Atmospheric Chemistry and Physics Discussions

Interactive
Comment

Interactive comment on "A novel tandem differential mobility analyzer with organic vapor treatment of aerosol particles" *by* "J. Joutsensaari et al."

J. Joutsensaari et al.

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Response to Referee # 2:

General comments: Mixed aerosols - see our response to Referee 1.

Specific comments:

1. OK

2. The fact that the complete hysteresis loop cannot be measured for adipic acid is no generic feature of the OTDMA. Rather, it results from the high deliquescence saturation ratio (about 0.95-0.96) of the substance in question. If one measured the behavior in water vapor of a substance that deliquesces at 96% R.H., similarly incomplete hysteresis loop would be seen.

The saturation ratio which the particle sees in the second DMA (and which is plot-

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ted on the figures) results from mixing of two flows which contain different amounts of solvent vapor. The volume of the aerosol flow is 10% of the sheath air flow, and if the aerosol flow is completely free of solvent vapor, the maximum S that can be reached within DMA 2 is 0.9 (corresponding to completely saturated sheath air). In order to make sure that we are on the lower branch of the hysteresis curve, we have to keep the saturation ratio of the aerosol flow below that of the sheath air, and in order to locate the deliquescence point, the S of the aerosol flow has to be below the deliquescence saturation ratio. In practice, as explained in the paper, the control of the aerosol flow saturation ratio was difficult, and we were not able to reach saturation ratios higher than 0.95 inside DMA 2 in such a way that we could have been certain we were measuring "increasing" saturation ratios (i.e. those on the lower branch of the hysteresis curve). When measuring the upper branch, the aerosol flow has a higher saturation ratio than the sheath air (thus "decreasing" saturation ratio). In these measurements the S of the aerosol flow can be kept close to unity, and thus it is possible to reach a higher S inside DMA 2 than in the increasing saturation ratio measurements, but we were still limited to S = 0.97-0.98. Note that these are exceptionally high values and rarely seen in measurements with water vapor; at high saturation ratios there is always the danger that temperature fluctuations somewhere inside the DMA apparatus cause the saturation ratio to reach unity, resulting in condensation on the walls, and the released heat, in turn, will change the conditions from those that were intended. Also, measurement of saturation ratio becomes more uncertain as it approaches unity.

All in all, even though we were not able to perform increasing saturatio ratio measurements at as high values of S as we would have liked to, we believe we have good indication that the deliquescence transition does occur at around S = 0.95. First, this is what we would expect from our solubility measurement, and second, as can be seen from Fig. 3, the growth factors at the two highest increasing saturation ratios are somewhat above unity, a common feature seen just before the deliquescence transition in almost all experimental studies. The fact that we have no data with decreasing saturation ratios below S = 0.82 is due to the time limitations mentioned in the response to

Referee 1. We simply had to stop the measurements because the apparatus had to be taken to a smog chamber campaign.

3. As noted in the response to Referee 1, our measurements in the smog chamber and field campaigns indicate that ethanol growth factors of internally mixed particles behave similarly as growth factors in water vapor in that they can be approximated as mole fraction weighted sums of the growth factors of the individual compounds. However, we do understand that in some circumstances this approximation could fail, e.g. due to salting out effects or chemical reactions caused by the absorbed ethanol. We will add discussion to the paper concerning these matters.

Interactive comment on Atmos. Chem. Phys. Discuss., 1, 1, 2001.

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