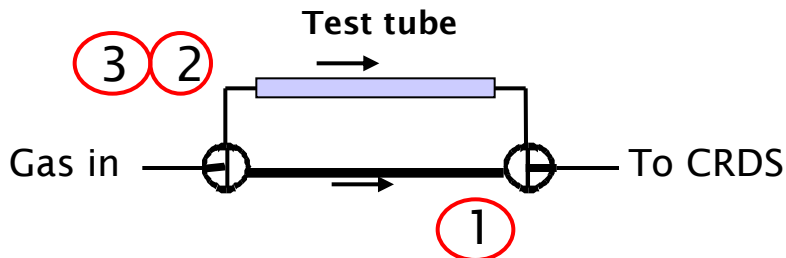
Water content: 0 – 1 % (25 ppm)

Gas generation setup

N₂

NH₃

9 ppm in N₂

1 %   H₂O

MFC
190

MFC
10

MFC
0
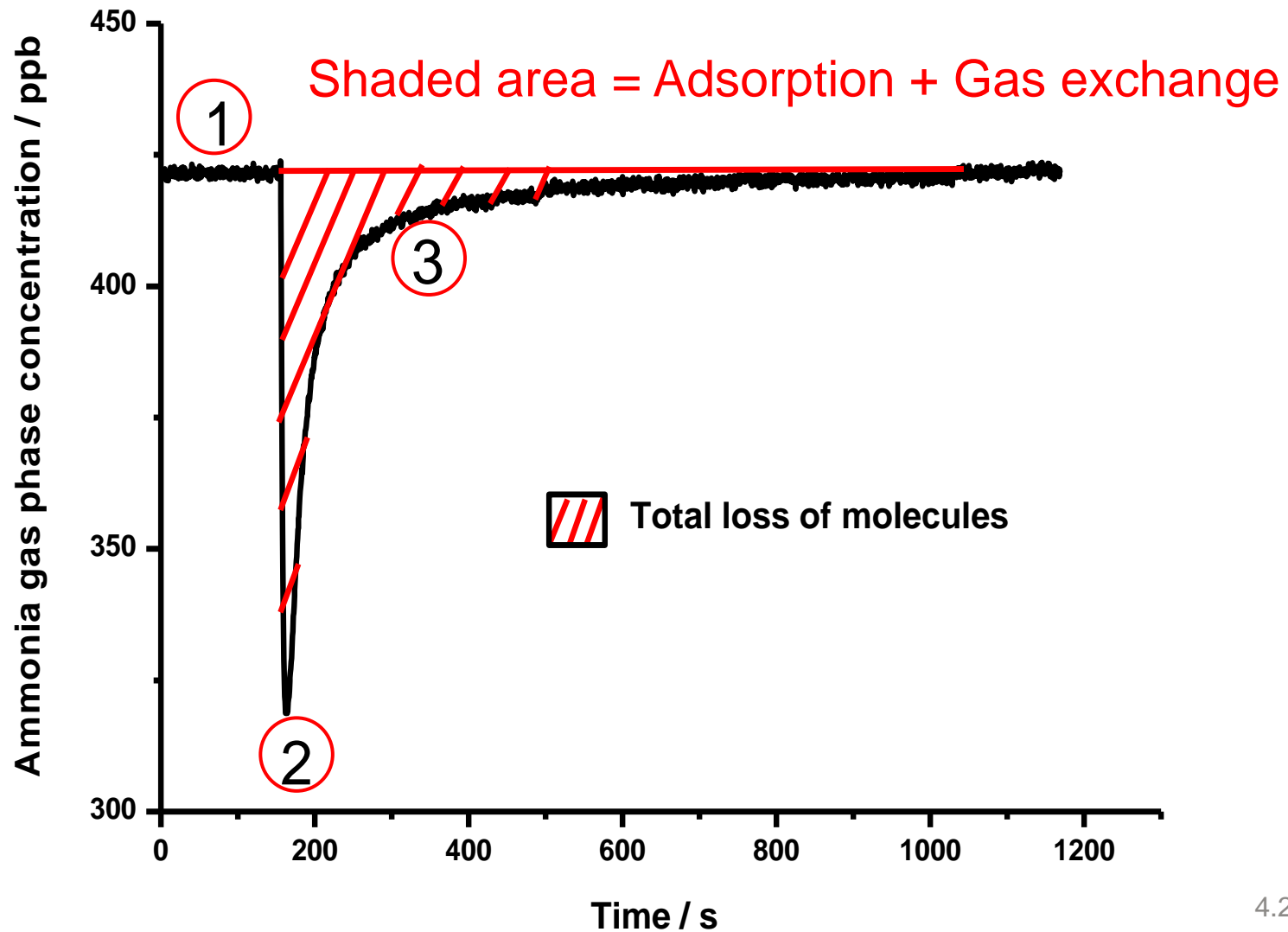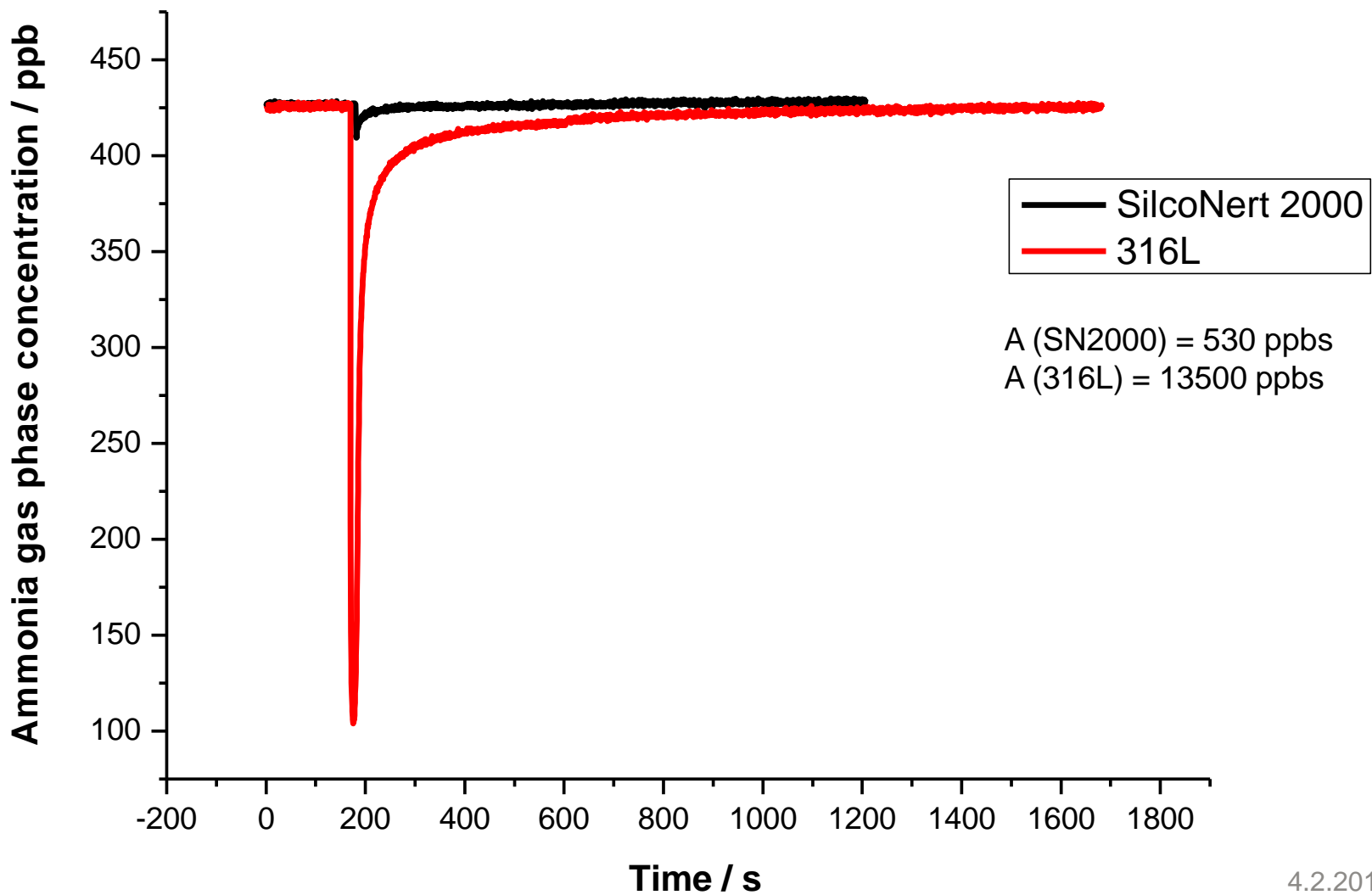
Test tube

