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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Influence of surface morphology on the immersion mode ice nucleation efficiency of hematite articles" *by* N. Hiranuma et al.

**Anonymous Referee #2**

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This paper presents systematic studies of the ice nucleating properties of milled and unmilled hematite particles. The particles are artificially generated (i.e. they are not natural samples), and are presumably of uniform composition and size. They are then ground with bronze beads into somewhat smaller sizes, their properties are measured (size, morphology, surface area, surface charge) and then they are injected into the AIDA chamber under immersion mode conditions. Although a small fraction of particles nucleate via deposition mode freezing, results are presented for immersion mode freezing. A conclusion is that the milled particles are better IN, and the different surface areas between the milled and unmilled samples cannot explain the observations.

Rather, it is thought that the surface roughness (e.g. pores, scratches) are important, acting as IN active sites. This is a reasonable hypothesis, and one supported just loosely by a number of prior experiments. I like this paper because it systematically attempts to address this roughness phenomenon.

Some comments:

1. The aerosol surface areas are measured in the AIDA chamber by APS only. APS instruments can have problems measuring surface areas for small particles. Are the authors confident that there is not significant aerosol surface area, at small particle sizes, present in the milled particle experiments that is not being captured by the APS? Were SMPS measurements also performed?

2. Just a small amount of chemical contamination could significantly affect the results. How did the authors confirm that chemical contamination of the milled samples did not occur when milling was conducted? For example, did any material from the bronze beads become attached to the hematite particles? Could the EDX results (mentioned in the Abstract) be explicitly described in more detail in the paper? What limit of detection do they have? How strong is the belief that the hematite particles are of the same composition milled and unmilled?

3. Although it is likely that surfaces of the milled particles are roughly at a microscopic level, there is no direct evidence in the paper to support this. Very high spatial resolution electron microscope images of these scratches/pits/edges would have made the paper much stronger.

4. I don't see strong justification for including the atmospheric modeling. It does not present major surprises, given the laboratory results that feed it.

5. Page 23761, line 8. What is meant by "aged"?

Overall, I think this paper should be accepted, after these concerns are addressed.



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