

***Interactive comment on* “Surface roughness during depositional growth and sublimation of ice crystals” by Cedric Chou et al.**

Anonymous Referee #3

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General Comments:

This unique laboratory study combines a laminar flow tube with a laboratory version SID-3 instrument, where flows from a “dry” and a “wet” laminar flow tube are mixed to control the supersaturation characterizing ice crystal growth at the flow tube outlet where SID-3 measurements are made (including microscope imagery). The methodology is adequately explained while the results are well explained, and the paper is well organized. The results advance our knowledge of the dependence of ice particle optical properties on ice growth/sublimation processes. I did not find much to criticize in this study.

Specific Comments:

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1. Page 5, line 2 regarding Fig. 4: The measurements agree well with the Fluent calculations except at $-40\text{ }^{\circ}\text{C}$ at low flow rates. Please suggest reasons for these differences.

2. Page 9, lines 15-16: “these observations indicate that the more growth-sublimation cycles are performed, the rougher the crystal can become.” Figure 11 does not seem to support this. Rather, the 3rd maximum in surface roughness in Fig. 11 (corresponding to the 3rd growth cycle) is slightly lower on average than the 2nd maximum in Fig. 11 (although both maximums are comparable). Therefore, it appears possible that a limiting roughness threshold exists that would not be exceeded in subsequent growth-sublimation cycles. This possibility should be acknowledged. Such a possibility seems consistent with our theoretical understanding of ice crystal surface kinetics and growth processes. Moreover, future work should explore this possibility by analyzing 3 or more continuous growth-sublimation cycles in multiple experiments at various wall temperatures. If a laboratory roughness threshold were established (possibly being supersaturation- and temperature-dependent), then the next logical step would be to look for evidence of this in natural cirrus clouds. Quantifying and bounding the degree of ice crystal surface roughness is needed to reduce uncertainty in the cirrus cloud radiative effect (CRE) in climate models.

Technical Comments:

1. Page 3, line 23: space between “the” and “central”.

2. Page 16, lines 19-21: Reference cited incorrectly. Title should be “Cloud chamber experiments on the origin of ice crystal complexity in cirrus clouds”, and the year of publication should be 2016. I have not checked other references; the authors should check these too.

3. Figure 3: In lower panels, the y-axis labels should be changed from “ration” to “ratio”. Regarding saturation profile panel “b”, should %5 l/min be 5 l/min?

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4. Figure 4: Flow units are in “dl/min”; should this be l/min? If not, define dl.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-254>, 2018.

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