**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "The link between organic aerosol mass loading and degree of oxygenation: an α-pinene photooxidation study" *by* L. Pfaffenberger et al.

Anonymous Referee #1

Received and published: 14 November 2012

This manuscript describes chamber studies that have produced highly oxidized a-pinene secondary organic aerosol (SOA) that is as oxidized as ambient aerosol. This is an interesting study because it is the first report of chamber SOA for this precursor with such a high level of oxidation and because the authors use it to address the roles that organic loading and OH exposure play in achieving this oxidation level. I think this work is useful from both experimental and modeling viewpoints and I recommend publication after the following issues are addressed:

Main Comments

1) The current manuscript under-utilizes all the information that can be obtained with a

high-resolution AMS. It is now typical for high-resolution AMS datasets from chamber data to be described not only in terms of their f44 and f43 values, but also in terms of their O/C and H/C ratios (see the Chhabra et al. article cited in this manuscript, for example). I recommend that the authors include Van Krevelen diagrams next to the f44-f43 diagrams and also add in O/C values in addition to f44 in figure 3. A supplementary figure showing the f44 vs. O/C (Aiken et al.) and f43 vs H/C (Ng et al. 2011a) would also be useful for reference to see how well the published empirical relationships work for this system.

2) It would be helpful if the authors put this work in context of other chamber work. Previous manuscripts (Shilling et al., Chhabra et al. (2011), Ng et al (2010)) have already identified the importance of operating at lower loadings and there are several other chamber studies on this particular system. What have the authors done differently to allow for operation with lower loadings? Are the authors also achieving higher OH exposures than is typical in smog chamber operation? A short paragraph in the introduction outlining and stressing the differences/advances made in this work would be useful for the reader who is not fully aware of all the details of chamber studies.

3) The data shown in Figure 3 (f44 vs. organic mass concentration) differs from tha shown in Figure 7 of Ng et al. (2010). The Figure 7 Caltech a-pinene photooxidation data (high NOx and low NOx) appear to level off at an f44 of 6% at less than 50 ug/m3, but in Figure 3 of this manuscript, f44 is still as higher than 10% even at 90 ug/m3. The authors should address this difference in discussion of Figure 3 of this manuscript.

In the Ng et al. Figure 7 the chamber data are consistent with ambient urban site data. How do the slopes obtained in this work compare to the f44 vs organic slopes discussed for this ambient urban site data in Figure S3 of Ng et al. (2011b)? I recommend that the authors add a little discussion on this comparison in the manuscript when discussing this slope in p. 24750, Line 5-10..

4) Table 2: Is there a way to graphically display so that it would be easier to digest? For

example, could you plot an image plot of OH exposure vs. organic mass colored by f44? A plot like this would make it easier to figure out the operating parameters which would yield the desired f44. The authors could also identify regions of this diagram which have been used in previously published a-pinene chamber studies to underscore why they haven't been able to achieve the high oxidation levels.

Minor comments

1) p. 24738, L17-20: the authors should be more explicit that there are some non-oxygenated precursors like naphthalene and toluene, for example, that also produce highly oxygenated SOA that is at the very edge of the LV-OOA range.

2) p. 24740, L7-9: The authors should be more explicit as to what they mean by extensive aging?

References cited:

1)Aiken, A.C., P.F. DeCarlo, J.H. Kroll, D.R. Worsnop, J.A. Huffman, K. Docherty, I.M. Ulbrich, C. Mohr, J.R. Kimmel, D. Sueper, Q. Zhang, Y. Sun, A. Trimborn, M. Northway, P.J. Ziemann, M.R. Canagaratna, T.B. Onasch, R. Alfarra, A.S.H. Prevot, J. Dommen, J. Duplissy, A. Metzger, U. Baltensperger, and J.L. Jimenez. O/C and OM/OC Ratios of Primary, Secondary, and Ambient Organic Aerosols with High Resolution Time-of-Flight Aerosol Mass Spectrometry Environmental Science & Technology, 42, 4478–4485, doi: 10.1021/es703009q, 2008.

2) J.E. Shilling, Q. Chen, S.M. King, T. Rosenoern, J.H. Kroll, D.R. Worsnop, P.F. De-Carlo, A.C. Aiken, D. Sueper, J.L. Jimenez, and S.T. Martin. Loading-Dependent Elemental Composition of a-Pinene SOA Particles. Atmospheric Chemistry and Physics, 9(3), 771-782, 2009.

3) Ng, N.L., M.R. Canagaratna, Q. Zhang, J.L. Jimenez, J. Tian, I.M. Ulbrich, J.H. Kroll, K.S. Docherty, P.S. Chhabra, R. Bahreini, S.M. Murphy, J.H. Seinfeld, L. Hildebrandt, N.M. Donahue, P.F. DeCarlo, V.A. Lanz, A.S.H. Prevot, E. Dinar, Y. Rudich, and D.R.

Worsnop. Organic Aerosol Components observed in Northern Hemispheric Datasets measured with Aerosol Mass Spectrometry. Atmospheric Chemistry and Physics, 10, 4625-4641, 2010. DOI: 10.5194/acp-10-4625-2010

4) Chhabra, P.S., N.L. Ng, M.R. Canagaratna, A.L. Corrigan, L.M. Russell, D.R. Worsnop, R.C. Flagan, and J.H. Seinfeld. Elemental Composition and Oxidation of Chamber Organic Aerosol. Atmospheric Chemistry and Physics, 11(17), 8827-8845, 2011.

5) N.L. Ng, M.R. Canagaratna, J.L. Jimenez, P.S. Chhabra, J.H. Seinfeld, and D.R. Worsnop. Changes in Organic Aerosol Composition with Aging Inferred from Aerosol Mass Spectra. Atmospheric Chemistry and Physics, 11(13), 6465-6474, doi:10.5194/acp-11-6465-2011, 2011a.

6) N.L. Ng, M.R. Canagaratna, J. L. Jimenez, Q. Zhang, I.M. Ulbrich, and D.R. Worsnop. Real-Time Methods for Estimating Organic Component Mass Concentrations from Aerosol Mass Spectrometer Data. Environmental Science & Technology, 45, 910–916, 2011b.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 24735, 2012.