A new inlet for simultaneous gas and particle phase measurements coupled to a chemical ionization high-resolution time-of-flight mass spectrometer

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We present data from a newly developed inlet coupled to a chemical ionization high-resolution time-of-flight mass spectrometer (CI-HRToF-MS). The inlet allows simultaneous measurements of the chemical composition of organic compounds in both the gas and the particle phase, crucial for partitioning studies. This new inlet has the following features:

- The gas and particle phase inlets are separate up to the entrance to the mass spectrometer, allowing separate flow, pressure, and temperature conditions for both channels. Thus artifacts in the particle phase due to gas adsorption to surfaces are minimized.
- Particles are collected on a PTFE filter and subsequently desorbed using heated UHP N_2 or zero air programmed to temperatures up to 200 C allowing for volatility studies. Measured thermograms are of equal quality as any metal surface we've tested.
- The PTFE filter collects particles with diameters between 10 and 1000 nm with > 99.9% efficiency, and has minimal gas adsorption effects.
- In addition, the PTFE filter does not suffer from size-dependent collection as do inertial impactors.

This new inlet coupled to a CI-HRToF-MS provides intriguing new possibilities to explore organic and inorganic compounds in the atmosphere in both the particle and the gas phase. It has successfully been tested at the plant aerosol atmosphere chamber facility (JPAC) at Forschungszentrum Jülich, Germany, and using a 1 m^3 teflon bag at the University of Seattle to study products of α-pinene ozonolysis and reaction with OH.

Figure 1 shows the total integrals of the signals of a series of desorptions with varying filter collection times of major α-pinene ozonolysis products in one experiment at the Seattle smog chamber. The chamber was at steady state. The totally desorbed mass increases linearly with filter collection time. Background signals ("blanks") were determined using a second PTFE filter upstream of the actual PTFE filter in the inlet. The very low signal during the subsequent desorption confirms that the filter suffers from a minimal gas phase artifact. Comparing this "blank" filter signal to that obtained after depositing particles demonstrates the high signal-to-noise ratio (> 6:1 for 0.5 µg collected) provided by this inlet.

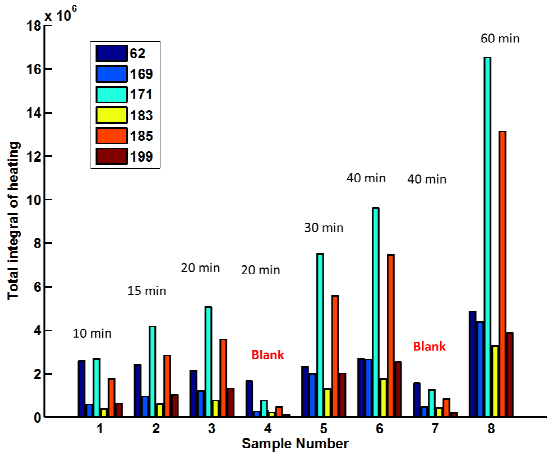

Figure 1. Total integrals of the signals of desorptions with varying filter collection times of major α-pinene ozonolysis products in one experiment at the Seattle smog chamber.

We discuss results from deployment of the new collector coupled to an HR-ToF-CIMS as part of chamber experiments and spring and summer field campaigns in systems dominated by biogenic emissions (α-pinene and isoprene). We also discuss the first results from the implementation of a MOUDI (Micro-Orifice Uniform Deposition Impactor) upstream of the PTFE filter of the inlet to study the chemical composition of sub-100 nm particles, specifically.

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