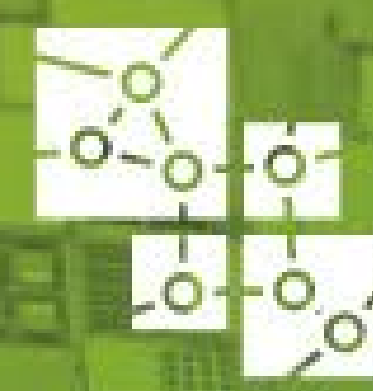




Sustainable Semiconductor Manufacturing

Comparison of FTIR and SIFT-MS for the Detection of Climate-relevant Gases in PE-CVD and Plasma Etching Processes in MEMS and Microelectronics Manufacturing

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Motivation

High GWP-gases like SF_6 , C_4F_8 and NF_3 are used in semiconductor plasma processes like PE-CVD chamber cleaning and plasma etching. Quantification and destruction of these gases are important to understand and lower their environmental impact. **SIFT-MS** and **FTIR** are evaluated as analytical technologies for quantification and verification of **destruction and removal efficiency (DRE)** of connected abatement systems.

SIFT-MS results

SIFT-MS (selected-ion flow-tube mass-spectrometry):

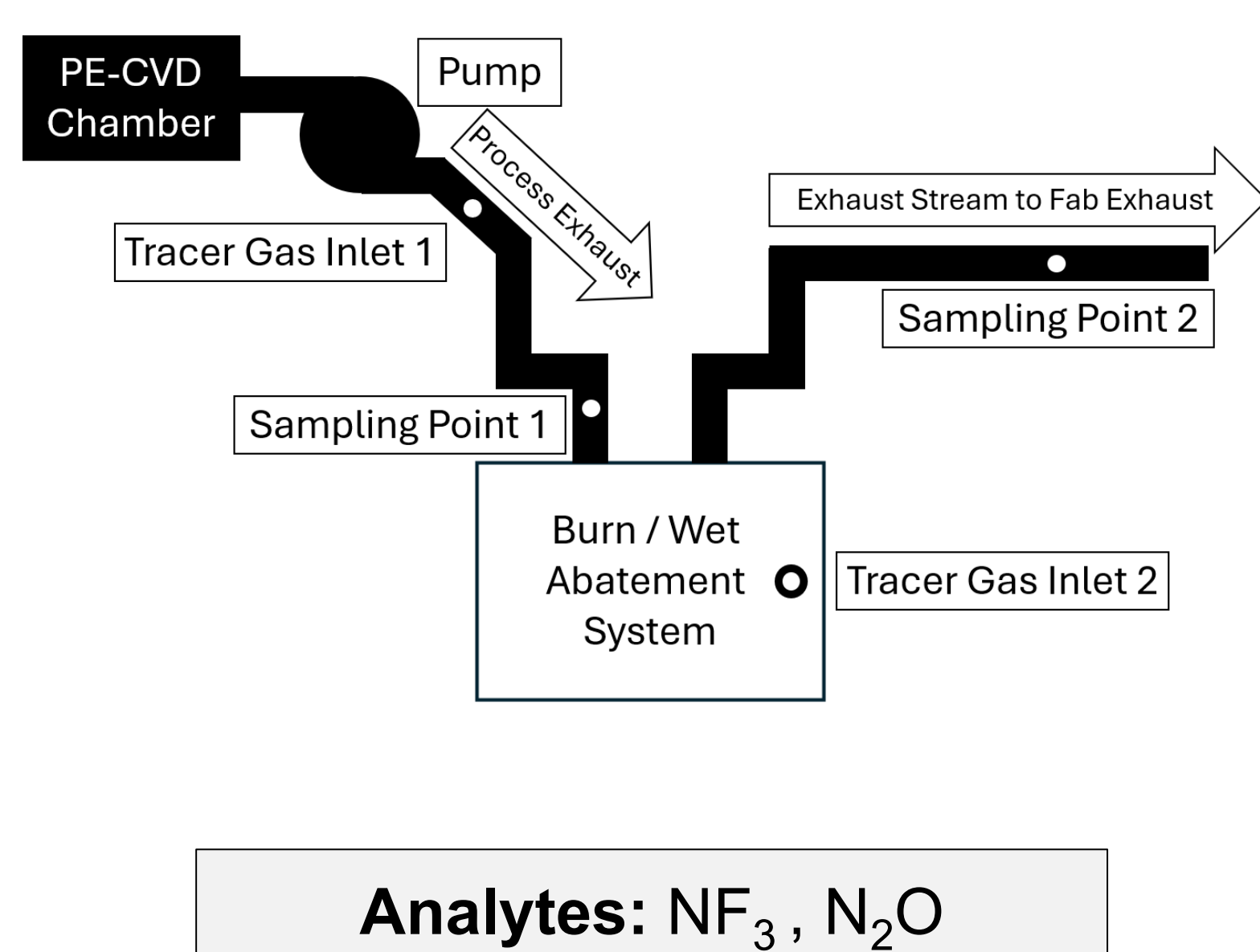
Reagent ions generated by the instrument react with the analyte in a flow-tube. The product ion is measured by QMS (quadrupole mass spectrometry) and characterised using a library.

