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Online Quantification of gaseous Amines via Aerosol Mass Spectrometry

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Atmospheric aerosols strongly influence earth's climate due to direct effects like scattering, reflection and absorption of sunlight, as well as indirect effects such as their influence on cloud formation. The atmospheric behavior of aerosol particles and their influence on climate depend significantly on their chemical composition.[1,2,3] Low-weight aliphatic amines are of increasing interest in current research, because they might play an important role in atmospheric nucleation processes and should be considered in climate models.[4,5,6]

The Time-of-Flight-Aerosol-Mass-Spectrometer (ToF-AMS) of Aerodyne Research Inc. has the ability to measure particles' diameter, mass and chemical composition in real time. The inlet system of the ToF-AMS separates the particle phase of the gas phase, thereby a strong enrichment of particles is achieved.[7] Thus only major constituents of the gas phase (>10 ppm) are detected.[8] Selective conversion of trace gases into particles allows to detect and quantify these trace gases at very low concentrations.

This work uses the ToF-AMS for the first time to quantify gaseous dimethylamine, trimethylamine, diethylamine and triethylamine. Acidic particles help to trap gaseous amines in the particle phase. These particles are produced by a pneumatic atomizer using a methanolic solution of phosphoric acid and nitrogen as carrier gas. In a $0.5\ L$ reaction chamber the continuous stream of gaseous amine (the analyte) encounters a continuous stream of acidic particles and converts from gas to particle phase online in a simple and quick acid-base-reaction. To calibrate the system known amine concentrations were produced, employing permeation tubes[9] in a tempered nitrogen flow. Limits of detection in the lower ppt-range were achieved. The first employment of this system was a series of chamber experiments measuring the amine emission of plants (*Chenopodium vulvaria* L. and *Mercurialis annua*) at different ozone concentrations and lighting conditions. Trimethylamine could be identified and quantified without any interferences caused by other emissions of the plants. This shows that the selective conversion of amines worked successfully in these experiments. We named our system to trap gaseous compounds in particles GTRAP-AMS (Gaseous compound TRapping in Artificially-generated Particles - Aerosol Mass Spectrometry).[10]

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