

***Interactive comment on “Irreversible loss of ice  
nucleation active sites in mineral dust particles  
caused by sulphuric acid condensation” by  
R. C. Sullivan et al.***

**Anonymous Referee #2**

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The following paper looks at the effect of acid and ammonium sulphate coatings on the ice nucleation ability of mineral dust particles. The topic is important for understanding the ice nucleation ability of mineral dust particles in the atmosphere. The paper also nicely adds to the growing body of literature on the topic and provides new insight. For example this paper addresses the effect of heat processing and ice nucleation below and above water saturation. As a result the paper is well suited for ACP. Below are some suggestions for improving the manuscript. The authors should address these comments adequately before publication.

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I suggest that the authors consider removing the data and discuss on the experiments with the H<sub>2</sub>SO<sub>4</sub> coatings followed by the water bath (3rd panel in Figures 4 and 5). The authors cannot rule out contamination by NH<sub>3</sub>, and as a result, the discussion is speculative. I suggest that this discussion be left for another paper when contamination can be ruled out.

Page 16903, line 2-3. Replace “ice vapour pressures” with “h<sub>2</sub>O vapour pressures” or “ice supersaturations”? The same comment applies to line 11.

A discussion on the kinetics of water uptake into the acid coated particles would be beneficial. Do the acid coatings come into equilibrium with the RH on the time scale of the experiments?

Page 16919, line 21-22. Could the results also suggest that only a fraction of the particles were coated with sulphuric acid? The results from the single particle mass spectrometer would be useful here.

Page 16920, line 20-23. Here I assume that “irreversibly” implies a chemical reaction. Could it also be the case that even at very low concentrations of sulphuric acid, sulphate still blocks active sites. Please discuss. I agree that the heat processing experiments show a chemical reaction.

I don't completely understand how the authors are deciding if a result is statistically different when comparing results from different processing. See for example:

Page 16914, line 25-26. “Coating with sulphuric acid at 70 or 85 C caused large decreases in fIN of at least one order of magnitude both below and above water saturation.” The results for T=-25C, RH<sub>w</sub>=105%, and coating with SA=70C does not appear to be consistent with this conclusion.

Page 16916, line 1-2. “The additional humidification step caused a larger decrease in fIN for the immersion/condensation-freezing regime compared to the SA coated reference treatment.” But, for T=-30C, RH<sub>w</sub>=105%, and SA=70C it looks like the error bars

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overlap.

Page 16917, line 25. "Sulphuric acid coated dust particles always had reduced fIN compared to uncoated dust, except for the 45 C coating in the immersion/condensation-freezing." Is this statement consistent with the T=-25C, RHw=105%, and SA=70C data? The data appear to overlap, at least for one measurement.

Page 16918, line 4. "Heating coated dust reduced fIN further in the immersion/condensation-freezing regime." Is this true for SA=70C? Again, I am not sure what error bars to consider here.

How are the authors judging whether or not a result is statistically different? I realize that repeating a measurement several times may be impractical during a campaign. Please expand on the method used to determine if a result is statistically different and ensure the conclusions and specific statements are in agreement with the statistics.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 16901, 2010.

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