FTIR results

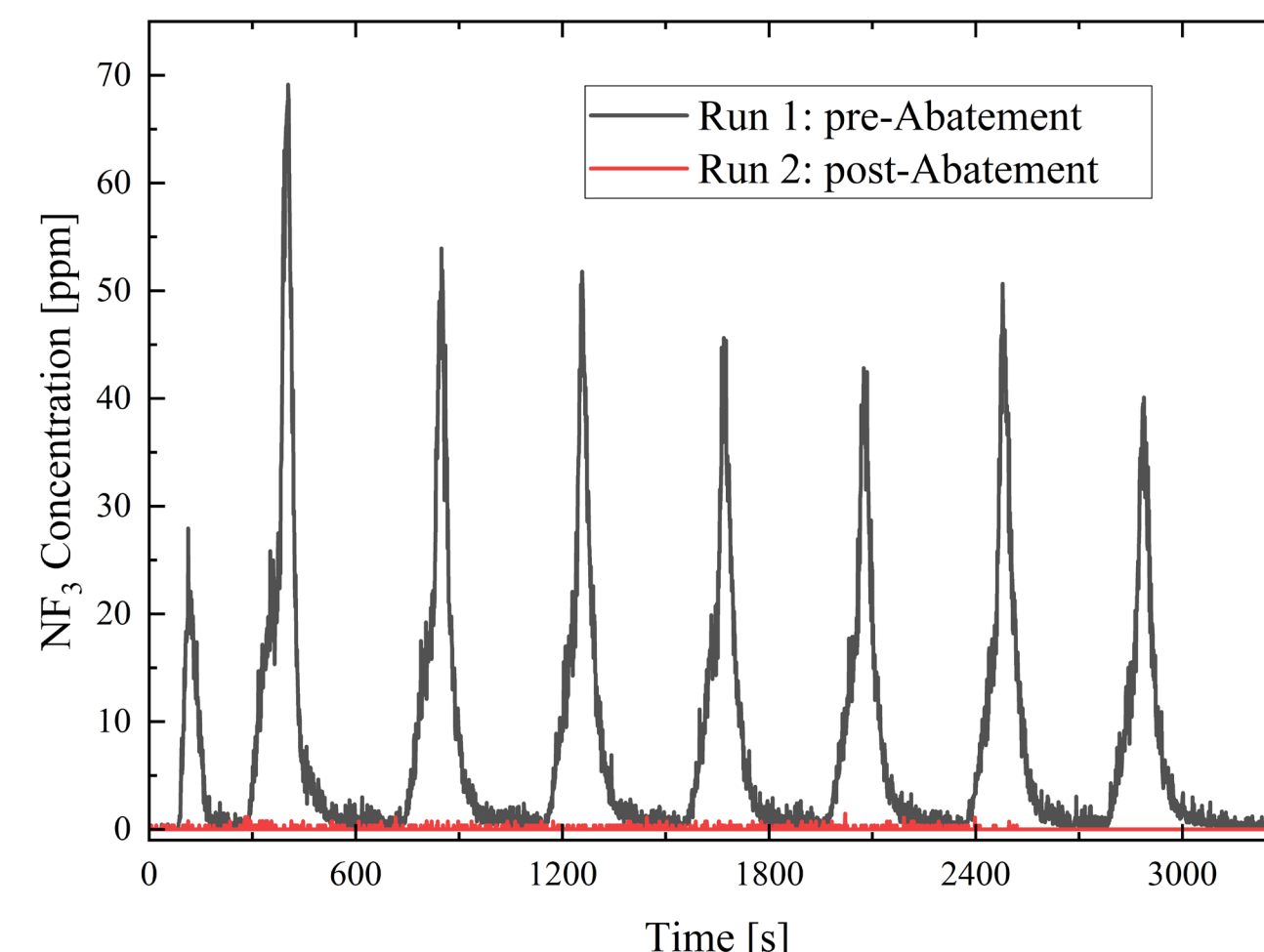
FTIR (fourier-transform infrared spectroscopy):

Using an infrared light source, the analytes characteristic response is measured and matched using a library.

