

Direct analysis of secondary organic aerosol using atmospheric-pressure glow discharge mass spectrometry

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Secondary organic aerosol (SOA) is formed when oxidation products of volatile organic compounds undergo gas-to-particle conversions. It accounts for a substantial fraction of ambient tropospheric aerosol and has implications on the earth's climate and human health. However, the characterization of the chemical composition and chemical transformations remain a major challenge in aerosol research and are bound to big uncertainties (Hoffmann *et al.*, 2011).

Today the Aerosol Mass Spectrometer (AMS) is probably the most common technique to obtain chemical and size-resolved information about sub-micron aerosol particles. It uses, however, an electron impact ion source, which is a hard ionization technique and leads to many fragmentations. Therefore, it is not possible with this instrument to monitor single organic compounds, which can serve as marker compounds for anthropogenic activities, wild fires or natural atmospheric conditions (Lanz *et al.*, 2010).

Addressing these technical drawbacks of the AMS and further questions concerning the chemical composition of SOA, we are developing a method to use atmospheric-pressure glow discharge mass spectrometry for the on- and offline analysis of SOA. Here we present the first application of the recently introduced flowing atmospheric-pressure afterglow (FAPA) ion source (Shelley *et al.*, 2011) for the chemical characterization of laboratory-generated SOA. The ion source is used for the offline analysis of SOA particles collected on PTFE-coated filters as well as the online analysis of SOA gas and particle phase.

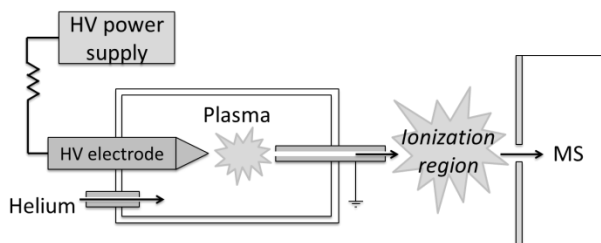


Figure 1. Schematic of the flowing atmospheric-pressure afterglow ion source combined with mass spectrometry.

The FAPA source is based on a Helium glow discharge plasma at atmospheric pressure, which is maintained between two electrodes in a ceramic discharge cell. Since one of the electrodes is a capillary, excited Helium atoms and other reagent ions can exit the discharge cell and ionize analyte molecules in front of the source (fig. 1). This very soft ionization technique

offers the possibility to obtain mass spectra with very little fragmentation (fig. 2). Additionally, the ion source can operate already at relatively low temperatures of about 50 °C, thus enabling the analysis even of very thermolabile substances in SOA.

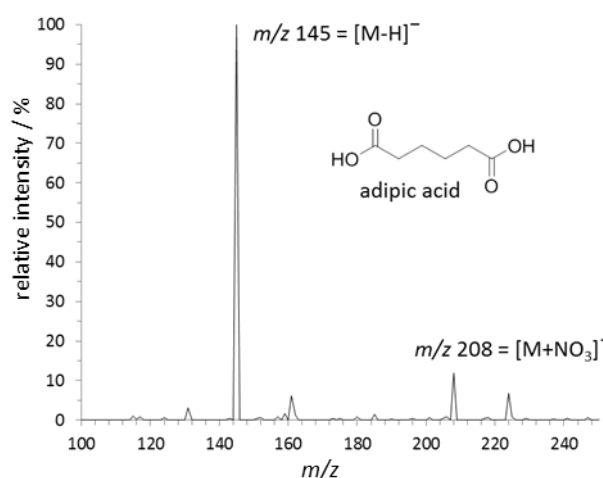


Figure 2. Mass spectrum of adipic acid in negative mode; the deprotonated molecular ion at m/z 145 is the most abundant signal, at m/z 208 a weak signal of the nitrate adduct is observed.

For all experiments SOA was produced from the ozonolysis of terpenes under dark and dry conditions. For offline experiments particulate matter was collected on PTFE-coated quartz filters and the collected particles were analyzed by desorption/ionization with the FAPA-MS. For online measurements the reaction chamber was directly connected to the ionization region of the FAPA-MS.

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