

Interactive comment on “Secondary organic aerosol formation from photooxidation of furan: effects of NO_x level and humidity” by Xiaotong Jiang et al.

Anonymous Referee #2

Received and published: 29 July 2018

This manuscript reported a series of indoor chamber experiments on secondary organic aerosol (SOA) formation from oxidation of furan in a smog chamber. Specifically, the authors conducted experiments under different concentrations of NO_x and variable RH conditions. They found that the relatively high NO_x level and increasing relative humidity can promote the formation of furan SOA. Based on mass spectra and FTIR analysis, the chemical composition of furan SOA were investigated, which are mainly organic nitrate compounds. The topic is appropriate for the journal, and the paper is in general well written. I believe this manuscript could be accepted after the following issues are addressed.

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Specific comments:

1. Page 3, line 29. “. . .that all the NO, NO₂, NO_x, and ozone concentrations were less than 1 ppb, and the particle concentration was lower than 10⁻³ cm⁻³.” NO_x=NO+NO₂, thus, “NO_x” should be deleted. The particle concentration should be 10³ cm⁻³ but not 10⁻³ cm⁻³. The reviewer doubts that the 4 hrs' clean time is long enough to make the chamber cleaned thoroughly. The number of particles in a fully cleaned chamber should be none or only several to dozens. How the authors eliminate the effects of background particles?
2. Page 3, line30, if this 10⁻³/cm³ number is correct? I think this is probably wrong.
3. Page 4, line 4. “NaCl was solid when RH was below 45 % (Gao et al., 2007), and liquid droplets when RH was higher than 60 % (Ge et al., 2017a)”. The DRH and ERH of NaCl are about 75% and 45%, respectively. The authors need to make sure that they clearly understand the conditions of the references and quote them correctly.
4. Page 4, line 14-15, what are the units of these numbers? if they are ppb for NO₂ and O₃, and particle numbers for the aerosol particles? Please clarify.
5. Page 4, line 27. “(Master (Master TD, Dani, Italy)”, the “(Master” should be deleted.
6. Page 6, Experimental section. The program settings of ESI-MS during sample analysis should be addressed.
7. Page 6, line 20. In the manuscript, the authors mentioned that “With the decrease of the NO_x concentration, the concentration of O₃ increased rapidly in the beginning of the experiment to reach the maximum, and then remained constant throughout.” As an oxidant, O₃ would be consumed during the experiments. The authors should explain the reasons why the O₃ could remain constant during the experiments. I do not think the explanation that “the main sinks of furan are oxidations by O₃ and OH, and the reaction products are RO₂ and HO₂ radicals, which promote the cycling of O₃ formation by converting the NO back to NO₂” is the main reason.

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8. Page 6, 3rd paragraph. During the experiment, the number concentration of particles decreased with time. Besides the coagulation of particles, the authors thought that "With SOA formation, organics start to dominate and result in enhanced growth of clusters, which promote the decay of the particle number concentration". I do not agree with that. The formation of clusters can promote the new particle formation, which will increase the particle number concentrations. On the other hand, what is the role of NaCl seed during the experiments? Is the SOA mainly formed on the surface of seed particles? Does the existed particles make senses on new particle formation? It is important to understand this process, because it is related to the formation mechanism of SOA.

9. Page 7, line 9. The authors mentioned that "Experiments were started with an average of $12.6 \mu\text{g m}^{-3}$ of NaCl seed aerosol". However, in part 2.1 on page 4, they said the initial mass concentrations of seeds were $6 \mu\text{g m}^{-3}$ on average.

10. Page 7, line 16. The sentence that "It exhibits a sharper increase of O₃ formation at 42 % RH than that at 5 % RH" is confusing, because it lacks of preconditions.

11. Page 7, line 17. The authors should show the reasons why the influence of RH on O₃ is not obvious compared to that of NO_x. What is the intrinsic mechanism?

12. Page 8, line 1 and line 17. Much higher SOA yield can be obtained under different RH conditions than that under different NO_x levels. Why? The authors should give the intrinsic mechanisms of SOA formation under different NO_x levels and RH conditions.

13. Fig. 4. The SOA yields had a sharper increase under <45% RH conditions, but a gentle increase at >45% RH. How the authors draw a conclusion that the ALW played an important role in gas/particle partitioning during the experiments? The abbreviation of "ALW" in the caption or "LWC" in the figure should be consistent.

14. Page 8, line 33. Although the organic groups of -COOH, -OH, -CO and -COH are hydrophilic, the hygroscopic growth factor (GF) of SOA is about 1.05 at 75% RH (Meyer

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et al., 2009), which is quite weak compared with that of NaCl and NaNO₃. Thus, the contribution of SOA to ALW is not important.

15. Page 10, 1st paragraph. The results of FTIR showed that all functional groups increased by factors of about 2 when the RH ranged from 42 % to 85 %. Why the SOA yields showed in Fig.4 only had an increase of 14% when RH ranged from 42 % to 85 %?

16. Fig. 9 is not clear enough. Positive and negative ion modes were used to analyze different kind of compounds, respectively. The authors should make a comparison between the same modes, and mark the identified compounds in the figure.

17. From the results of FTIR and ESI-MS, the authors obtained that the compounds were similar both under different NO_x levels and RH conditions. Does it demonstrate that the SOA formation mechanisms are similar? If so, what's the role of seed particles in the experiments? What is the mechanism of furan SOA formation?

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-477>, 2018.

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