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A novel tandem differential mobility analyzer with organic vapor treatment of aerosol particles

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Abstract. A novel method to characterize the organic composition of aerosol particles has been developed. The method is based on organic vapor interaction with aerosol particles and it has been named an Organic Tandem Differential Mobility Analyzer (OTDMA). The OTDMA method has been tested for inorganic (sodium chloride and ammonium sulfate) and organic (citric acid and adipic acid) particles. Growth curves of the particles have been measured in ethanol vapor and as a comparison in water vapor as a function of saturation ratio.

Measurements in water vapor show that sodium chloride and ammonium sulfate as well as citric acid particles grow at water saturation ratios (S) of 0.8 and above, whereas adipic acid particles do not grow at $S <$ 0.96. For sodium chloride and ammonium sulfate particles, a deliquescence point is observed at S = 0.75 and S = 0.79, respectively. Citric acid particles grow monotonously with increasing saturation ratios already at low saturation ratios and no clear deliquescence point is found.

For sodium chloride and ammonium sulfate particles, no growth can be seen in ethanol vapor at saturation ratios below 0.93. In contrast, for adipic acid particles, the deliquescence takes place at around S = 0.95 in the ethanol vapor. The recrystallization of adipic acid takes place at $S <$ 0.4. Citric acid particles grow in ethanol vapor similarly as in water vapor; the particles grow monotonously with increasing saturation ratios and no stepwise deliquescence is observed.

The results show that the working principles of the OTDMA are operational for single-component aerosols. Furthermore, the results indicate that the OTDMA method may prove useful in determining whether aerosol particles contain organic substances, especially if the OTDMA is operated in parallel with a hygroscopicity TDMA, as the growth of many substances is different in ethanol and water vapors.

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