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Real-time analysis of ambient organic aerosols using aerosol flowing atmospheric-pressure afterglow mass spectrometry (AeroFAPA-MS)

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Organic aerosol accounts for a major fraction of atmospheric aerosols and has implications on the earth's climate and human health. However, due to the chemical complexity its measurement remains a major challenge for analytical instrumentation.[1]

Here, we present the development, characterization and application of a new soft ionization technique that allows mass spectrometric real-time detection of organic compounds in ambient aerosols. The aerosol flowing atmospheric-pressure afterglow (AeroFAPA) ion source utilizes a helium glow discharge plasma to produce excited helium species and primary reagent ions. Ionization of the analytes occurs in the afterglow region after thermal desorption and results mainly in intact molecular ions, facilitating the interpretation of the acquired mass spectra. In the past, similar approaches were used to detect pesticides, explosives or illicit drugs on a variety of surfaces.[2,3] In contrast, the AeroFAPA source operates "online" and allows the detection of organic compounds in aerosols without a prior precipitation or sampling step.

To our knowledge, this is the first application of an atmospheric-pressure glow discharge ionization technique to ambient aerosol samples. We illustrate that changes in aerosol composition and concentration are detected on the time scale of seconds and in the $ng{\cdot}m^{-3}$ range. Additionally, the successful application of AeroFAPA-MS during a field study in a mixed forest region in Central Europe is presented. Several oxidation products of monoterpenes were clearly identified using the possibility to perform tandem MS experiments. The acquired data are in agreement with previous studies and demonstrate that AeroFAPA-MS is a suitable tool for organic aerosol analysis. Furthermore, these results reveal the potential of this technique to enable new insights into aerosol formation, growth and transformation in the atmosphere.

References:

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