

Analysis of organic compounds in aerosols by using a proton transfer reaction-mass spectrometer

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Organic material accounts for a substantial fraction of atmospheric fine particulate matter that affects the global climate by direct and indirect effects as well as human health. Many gas-phase organic compounds undergo oxidation in the gas phase to yield products, generally oxygenated, that have sufficiently low vapor pressures that they will partition themselves between the gas and aerosol phases. Such compounds are often referred to as semi- or non-volatile, and when residing in the aerosol phase, as Secondary Organic Aerosols (SOA). Understanding the chemical composition and formation processes of SOA is required for a quantitative assessment of its production, properties and environmental effects.

Proton transfer reaction-mass spectrometry (PTR-MS) is a newly developed technique in late 1990's, which allows for fast and sensitive measurements of volatile organic compounds (VOCs) at trace levels in air. The proton transfer reaction (PTR) ionization is one of chemical ionization (CI), which enables soft ionization of chemical species that have a proton affinity higher than that of the reagent species (i.e., water in many cases). The PTR from hydronium ions (H_3O^+) occur with many VOCs except low-molecular weight nonmethane hydrocarbons (NMHCs), and it produces predominantly protonated ions with less fragmentation than electron-impact ionization (EI) does. Recently, the PTR ionization method was coupled to time-of-flight mass spectrometers (TOFMS). The use of TOFMS has advantages of the ability to acquire a full mass spectrum in one measurement and of high mass resolution, leading to explicit identification of the compounds of interest. Practically, separation of isobaric compounds would be easier with PTR-TOFMS than with PTR-QMS.

In the present study, we used a PTR-TOFMS for an analysis of organic compounds vaporized from aerosols such as SOA by heating. SOA particles were collected on a Quartz-Fiber-Filter that was held by a custom-built quartz holder and was attached to the sample inlet of the PTR-TOFMS instrument. Ion signals were observed even at room temperature. When heating the filter, observed ion signals shift to higher m/z . This suggests that the ion signals were attributed to organic compounds in aerosols. Preliminary results of SOA produced in the reactions of hydrocarbons with O_3 will be presented and discussed.