

Comment on acp-2021-883

Anonymous Referee #2

Referee comment on "Enhanced soot particle ice nucleation ability induced by aggregate compaction and densification" by Kunfeng Gao et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-883-RC2>, 2021

This paper presents results from laboratory experiments investigating the ice nucleating (IN) ability of two types of soot. Test samples were physically agitated to change their physical morphology and the IN ability of the fresh and "aged" particles were measured with a continuous flow diffusion chamber. Samples were also meticulously characterized to determine the physical changes induced by mechanical agitation. The experiments are well designed and extremely thorough and the results are clearly presented. I recommend that this paper be published after consideration of a few minor points listed below.

- Two types of commercially available soot were used for this study. However, there is no discussion of why these soot types were chosen, and whether they are at all representative of atmospheric soot emissions. Further, results show that the two soot types behaved differently when physically aged, indicating that there is some species dependence to the reported results. Some discussion of the generalizability, and limitations, of the results should be included. Also, some discussion should be included about why these two samples were chosen.
- The soot samples were "aged" by mechanical agitation with a stir rod for up to two weeks. The authors claim that this resulted in only physical changes to soot particles. However, is it possible that there was some uptake of organic vapors (which are ubiquitous unless working in extremely clean conditions) during this time? And, if so, how might this have affected the results? This is especially important as the soot samples were first stripped of all deposited vapors via heating under vacuum, and thus would have been very susceptible to organic vapor uptake.
- Related to the above, atmospheric aging almost always involves chemical changes. Thus, while this study provides a detailed examination of the changes in IN ability due to (likely) physical changes, how can these results be applied to the atmosphere? Some discussion of this should also be included.
- I would recommend rearranging section 3 and dividing it into separate "Results" and "Discussion" sections. Specifically, I would move figures 11 – 13 earlier when discussing the physical changes to the soot particles. Then present the IN results and have a separate section discussing how the physical changes might result in the IN changes and what the implications of these changes are. However, this is just a recommendation and I leave the final decision up to the authors.

- In Figure 4 you should change the symbols for fresh samples to open markers to match the other figures.
- While the paper is generally well written, it would benefit from thorough proofreading for English grammar and word usage.