Aerosol Gas Exchange System (AGES) for Engine Exhaust Conditioning

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DownToTen

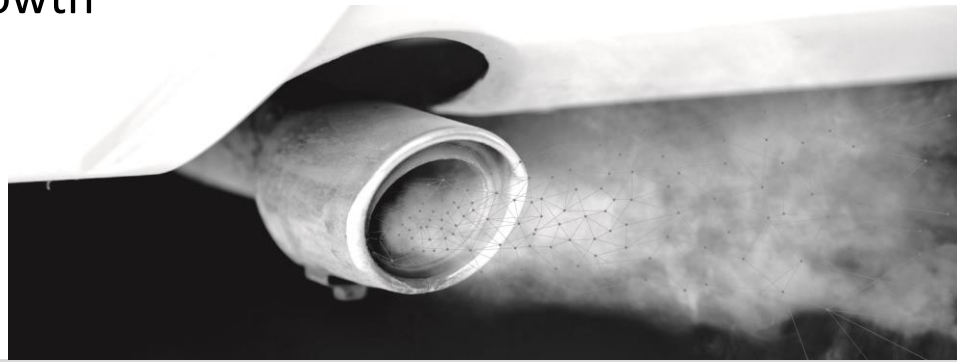
DownToTen is a Horizon 2020 funded project addressing engine exhaust particles down to at least ten nanometers

- → Description of the nature of sub 23 nm particles
- → Development of a robust sampling and measurement methodology
- → Set up a PN-PEMS demonstrator
- → Assessment of the fraction of particles left out of control (secondary aerosol)

Motivation

Future European Emission standards
Regulation of **SOLID** particle number emissions **≥ 10 nm**

→ Removal of volatile particles
→ Inhibiting of sub-cut size particle growth
→ Prevention of nucleation



State of the Art

Evaporation Tube

Hot dilution to lower partial pressure of volatile compounds in gas phase and providing residence time to evaporate volatile particles

Thermodenuder

Heating aerosol and adsorption of evaporated material using a cooled activated carbon adsorption section. Limited storage capacity.

Catalytic Stripper

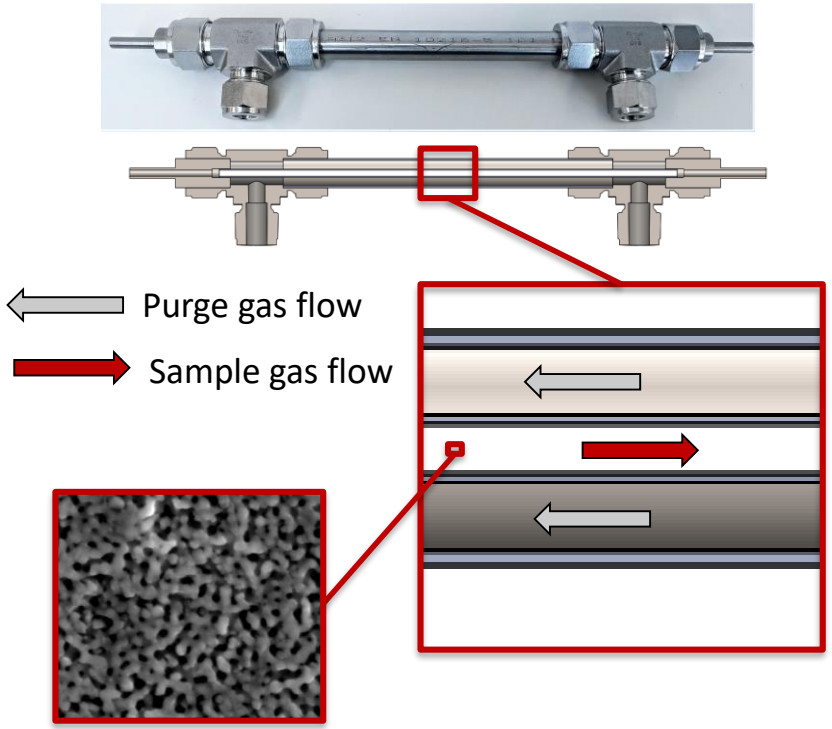
Oxidation of organic substances and storage of sulphur. Robust but high losses.

