Aerosol-chamber study of the α-pinene/O_3 reaction: Influence of particle acidity on aerosol yields and products

O. Böge; Y. Iinuma; T. Gnauk; Y. Miao and H. Herrmann

Leibniz-Institut für Troposphärenforschung e.V., Leipzig
Corresponding author: Olaf Böge, Email: boege@tropos.de

The present study focuses on possible effects of aerosol aqueous phase chemistry under acidic conditions following gas phase α-pinene ozonolysis. Such particle chemistry could lead to (i) an increase of SOA which might be important on a global scale and (ii) the formation of higher molecular weight products the sources of which in tropospheric particles have not been clarified before.
α-Pinene ozonolysis was carried out in the presence of ammonium sulphate or sulphuric acid seed particles in a 9 m^3 Teflon chamber at mixing ratios of 100 ppbv for α-pinene and about 70 ppbv for ozone. The evolution of size distribution was measured by means of a differential mobility particle sizer (DMPS).
The resulting secondary organic aerosol was sampled by a denuder/quartz filter combination for the determination of the total organic carbon concentration in the particle phase. For analysis of individual chemical species in the particle phase a denuder/PTFE filter combination was used for sampling. The PTFE filters were extracted with methanol/water for CE-MS analysis.
Time series of the α-pinene oxidation products in the particle phase were obtained by means of a condensation-growth and impaction system which was newly developed in our institute. This system uses condensational growth of particles and impaction to collect the particles for off-line chemical analysis.
Compared to the experiments with ammonium sulphate seed particles, an increase of almost 40% in measured OC concentration was observed from the experiments with sulphuric acid particles. A number of compounds with M_w >300 have been detected from the experiments with sulphuric acid seed particles. The mass spectrum of CE-MS analysis (Figure 1) shows the compounds with m/z ranging from m/z 300-700 with an intensive peak at m/z 369 followed by m/z 353. Subsequent MS^n experiments indicated that m/z 369 [M-1] is a possible hydration and polymerization product of Mw 186 and 184 (data not shown). This result suggests that particle acidity of atmospheric of atmospheric aerosols plays an important part in the heterogeneous reaction of SOA and may explain an unresolved fraction of organic aerosols in the atmosphere.

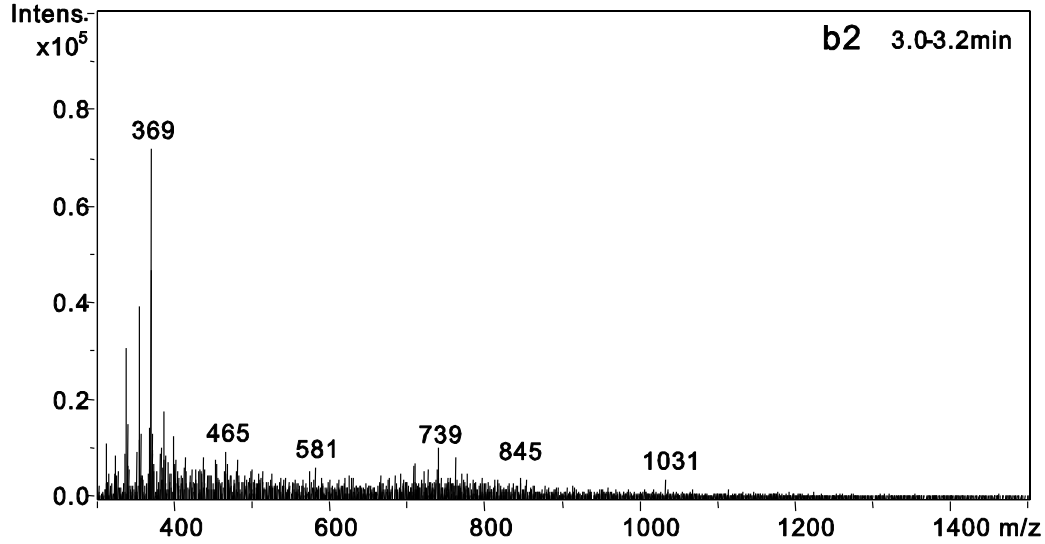

Figure 1. Background subtracted mass spectra of the CE-peak between 3.0 and 3.2 min

This work was supported by the BMBF within the atmospheric research program AFO 2000 under FKZ 07ATF25, BEWA.