3-way valve

By-pass

3-way valve

To CRDS

Study protocol

A) Test tube is flushed with indoor air (≥1 h) and pure N_2 (≥0.5 h)

B) Vacuum line and ring-down cavity (except test tube) are exposed to NH_3 (in N_2)

C) Concentration of ammonia is measured after ~1 h

D) Actual real-time adsorption measurement at 6548.79 cm^{-1} in 3 phases:

1) Ammonia gas flow via by-pass line
2) Ammonia flow switched to go via test tube
3) Slow recovery of ammonia signal

Dursan, 420 ppb

Shaded area = Adsorption + Gas exchange

Total loss of molecules

A (SN2000) = 530 ppbs
A (316L) = 13500 ppbs

Adsorption on metal / coated surfaces

Metal / coating	Adsorption* (10^{12} molecules/cm^2)	St. deviation (10^{12} molecules/cm^2)
SilcoNert 2000	5.7	0.6
SilcoNert 1000	14.6	0.9
EP SS316L	72	11
Dursan	101	5
SS316L	138	21

*Average of 3 measurements NH_3 conc = 420 ppb, p (tube) = 176 mbar
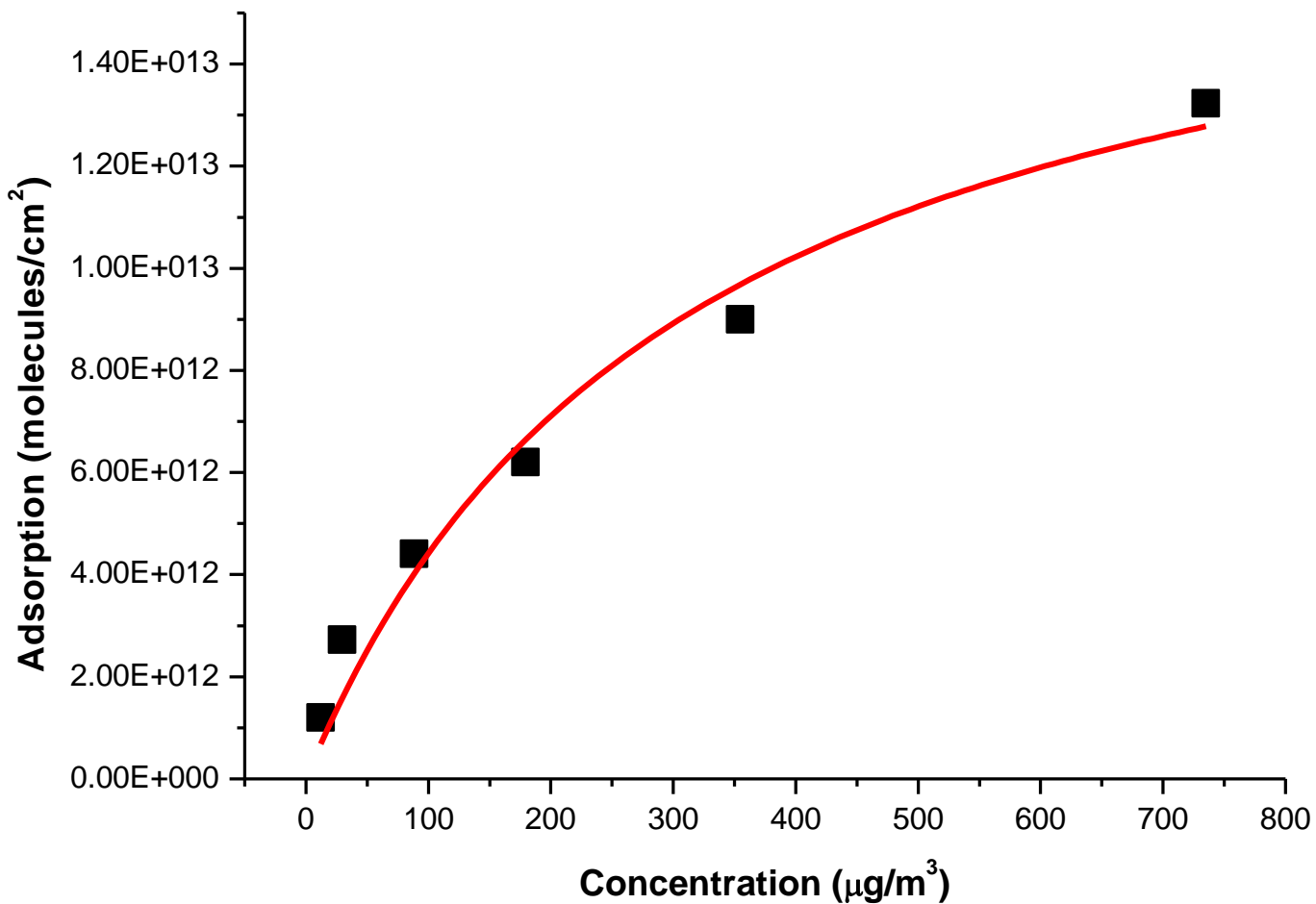
Adsorption on polymer surfaces

