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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Efficiency of immersion mode ice nucleation on surrogates of mineral dust" *by* C. Marcolli et al.

Anonymous Referee #2

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General comments: In this manuscript Marcolli et al. present an experimental study of the efficiency with which mineral dust nucleates ice within water droplets. In their experiments they employed a differential scanning calorimeter to measure the temperatures at which ice nucleated in droplets which contained Arizona Test Dust (ATD) inclusions. These droplets were suspended in oil emulsions. By varying both the size and concentration of mineral dust particles in the droplets and then modelling the results in the framework of classical nucleation theory they were able to draw some important conclusions about how mineral dust particles act as ice nuclei. This paper is well written and of is focused on very topical questions that are within the scope of ACP. I recommend this paper for publication in ACP subject to satisfactory responses to the following comments.

Specific comments: 1) What is the influence of the lanolin surfactant, if any? Lanolin is added to the oil phase in order to stabilise the water-oil interface. Is it possible that the lanoline also goes to the solid-aqueous interface (i.e. the surface of the immersed ATD) and therefore alters the ice nucleation efficiency of the mineral particles? The authors quote a few papers where heterogeneous nucleation in the immersion mode has been studied in oil emulsions as a justification for this approach. However, in these previous studies (Zuberi et al and Zobrist et al) the solid particles were generated within the aqueous droplets only after the emulsion had been formed. Hence, it is difficult to see how the surfactant could get to the solid-aqueous interface. The present study employs a different approach. Here the authors mixed an aqueous suspension of ATD with oil using a high speed mixer, i.e. they mechanically break the solution down into small droplets. I am concerned that during this vigorous mixing process ATD particles could come into contact with oil and pick up some lanolin at their surface. Maybe the authors have thought about if lanoline would energetically be allowed to sit at the solid-liquid interface. If the authors are happy that the surfactant is not an issue, then they should indicate why in the manuscript.

2) P 9700 (lines 17-21). This seems to be repeated from earlier in the paper.

3) P9701 (lines 19-21). Here the authors discuss the relevance of their results to Knopf and Koop's ice nucleation experiments. The authors have made a distinction between immersion and condensation freezing. My understanding is that condensation freezing is where one starts with a dry solid particle and it takes up water and some remaining solid then nucleates ice within the droplet. Whereas immersion freezing is where a solid particle immersed in liquid then nucleates ice. Surely, in the condensation mode once a solid particles is immersed in water then it becomes the immersion mode. The only distinction is the history of the droplet. Hence, the authors explanation doesn't seem to explain why there is a difference between your and Knopf's experiments. An alternative explanation might be the differences in time spent at one temperature. I think Knopf and Koop spend longer at 260 K than the present authors and therefore

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nucleation should be more probably.

4) P 9702 (lines 10-13) I do not understand these lines. Maybe delete lines 11-13 and leave a revised form of line 10?

5) p9704 and 9705. How were the parameters in eq 8 derived. Is this some sort of best fit to the data? Did you perform a least squares fitting procedure? Is this a unique solution? Please clarify.

Technical comments: 1) P9700 (line 15). 'Modeled' should be 'Modelled'. I am using a UK dictionary not a US one (not sure what the ACP rules are?).

2) P9699 (line 5). Full stop after balance and start a new sentence.

3) P9699 (line 5 and 6). I suggest you revise this to the following: In the AIDA chamber Benz et al observed homoĚĚ.

4) P9705 (line 19) Replace 'Neither the contact angle nor the active site distribution allows to fully explain the tail to higher freezingĚ..' with 'Neither the contact angle nor the active site distribution fully explain the tail to higher freezingĚ..'

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 9687, 2007.

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Interactive Comment