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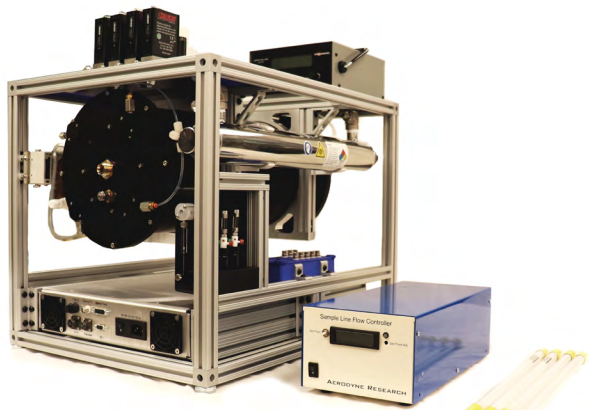
Technology Enhancing Science

PAM

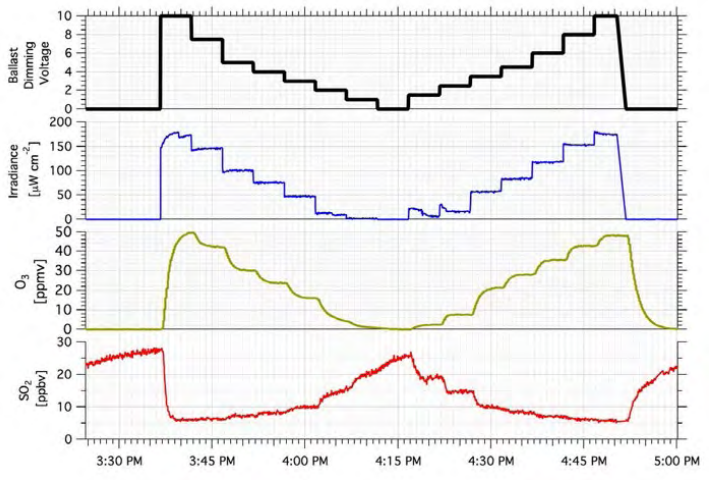
Potential Aerosol Mass Oxidation Flow Reactor

A highly oxidizing environment that simulates oxidation processes on timescales of days in the atmosphere in minutes in real time



Applications

- Laboratory or field studies of secondary aerosol generation via gas-phase oxidation of gas-phase precursors
- Heterogenous oxidation of primary aerosols
- Compatible with gas and particle mass spectrometry techniques
- Complement to laboratory smog chamber techniques commonly used to generate secondary organic aerosol (SOA)



Advantages

- Field deployable
- **Oxidants:** O_3, OH, NO_3, Cl, Br
- Wide range of oxidant exposure times attainable with dimmable UVC, UVB or UVA at high measurement throughput/ resolution
- Oxidant concentrations are 100 to 10,000 times larger than in the daytime troposphere, simulating days of atmospheric oxidation in minutes

Time series from an example OH exposure calibration experiment using SO_2 as a reactive tracer species. Using the included control software, the dimming voltage applied to UV lamp ballasts is stepped from 0-10 VDC, which varies the UV irradiance and the ozone mixing ratio in the PAM chamber.

Ask about our new PAM Dual & Triple Oxidation Flow Reactors

- Extends applications of the PAM OFR by providing the ability to simulate multiple oxidation processes in parallel
- Enables automated fast switching of instruments between OFRs
- Configurable to input different precursors into OFRs using the same oxidant, or the same precursor into OFRs using different oxidants

Potential Aerosol Mass (PAM) Oxidation Flow Reactor

Specifications

OH Exposure

- 2 x 10^{11} to 2 x 10^{12} molec cm^{-3} sec at 100 sec residence time

Components/Available Options

- OFR with UVC/UVB/UVA lamps
- Humidifier
- Ozone chamber and analyzer
- UV & RH/T sensors
- Switching valves
- Flow controllers
- Syringe pump

Size/Weight

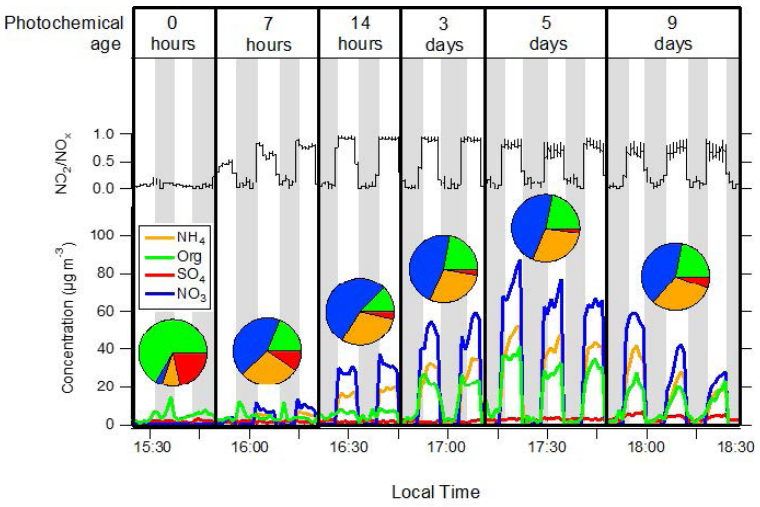
- 24" x 18" x 18" (L x W x H); 80 lbs [61 cm x 46 cm x 46 cm; 36 kg]

Electrical

- 225 Watts max, 110-220 VAC, 50-60 Hz

Required Accessories

- N_2 purge gas for UV lamps
- Carrier gas
- Instrument and makeup flows
- Windows PC



Example measurements obtained with a PAM reactor. Secondary ammonium, sulfate, organic, and nitrate aerosols are generated from OH oxidation of gas-phase motor vehicle emissions inside the Fort Pitt Tunnel in Pittsburgh, Pennsylvania, USA (Tkacik et al., Environ Sci. Technol. 2014). Shaded periods are when the tunnel air bypassed the PAM reactor.

PAM reactor installed on top of the Peking University mobile lab in Beijing, China (K. Liao et al., ES&T, 2021; Photo: Prof. Qi Chen, Peking University).

PUBLICATIONS

Lambe, A. T., A. T. Ahern, L. R. Williams, J. G. Slowik, J. Wong, J. P. D. Abbatt, W. H. Brune, N. L. Ng, J. Z. Wright, D. R. Croasdale, D. R. Worsnop, P. Davidovits and T. B. Onasch, Characterization of aerosol photooxidation flow reactors: heterogeneous oxidation, secondary organic aerosol formation and cloud condensation nuclei activity measurements, Atmospheric Measurement Techniques 4, 445–461, 2011.

Rowe, J. P., Lambe, A. T., and Brune, W. H.: Technical Note: Effect of varying the λ = 185 and 254 nm photon flux ratio on radical generation in oxidation flow reactors, Atmos. Chem. Phys., 20, 13417–13424, https://doi.org/10.5194/acp-20-13417-2020, 2020.

Additional references available at https://sites.google.com/site/pamwiki/

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