Polymer	Adsorption* (10^{12} molecules/cm^2)	St. deviation (10^{12} molecules/cm^2)
PVDF	1.0	0.1
PELD	4.4	0.6
PTFE	7.5	1.9
FEP	8.6	0.3
PFA	13.9	1.0

*Average of 3 measurements   NH$_3$ conc = 8750 ppb, p (tube) = 119 mbar
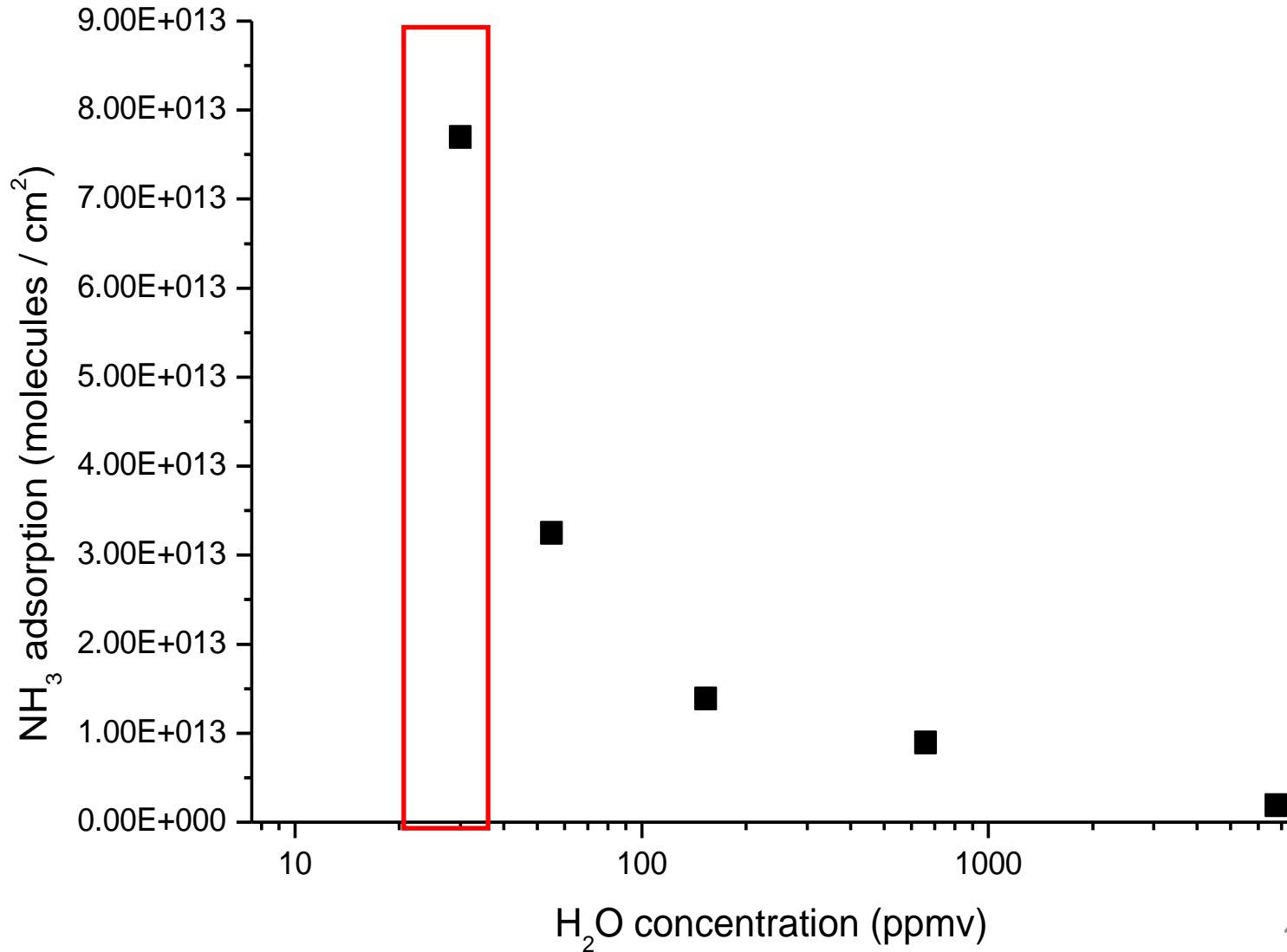
Langmuir isotherm

