Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-285

Anonymous Referee #1

Referee comment on "An oxidation flow reactor for simulating and accelerating secondary aerosol formation in aerosol liquid water and cloud droplets" by Ningjin Xu et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-285-RC1, 2022

The authors present a new flow reactor designed for investigating multiphase chemistry in aerosols and cloud droplets. This is an interesting and technically challenging idea, which could potentially be an important tool to gain insights into these understudied processes. Care was taken in the design of the reactor to avoid temperature gradients due to the UV lamps, which would interfere with multiphase partitioning, to minimize losses of soluble gases, and to strictly control RH. They use a Spot sampler to generate cloud-like droplets from seed aerosol for study in the reactor. They present preliminary results for studies of the influence of aqueous processing on SOA formation in the lab and using ambient air. I believe the manuscript is publishable in AMT after some minor issues are addressed and the manuscript is revised accordingly.

- The article is too long, with 17 figures in the main text. Surely this can be tightened up, with some material moved to SI. At the same time the most interesting figure (the second Figure S2 - there are two Figure S2s) has been relegated to the SI.

- The abstract is also too long. It's not immediately clear what "transmission efficiencies" are upon reading the abstract without first reading the manuscript.

- Why is K2SO4 used instead of other particle types which may be more representative of atmospheric aerosol or more typical of laboratory studies of aerosol and cloud chemistry? I think the question is answered several pages later on line 496 but should also be acknowledged when this is first mentioned. Also note that "neutral" isn't really representative of ambient aerosol or cloudwater pH (cf. Pye et al. 2020)

- the size dependence of the particle tranmission efficiency is mentioned, and compared with other studies, but no physical explanation for decreasing transmission for smaller particles is given. One would expect the opposite.

- The SO2 transmission efficiency at high RH is low. Presumably studying SO2 multiphase chemistry was one of the main intended purposes of this apparatus. Can the authors comment on how this issue may impact the design of future studies?

- line 444: 'described in by (Mitroo et al)'... clean that up

- residence time distribution: why is there a distribution at all if the gases or particles are introduced in the same location and sampled in the same location (if this is not the case it's not possible to tell from the text)? How are three measurements sufficient to construct the whole RTD curve and detect the absence of a long tail?

- line 490 - I would either delete or rephrase this. You are presumably introducing this apparatus for the first time in this manuscript, why are you making this statement about it not being applied very often to cloud chemistry studies when that is the most novel and unique application?

- Figure 9 and Figure S2. See my comment above about the second Figure S2. It is much more interesting than Figure 9. Figure 9 has been sufficiently described in the text lines 500-507. It could be made panel B of a figure which focuses on the data in Figure S2, moved to SI, or eliminated. How was the low SO2 transmission efficiency dealt with in these calculations?

- Is the relatively short residence time of APPA compared to a chamber experiment an issue when it comes to SOA studies?

- What is the reader supposed to take away from the SOA yield studies shown in Figure 15? Were these yields consistent with expectations?

- funding acknowledgement seems to be missing.