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Interactive comment on “CCN activation of fumed silica aerosols mixed with soluble pollutants” by M. Dalirian et al.

Anonymous Referee #1

Received and published: 9 October 2014

General comments

This study presents measurements of the CCN activity and agglomerated structure of pure and mixed particles containing an insoluble (fumed silica) and/or soluble component (either ammonium sulphate, sucrose, or BSA). Measured critical supersaturations are found to compare well with predictions from Köhler and adsorption theory based models when the agglomerated nature of the particles and the size dependence of the soluble volume fraction of the mixed particles are taken into account. The measurements are high quality and linked well to existing theory, and the material is presented clearly and concisely. The CCN activity of mixed insoluble-soluble particles is an important and timely topic and within the scope of ACP.

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My only major general comment concerns the agglomeration part of the study. I believe 2 important things are missing:

1) a discussion of why it is important to consider particle shape in the context of the theoretical frameworks that are discussed. Specifically, what are the physical reasons for using the surface equivalent diameter rather than mobility diameter in each term in Eq. 13?

2) a study of the sensitivity of predicted critical supersaturations to particle shape. Given the sensitivity of predicted critical supersaturations to the FHH adsorption parameters and soluble volume fraction, and the fact that both of these sets of parameters can be difficult to know for ambient particles, is it even necessary to account for particle shape?

Specific comments

P 23174, L18 - It seems the mass measurements were only performed for pure silica particles. What surface equivalent diameters were used for the mixed particles?

P 23174, L 24 - Were the contributions of the smaller soluble particle mode subtracted from both the CCN and CN measurements? How were the contributions of the smaller completely soluble particles to CCN concentrations determined? From theory?

P 23175, L 25 - Confusing statement. The A_{FHH} coefficient derived in this work is similar to that reported by Kumar (2011a) but the B_{FHH} coefficients are quite different, which I guess is why the results agree better with the Keskinan (2011) curve than Kumar (20011a) curve in Fig. 6?

P 23175, L 26 - Its concluded that these data are not sufficient to uniquely constrain the FHH adsorption parameters. What would be sufficient data? Given the complexity of atmospheric aerosols is it reasonable to expect useful FHH adsorption parameters could be obtained for modelling more complex systems?

P 23176, L6 - How pure? Need to be more specific since it is not mentioned in the

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experimental methods section.

P 23177, L14 - The structure idea could be tested by exploring the sensitivity of critical supersaturation to particle shape as mentioned above. E.g. Is the range of theoretical predictions of critical supersaturation for realistic shape factors comparable to the differences in critical supersaturation observed in Fig. 8c.

P 23197, Fig 9 - (and Figs. 10 and 11) Recommend keeping the same colour code as Figure 8, red - 5

Technical comments

P 23171, L18 - Typo in the equation for ϵ_s

P 23177, L24 and 28 - Typos in ω and ϵ

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 23161, 2014.

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