

Interactive comment on “Studies of propane flame soot acting as heterogeneous ice nuclei in conjunction with single particle soot photometer measurements” by I. Crawford et al.

Anonymous Referee #2

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This manuscript describes the measurement of a series of controlled experiments in which the ice nucleation efficiencies of soot particles of varying composition (organic and sulphuric acid content) are investigated using a combination of particle generation, freezing chamber, and sampling instrumentation. The authors report a decrease in IN activity with increasing organic aerosol content, and the approach of IN activity to that comparable to homogeneous nucleation of sulphuric acid with the addition of this acid to the soot+OC mixtures. The results of this work are relevant for the atmospheric/climate community, and the measurements are technically credible. The manuscript is recommended for publication in ACP after the comments below are addressed.

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It is unclear how the authors arrived at the nominal organic carbon contents of 5, 30, and 70% (mass basis?). Also, can the authors make statements about the composition in the organic fraction of the aerosol and its relevance?

Are the non-incandescing particles possibly purely OC? Given the size range over which the SP2 can measure scattering particles, would it be faithful to say that these fractions represent the number fraction of all particles generated by the CAST burner, or could there be smaller or larger particles outside of this range that may also be influencing the results?

How comparable is the (sulphuric-acid) coated to non-coated case as there is an additional "pre-treatment" (heating) of the soot+OC aerosol prior to sulphuric acid coating? Could this not evaporate organics or modify the morphology of the soot? Why were the temperature treatments different for the OC5 and OC70 case?

What is the estimated mass fraction or coating thickness of sulphuric acid on the particles? Were there any TEM images taken for sulphuric acid-coated BC particles? Were there noticeable differences in size (either through mass addition or collapsing of fractal aggregates of BC) as measured by the SMPS? From this work, is it possible to speculate whether another acid species can play a similar role in the atmosphere, or are the effect effects specific to the molecular properties of sulphuric acid (based on a mechanistic interpretation of the observations)?

It is a notable conclusion that the coating of sulphuric acid draws the required ice nucleation supersaturations toward that of homogeneous sulphuric acid, but how is it that homogeneous freezing of sulphuric acid becomes the dominant mechanism even while they are internally mixed with particles shown to form ice nuclei at lower saturation ratios (OC5 case)? It would seem that the nucleation rate should be governed by the fastest mechanism in the system. Also, some statement of sulphuric acid content on a mass or coverage basis would be helpful to interpret the magnitude of influence of sulphuric acid coatings for the OC30, OC70 cases.

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p.11014, sentence beginning on line 5 – not sure if this sentence is structured as intended.

p.11016. Can you discuss the relevance of the reference expansion measurements?

p.11018 – this "coating" is due to the remaining ice, or it is due to the enriched fraction of organics in activated particles? Is it possible to detect the difference in the mass size distributions in the interstitial particles?

Figures 5 and 7 – which work does ACP 2003 refer to? Also, shading areas corresponding to atmospherically-relevant ranges of supersaturations in these figures would be helpful to place the work in appropriate context.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 11007, 2011.

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