Geophysical Research Abstracts
Vol. 16, EGU2014-14997, 2014
EGU General Assembly 2014

Towards depth profiling of organic aerosols in real time using aerosol flowing atmospheric-pressure afterglow mass spectrometry (AeroFAPA-MS)

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Organic aerosol accounts for a substantial fraction of tropospheric aerosol and has implications on the earth's climate and human health. However, the characterization of its chemical composition and transformations remain a major challenge and is still connected to large uncertainties (IPCC, 2013). Recent measurements revealed that organic aerosol particles may reside in an amorphous or semi-solid phase state which impedes the diffusion within the particles (Virtanen *et al.*, 2010; Shiraiwa *et al.*, 2011). This means that reaction products which are formed on the surface of a particle, e.g. by OH, NO_3 or ozone chemistry, cannot diffuse into the particle's core and remain at the surface. Eventually, this leads to particles with a core/shell structure. In the particles' cores the initial compounds are preserved whereas the shells contain mainly the oxidation products. By analyzing the particles' cores and shells separately, thus, it is possible to obtain valuable information on the formation and evolution of the aerosols' particle and gas phase.

Here we present the development of the aerosol flowing atmospheric-pressure afterglow (AeroFAPA) technique which allows the mass spectrometric analysis of organic aerosols in real time. The AeroFAPA is an ion source based on a helium glow discharge at atmospheric pressure. The plasma produces excited helium species and primary reagent ions which are transferred into the afterglow region where the ionization of the analytes takes place. Due to temperatures of only 80 ˚C to 150 ˚C and ambient pressure in the afterglow region, the ionization is very soft and almost no fragmentation of organic molecules is observed. Thus, the obtained mass spectra are easy to interpret and no extensive data analysis procedure is necessary. Additionally, first results of a combination of the AeroFAPA-MS with a scanning mobility particle sizer (SMPS) suggest that it is not only possible to analyze the entire particle phase but rather that a separate analysis of the particles' shells and cores is feasible by adjusting flow rates and temperatures in the ionization region.

References:

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