Thermal-wet abatement (PE-CVD clean)



Analytes: NF_3 , N_2O

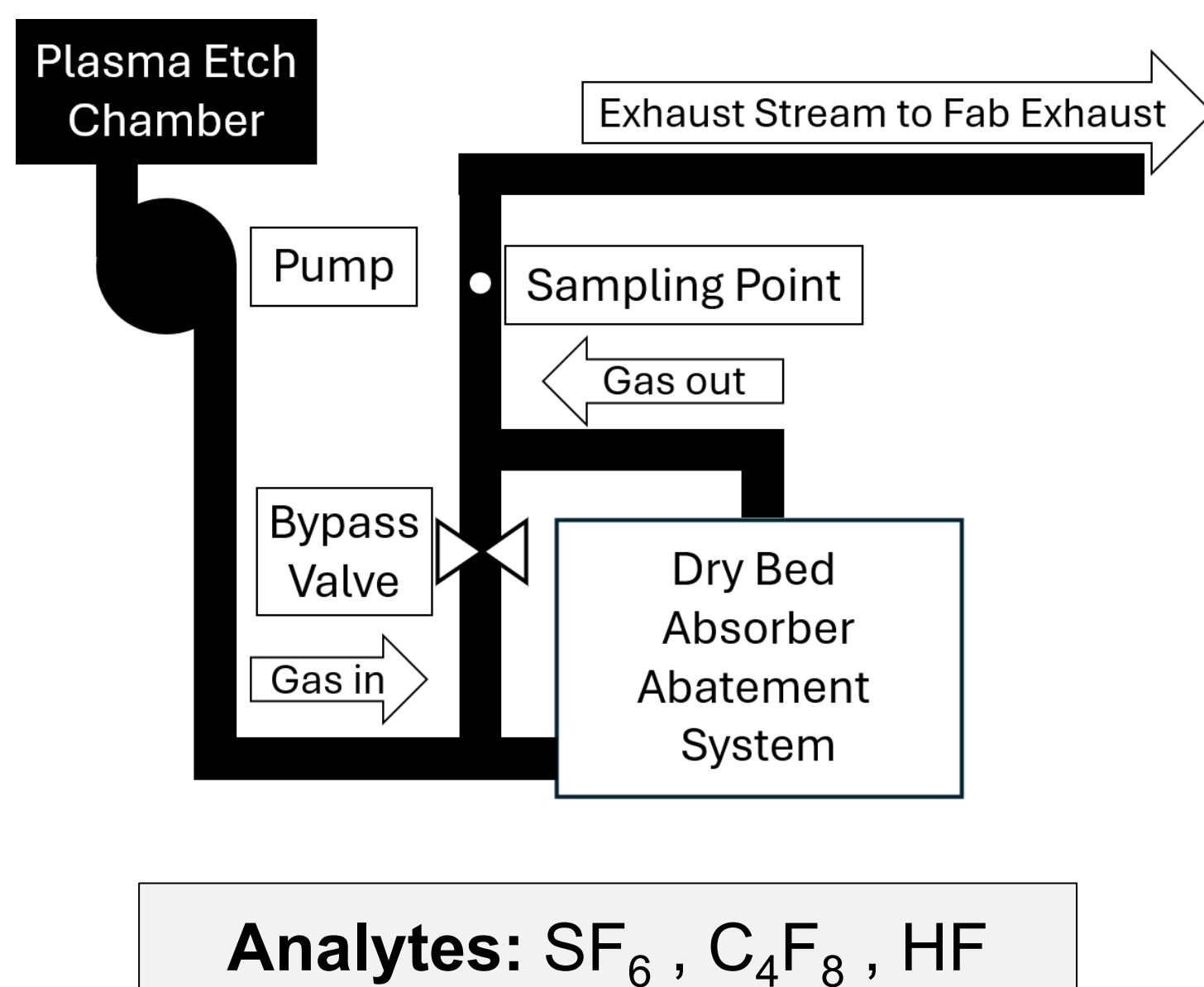


Analyte	NF_3
DRE [%]	99.9

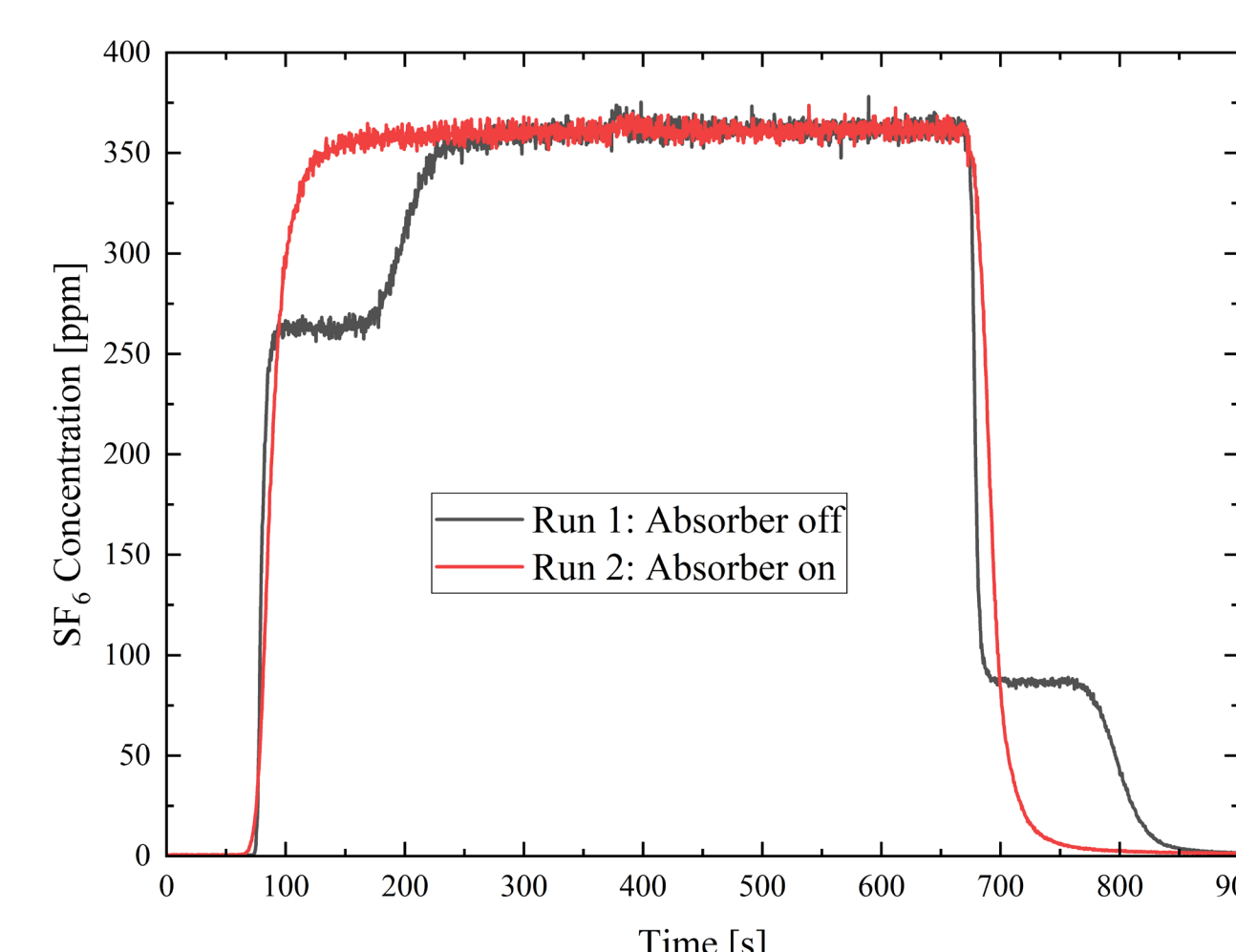
- NF_3 pre-abatement concentrations were too high to measure without N_2 dilution setup.
- N_2 dilution setup used for SIFT-MS was not available for FTIR. Instead, max. flow conditions were assumed for DRE calculation based on FTIR.

Analyte	NF_3	N_2O
DRE [%]	99.7	99.9

Dry-bed absorber (plasma etch)



Analytes: SF_6 , C_4F_8 , HF



Analyte	SF_6	C_4F_8
DRE [%]	0	0

- SF_6 and C_4F_8 pre-abatement concentrations were too high to measure without dilution setup. Instead, max. flow conditions were assumed for DRE calculation.
- HF concentration could be measured pre- and post-abatement.

Analyte	SF_6	C_4F_8	HF
DRE [%]	0	0	97.1

Summary

FTIR + SIFT-MS

can measure F-gas and can be used for DRE determination

DRE literature value for NF_3 confirmed
thermal wet abatement works well for NF_3

Dry bed absorber not suitable for SF_6 and C_4F_8
but works well for removing HF

Dilution setups required
typical pre-abatement concentrations too high for sensitive instruments