Atmos. Chem. Phys. Discuss., 3, S2475–S2478, 2003
www.atmos-chem-phys.org/acpd/3/S2475/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Interaction of aerosol particles composed of protein and salts with water vapor: hygroscopic growth and microstructural rearrangement" *by* E. Mikhailov et al.

E. Mikhailov et al.

Received and published: 30 January 2004

We thank Ari Laaksonen for the thorough review, positive evaluation, and constructive suggestions for improvement of our manuscript. Most suggestions will be implemented in a revised version. Answers to his specific comments (italic font; ACPD, 3, S1812-S1814, 2003) are given below.

Specific Comments

1) Accuracy of RH measurement. It is stated on p. 4763 that the accuracy of particle sizing and RH measurements is estimated to be +/- 2 %. Does this mean that if you measure an RH of 10 %, the error bar is at RHs between 9.98-10.2 % ? I suspect not.

Indeed the value of +/- 2% stands for the absolute accuracy over the whole RH mea-

surement range as indicated on p. 4761, l. 23 (e.g., 10 % +/- 2 % RH). The misleading formulation on p. 4763 will be removed in the revised manuscript.

2) Accuracy of growth factor measurement. On p. 4763 the accuracy of the diameter measurement is given as +/- 2%. On p. 4775 the relative measurement uncertainty of the GF is given as +/- 1%. How was this determined? Assuming the +/- 1% is correct, isn't it within the realms of possibility that in Fig. 4 there has been a drift in the system between the hydration and dehydration measurement series which has caused the crosses and the circles to move apart by 0.01 GF-units? In this case, I would not make any conclusions concerning microstructural rearrangement based on Fig. 4.

+/- 2 % is our estimate for the (relative) uncertainty in the absolute determination of mobility equivalent diameters (p. 4763). +/- 1 % is the precision of growth factors calculated from repeatedly measured mobility equivalent diameters, i.e. the typical scatter of data points within a narrow range of relative humidity as plotted in Figures 4, 5, 9, 10, 12, 13. The initial dry particle diameter ($D_{b,i}$) was regularly controlled to avoid drifts and measurement artifacts, and its relative standard deviation during H-TDMA experiments (up to 6 hours, up to 30 repeated measurements) was generally less than 1 %. Therefore we consider growth factor deviations by +/- 1% and more as significant. Nevertheless, we agree that such small deviations should not be over-interpreted, which we think not to have done. Ongoing experiments confirm significant deviations between the NaCl particle mobility equivalent diameters measured before deliquescence upon hydration and after efflorescence upon dehydration, depending on the conditions of aerosol generation. The new experiments and results will be presented in a follow-up publication.

3) Hypothesis 1. on p. 4778: Particles formed by crystallization are of (near-)cubic shape, regardless of the extent of NaCl supersaturation in the solution from which they crystallize. This is probably true in the sense that the particles have sharp corners. However, looking at the smaller ("irregular") particles in Fig. 6A1, I wouldn't say that they (at least all of them) are just cubes which have somewhat rounded corners (i.e.

ACPD

3, S2475–S2478, 2003

"between near-cubic and near-spherical") resulting from interaction with water vapor at 35% RH. Instead, elongated shapes can be seen, which probably result from fusion of two or more crystals growing in the drying solution droplet. The probability of having more than one crystal growing simultaneously depends on the extent on NaCl supersaturation in the solution droplet. In this sense the Hypothesis 1. is probably not formulated in the best possible way.

We agree that some of the particles illustrated in Fig. 6A1 appear to have irregular shapes which are not just in between cubic and spherical. This may indeed be due to irregular or multiple crystal growth upon efflorescence of the aqueous droplets, but it might also be due to (artificial) modifications during particle sampling and electron microscopy. In ongoing experiments we are trying to find out more about the actual shape of NaCl particles crystallizing from efflorescent solution droplets and its dependence on the drying conditions (supersaturation). The results will be presented in the follow-up publication mentioned above. For the time being, we agree that hypothesis 1 was not formulated in the best possible way. In the revised manuscript we will omit the formulations "in between cubic and spherical" (p. 4777, l. 8) and "regardless of NaCl supersaturation in solution droplet from which they crystallize" (p. 4778, l. 1).

Technical Comments

1) Abbreviations and acronyms are used in scientific papers because of space limitations and/or page charges. Neither is the case in ACP, and therefore the use of excessive abbreviations should be discouraged. Especially abbreviations which are not self-explanatory are irritating and should be avoided. Thus, please do not use the terms H-TDMA mode 1,2,3. The terms hydration mode, dehydration mode and hydration-dehydration mode are self -explanatory and not even that much longer. Also terms like SDD, VA, FP etc are not necessary.

In principle we fully agree that abbreviations and acronyms should not be used excessively. Nevertheless, we consider the used abbreviations useful or even necessary for

ACPD

3, S2475–S2478, 2003

Interactive Comment

a concise description of our measurements and calculations.

We think that some sentences referring to hydration dehydration (mode 3) as well as hydration (mode 1) and dehydration (mode 2) experiments would be hard to understand without the numerical distinction of different operation modes (e.g., p. 4783, l. 17/18; p. 4796, l. 7/8). Moreover, the terms hydration, dehydration and hydration dehydration refer primarily to the physical processes experienced by the investigated particles, whereas the H-TDMA modes 1-3 refer to the instrument operation. In the present manuscript the processes of hydration, dehydration, and hydration dehydration are investigated each only in one specific H-TDMA operation mode. In the planned follow-up publication, however, we will present hydration dehydration experiments in an additional fourth mode of H-TDMA operation (with pre-drying of the aerosol flow before DMA2). Therefore we would prefer to continue with the chosen nomenclature.

With regard to the model abbreviations VA and FP we think that some figure captions (Figs. 7, 8 and 13) and sentences in the model sections (e.g., in section 4.4.3) would become unnecessarily bulky if we abandoned these rather simple and unambiguous abbreviations. The reason why we used the abbreviation SDD in the text is not only to avoid frequent repetition of the relatively bulky expression "silica gel diffusion dryer" (e.g., p. 4777-4780), but also for immediate recognition in Figure 1. Therefore we would prefer to continue with the chosen nomenclature.

In fact, we still believe that the used abbreviations facilitate rather than complicate the reading of our relatively long manuscript. The manuscript length on the other hand, appears to be required for a complete and traceable description of the presented experiments, calculations, and conclusions.

2) On p. 4786, 2nd line from the bottom, there's an extra "seems".

Will be removed.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 4755, 2003.

ACPD

3, S2475–S2478, 2003

Interactive Comment