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Atmospheric
Chemistry
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Discussions

Interactive comment on "Wavelength and NO_x dependent complex refractive index of SOAs generated from the photooxidation of toluene" *by* T. Nakayama et al.

Anonymous Referee #3

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This study investigates the dependence of the complex reflective index at 405nm, 532nm, and 781nm of SOA formed from toluene and 1,3,5-trimethylbenzene as a function of NOx. It is found that the k values for toluene SOA increase to shorter wavelengths at <405nm, and the k value at 405nm increases with NOx concentration. The authors note that the light absorption for 1,3,5-trimethylbenenze SOA is negligible at all wavelengths.It is hypothesized that nitro-aromatic compounds such as nitro cresols are the major contributors to light absorption of toluene SOA.

While this work can provide further information for understanding the optical properties of aerosols, in many places the discussions are inadequate and/or not clear (see specific comments below). The authors need to address these issues before the manuscript can be recommended for publication.

Specific comments:

1. Page 14556, experiment section. The initial hydrocarbon concentration used is about 4ppm for toluene experiments and 2 ppm for 1,3,5-TMB experiments, which leads to the formation of $>$ 100 ug/m3 SOA in some experiments. With such a high SOA loading, more semi-volatile species would partition into the particle-phase and result in an SOA composition that is very different from experiments performed at more atmospherically relevant loadings. How would this potentially affect their measurements and conclusions? The authors need to comment on the atmospheric relevance of their experiments. (with the exception of some very polluted places, typical ambient aerosol loading is much lower than 100 ug/m3).
2. Page 14556, lines 26-29. The authors noted that the bsca (532nm) was not used in this study as a strong particle size dependence of the calibration factors was found. The authors need to include more details and discussions regarding this. Why is such size dependence calibration only found in the 532nm case? What sizes of PSL particles are used? Further, how are the uncertainties noted in line 29 calculated?
3. Page 14557, line 15. I would imagine with all absorption and scattering coefficient measurements at 405nm, 532nm, and 781nm, the authors would also measure the extinction coefficients at these 3 wavelengths. Is there a reason why only the extinction coefficient at 532nm is measured?
4. Page 14558. The authors wrote “significant light absorption was found at 405 and 532nm in run A4”. However, it is difficult to tell how “significant” the light absorption is at 532nm from Figure 3b (it looks like the values are around zero from the scale in Figure 3b).

5. Page 14560, lines 11-22. The authors noted that at 532nm, a non-negligible k value (1e-3) is obtained under high NOx conditions. Later, the authors wrote that the typical uncertainty in k value determined by PASS-3 is $\sim$ 1e-3. Therefore, it would seem like the measured k vale is just in the uncertainties? If so, I do not think the author can read too much into the value. The authors also need to be more explicit as how they calculate the uncertainties.

6. Page 14560, last paragraph. The authors wrote "the light absorption of toluene SOA steeply increases to short wavelengths at $<$405nm". This work does not have any measurements at $<$405nm, and it seems to me that this statement is made by including the data from Nakayama et al and Zhong and Jang. However, the error bar in the k value in the earlier Nakayama work is very large. I do not think that the authors can conclude from Figure 5 that there is a steep increase at $<$405nm. Further, while the experimental conditions in the earlier Nakayama work are probably similar to the current work, it is not clear if this is the same case for the work by Zhong and Jang. The authors need to comment on this.

7. Page 14561, lines 9-11. The authors wrote "…because the stronger light absorption under high NOx conditions would cause a larger increase in the n values of the long-wavelength side". I do not understand this. The n value at 405nm increases from 1.45 to 1.57, the n value of at 532 nm increases from 1.43 to 1.50. From these results it seems like there is a larger increase in n value at *shorter* wavelength?

8. Page 14561, lines 15-24. Again, from the uncertainties, I do not agree with the authors that the k value at 532nm is also increasing. Further, why does the k value show a clear increase with NOx at 405nm, but no so much at 532nm? The authors need to discuss this.

9. Page 14564, lines 18-19. Given that most of toluene is still no reacted at the end of the experiment (Figure 2) and that the reaction time is not too long ($\sim$4 hours),

it is surprising that the O/C of toluene SOA is as high as 0.73. What is the [OH] in the chamber? The authors need to comment on how these O/C values compared to those in literature.

10. Page 14580. Table 1. The results show that more SOA is formed in experiments with a higherNOx concentration. Is this a result of the enhanced radical reaction with NO2 (owing to the high NO2 in the chamber)?

Technical comments:

1. Page 14553, line 16. Missing comma before “corn”.
2. Page 14553, line 17. Missing comma before “coal”.
3. Page 14554, line 4. Missing comma before “the”.
4. The authors should box all the figure legends to avoid confusion of the legend with the actual data points. (Especially Figures 5 and 6).

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 14551, 2012.