Counter Flow Denuder

Cylindrical porous glass membrane (sample flow)

Counter flowing sample and purge flows

Diffusional exchange of sample gases and purge gas



Hagino, H., 2017. Laboratory evaluation of nanoparticle penetration efficiency in a cylindrical counter flow denuder for non-specific removal of trace gases. *Aerosol Science and Technology*, *51*(4), pp.443-450.

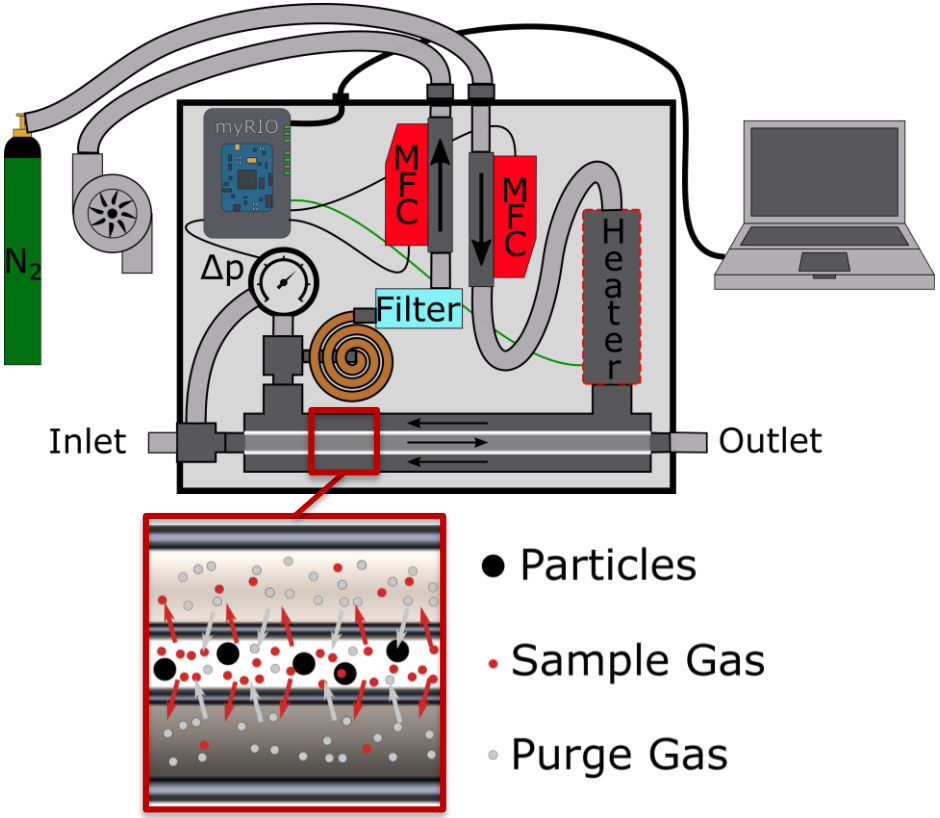
Aerosol Gas Removal System

Purge gas flow rate control

