Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2021-61-RC2, 2021

Comment on acp-2021-61

Anonymous Referee #2

Referee comment on "SO_2 and NH_3 emissions enhance organosulfur compounds and fine particle formation from the photooxidation of a typical aromatic hydrocarbon" by Zhaomin Yang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-61-RC2, 2021

General comments

The authors have studied SOA formation from photo-oxidation of 1,2,4-trimethylbenzene under different concentrations of NOx, SO2 and NH3 in an indoor smog chamber. The reactants and the particle generation and growth were monitored using a series of standard instrumentations. The chemical functional groups were characterized by ATR-FTIR in each experiment and inorganic constituents were analyzed using ion chromatography. The molecular level information is provided using UPLC-HRMS and dd-MS2 scans. Ten new organosulfates are identified in the presence of SO2, including 3 in which the origin was previously unknown and some previously reported to be originated from biogenic precursors. Formation mechanisms for 8 of the newly identified organosulfates are proposed based on previous literature. Their results indicate that SO2 is a key parameter for ultrafine particle formation. A synergistic effect of NH3 and SO2 in particle formation is also shown, indicating the importance of reducing both SO2 and NH3 emissions to improve lowering PM. Their results also suggest that ammonium sulfate form by the reaction of NH3 with H2SO4 facilitate aerosol formation and growth through condensation of organic vapors.

This article advances the current knowledge of aerosol formation from photo-oxidation of a typical aromatic hydrocarbon in the presence of NOx, SO2 and NH3, therefore is of interest to the scientific community of ACP. The manuscript is well written and organized. The experiments are well executed, methods are explained adequately, results are discussed thoroughly, and conclusions are well supported. I have some minor comments to improve the quality of this manuscript that are listed below. I recommend accepting this manuscript for publication in ACP with minor revisions.

Specific comments

Line 13 – Indicate the major emission sources of TMB.

Line 45 – Define ‘certain regions.

Line 54-56 – Add reference/s.

Line 98-99 – Briefly indicate what MCM is and add a link to the version.

Line 210 – Indicate how the mass calibration was performed.

Line 200 – Indicate the mass resolution in full MS, top N in dd-MS2, isolation width (mass window) etc

Line 277 – Add initial growth rates to Table 1 or SI.

Line 277-280 – Can the authors elaborate the reasons for the observed non-linear response of the particle diameter with initial SO2 concentrations?

Figure 4 – Indicate what error bars represent.

Figure 5 – Indicate the experiment numbers relevant to a) to f)

Lines 346-348 – Add detailed information of the common products observed in SO2 free and SO2 involved experiments to the SI.

Table S3 – Indicate clearly whether this table shows the compounds that are detected in both SO2 free and SO2 involved experiments with NH3 or the products only formed from the experiments involved both NH3 and SO2.

Tables S2 and S3 – Add UPLC retention times.

Technical corrections

Line 105 – Add ‘in the atmosphere’ to the end of “Given the ubiquity of SO_2, NH_3, and TMB…

Line 200 – It is better to write it as data-dependent MS/MS (dd-MS2) scans

Line 206 – Add B after 3%.

Figure 6 – Label the red structures as OS-226, OS-228…etc. (Authors may replace the chemical formula with their abbreviated names as the structures are shown.)

Figure 10 – Match the color of the TMB on the figure with carbon number (should be light blue as it has 9 carbons)