Effect of water

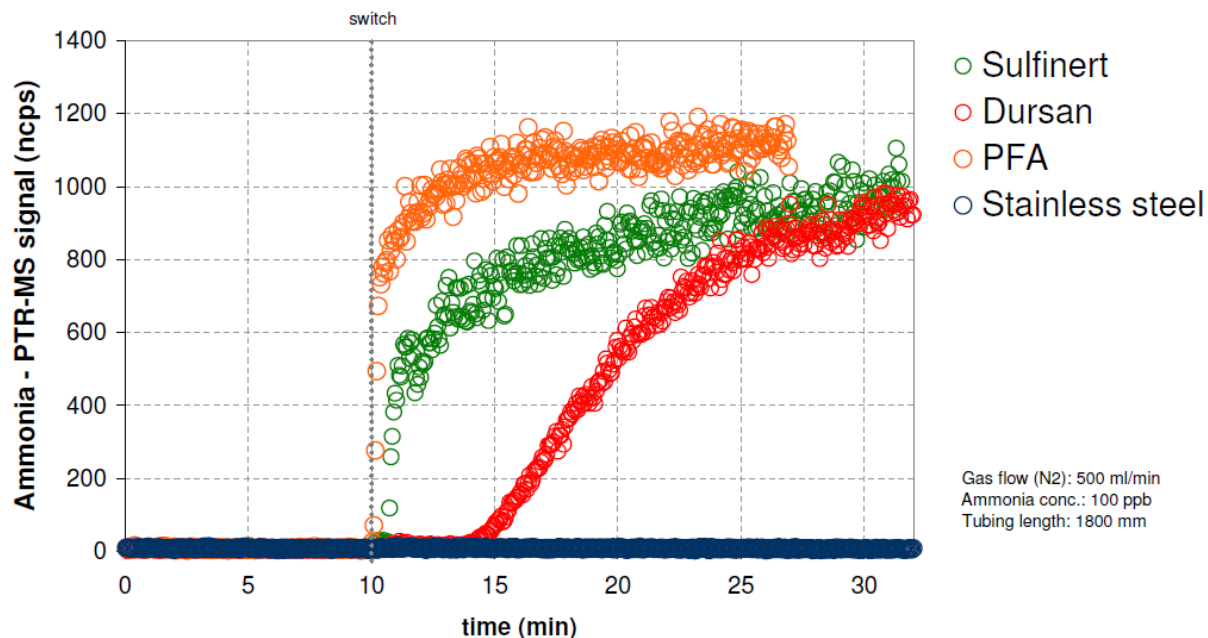SS 316L

Comparison to PTR-MS data*

CRDS:

SS > Dursan >> SN2000 > PFA

PTR-MS:

SS >> Dursan >> SN2000 > PFA

Ammonia transport through different tubings

*SilcoTek Corporation, Sulfinert = SilcoNert 2000

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