Purge gas temperature control

Controlled pressure difference between purge gas and sample

→ Applicable under broad range of conditions



Advantages

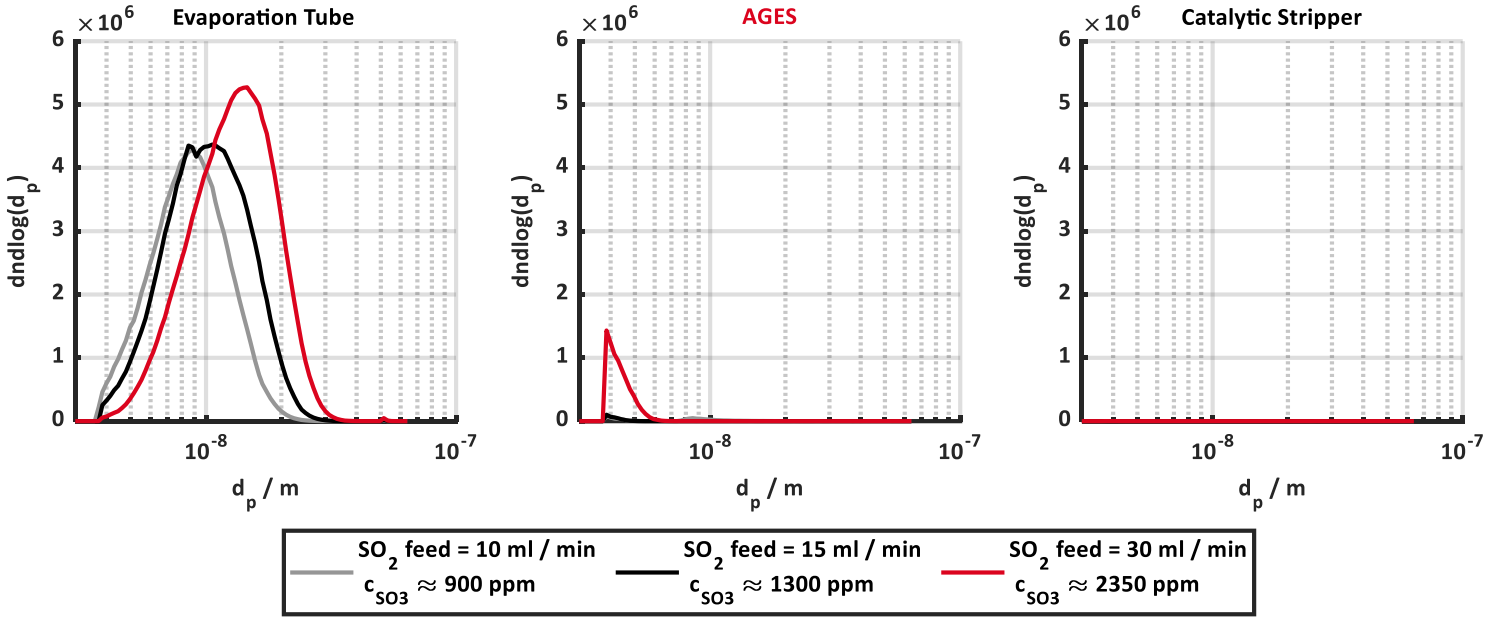
Partial pressure of volatile compounds in gas phase is lowered by removing them

Transport in the purge gas flow eliminates the issue of limited storage capacities

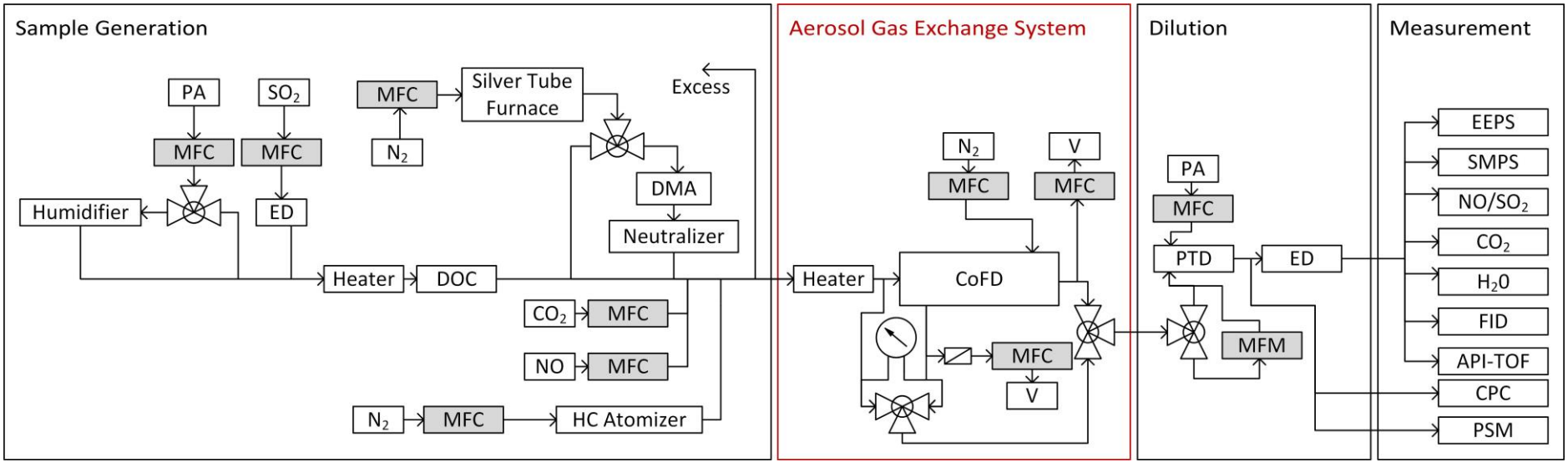
No uncertainty-causing chemical reactions involved

