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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Novel method of generation of$Ca(HCO_3)_2$ and $CaCO_3$ aerosols and first determination of hygroscopic and cloud condensation nuclei activation properties" *by* D. F. Zhao et al.

Anonymous Referee #1

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The authors describe the development of a method to generate calcium bicarbonate/carbonate aerosol. Each step of the generation (solution atomization, drying, heating) is well-known to aerosol community but the combination of procedures is certainly a new and interesting approach. Overall the study combines an impressive number of experimental techniques, which give the authors an opportunity to describe the details of $Ca(HCO_3)_2$/$CaCO_3$ particle hygroscopisity and CCN behaviour. To my mind the use of Aerodyne AMS to detect solid carbonate particle is a novel approach and according to this paper has a potential to deliver quantitative results for artificially generated

aerosol. Despite the difficulties with collection efficiency the AMS results seem to be convincing that saturating $CaCO_3$ solution with carbon dioxide leads to formation of particles that outgas more CO_2 (than expected from $CaCO_3$) upon heating at 900°C in the vaporizer. The humidograms show a very moderate growth of generated particle size as a function of relative humidity (which is expected) with an interesting "compacting" feature for bicarbonate. Large chamber experiments put the laboratory results into "realistic atmosphere" prospective and amplify the significance of the findings. The paper and topic would be of interest to readers of *ACP* and I therefore recommend it for publication after the comments below have been addressed.

Specific comments:

1. As the collection efficiency is discussed in another submitted manuscript it would be useful to give more details about possible gas phase contribution to m/z 18 and 44.

2. Plotting data of Sullivan et al. (2009b) in Fig.9 sets a good benchmark for comparison of CCN activation properties. Atmospheric relevance of this figure can be significantly enhanced by adding data from Fig.2 of Koehler et al. (2009) *GRL*. This will allow a reader to compare properties of chemically resolved particles and complex dust surrogates.

3. Chan et al. (2005) *ACP* made a strong recommendation for reporting residence time for HTDMA systems. It would be desirable to give this detail for the system used here as the reference Buchholz et al. (2007) is not easy to access.

Minor suggestions:

p. 8011, L. 2 specify what do you mean by fine mode

p. 8011, L. 17 CO_2 formation has been also reported by Santschi and Rossi (2006) *J.Phys.Chem A* during trace gas uptake experiments with calcite

p. 8013, L. 14 expand CO_2 4.5, is 4.5 purity?

p. 8013, L. 14 20 mbar is pressure difference, right?

p. 8014, L. 7 change unstable to thermodynamically unstable

p. 8017, L. 14 add reference Wiedensholer (1988) *J.Aerosol Sci.* when referring to natural charge distribution.

p. 8018, L. 12 remove (Linde LiPur 6.0) as it was mentioned earlier

p. 8028, L. 6-8 the authors suggest a fast surface reaction and slow core conversion. Surface to bulk kinetic constrains were also suggested earlier for dust surrogate ATD reaction with nitric acid by Vlasenko et al. (2009) *PCCP*

p. 8028, L. 21 HNO_3 origin (heterogeneous or photochemically produced in situ?) should be specified as it was not added directly

p.8028, L. 28 specify major AMS peaks used for nitrate measurement

Technical:

Fig.8 use more legend types and other colors

Fig.11 specify in the caption green points. Different grades of blue are hard to distinguish. For example, middle blue curve is hard to find

Fig.12 Y-axis, closing bracket for units is missing.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 8009, 2010.