Low particle losses

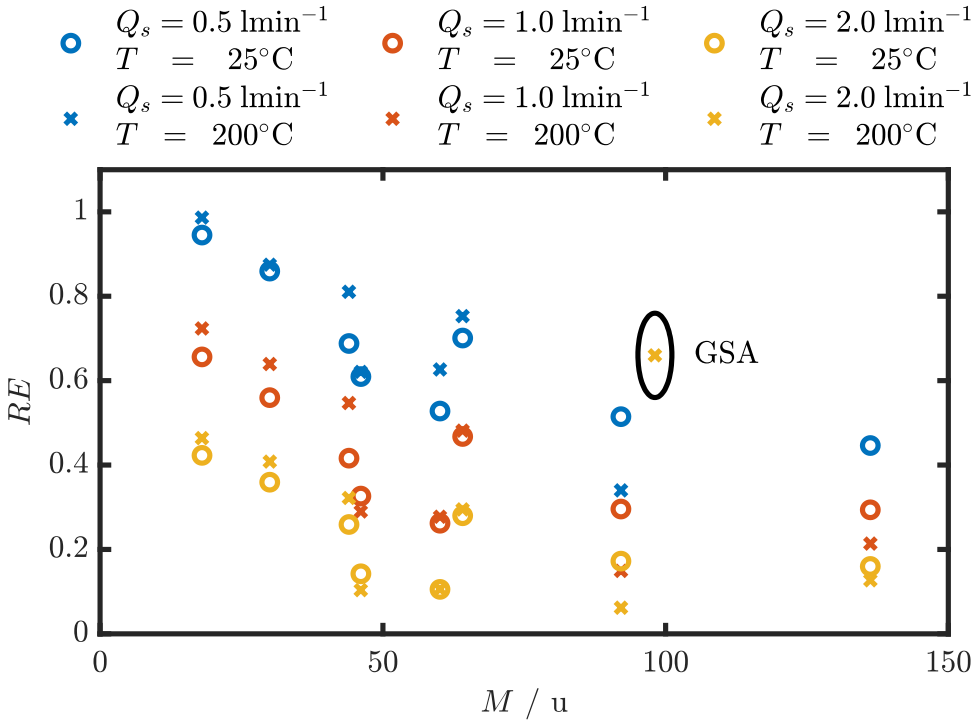
Nucleation Mode Prevention



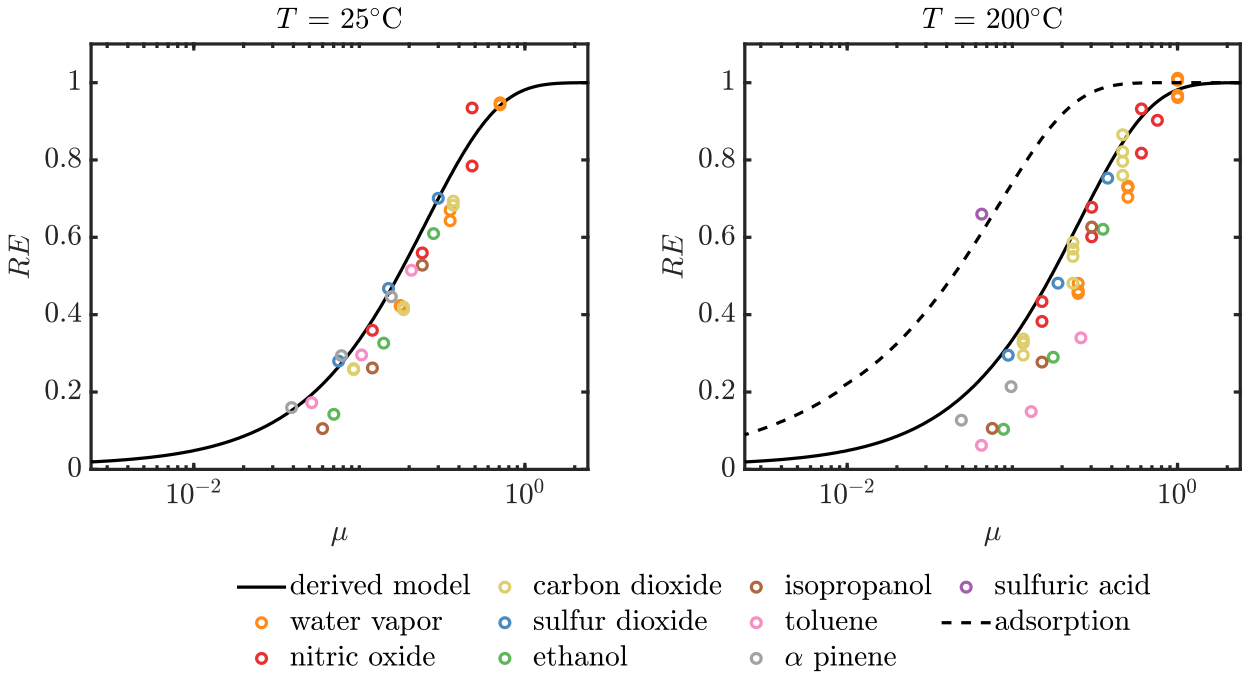
Experimental Setup



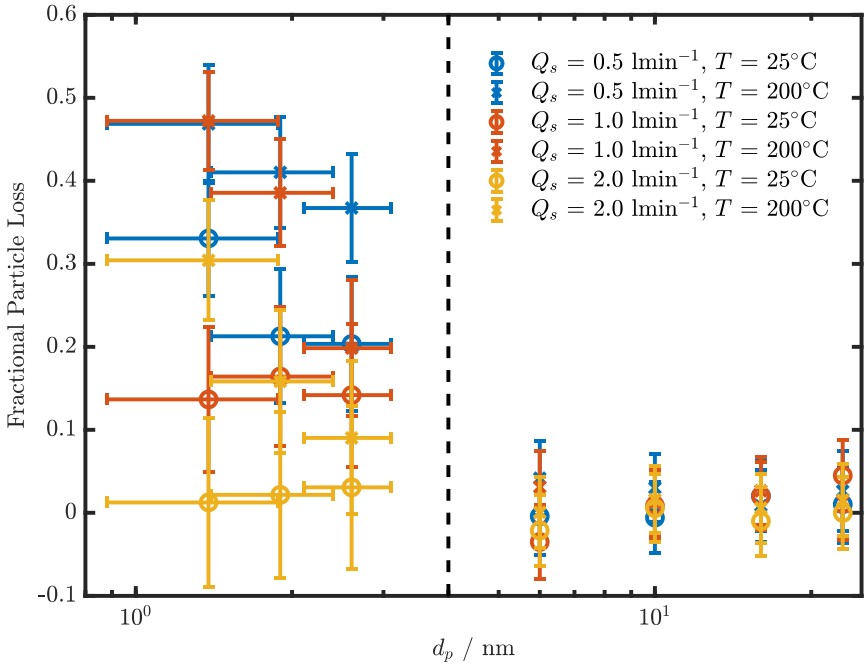
Removal Efficiency



Removal Efficiency



Particle Losses



Conclusion

Low particle losses compared to established devices

Applicable at elevated temperatures

Model for the exchange efficiency for gases

Application specific optimizations

WE ARE EXPLORING
THE **DOWN TO TEN**
WORLD OF EMISSIONS
AND WE WILL WORK
TOGETHER TO BRING IT
TO SUPER LOW LEVELS.