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Atmospheric Measurement Techniques Discussions

Interactive comment on "Effect of secondary organic aerosol coating thickness on the real-time detection and characterization of biomass burning soot by two particle mass spectrometers" *by* Adam T. Ahern et al.

Anonymous Referee #2

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General comments:

The manuscript reports the performance of two commercially available real-time aerosol mass spectrometers, soot-particle aerosol mass spectrometer (SP-AMS) and laser ablation aerosol particle time of flight mass spectrometer (LAAPTOF), based on the observations from a series of chamber experiments. Soot particles generated by wood burning was used as a source of black carbon core for the a-pinene SOA coating experiments. Single particle soot photometer was used to quantify refractory black carbon (rBC) mass. This manuscript mainly focuses on the interpretation of SP-AMS

measurements, providing valuable information to improve our understanding of collection efficiency of SP-AMS, and provide useful data to demonstrate quantitative aerosol mass measurement using LAAPTOP. The data analysis is comprehensively performed and the manuscript is well written. However, there are a few points directly linked to the major conclusion of this paper that required further justification (please see major comments below). Overall, I highly recommend this manuscript to be published in Atmospheric Measurement Techniques after addressing the specific comments below.

Major comments:

1) SOA fragmentation: Section 3.1, page 13 and line 19-14: It is unclear whether the a-pinene SOA mass spectra obtained with a conventional AMS using a thermal vaporizer operated at 600 degree Celsius is from the "IR laser off" measurements in this study or from the literature. Variations of SOA composition produced from different chamber conditions are commonly observed and AMS mass spectra of SOA can be somewhat instrument dependent. This type of comparison would be more valuable if those mass spectra were obtained from the same chamber experiment and AMS. Furthermore, what is the possible reason to give less fragmentation for those organics are vaporized by the IR laser? If the proposed argument is correct, it is expected to observe gradual changes in fragmentation pattern of organic as a function of SOA coating thickness on BC surface (i.e. narrower particle beam and hence more SOA vaporized by the thermal vaporizer instead of the IR laser). Please discuss.

2) rBC fragmentation: Section 3.1, line 8-12 and Figure 7: Quantification of Cx ions, especially those greater than C6 with relatively weak signals (from Figure 6), may be influenced by organic fragments that overlap with Cx ions in the peak-fitting of high resolution mass spectra. The influence can become more significant as the SOA mass associated with BC increased. Please discuss this possible uncertainty on the observed trend in Figure 7.

3) Page 17, line 20-23 and Page 18, line 11-14: This argument is based on the assump-

tion that all particles are homogeneous and completely internally mixed but it seems unlikely the case for the monodisperse particles used for the SOA coating experiments. As shown in Figure 3 (top panel), the size-selected particles have a wide range of dva and the size distributions of potassium and rBC are not completely ovelapped to each other. A recent field work has demonstrated non-uniform mixing of potassium in the aged biomass burning emissions (Lee et al., 2016). Please clearly state the assumptions used in the data analysis and briefly discuss how may this uncertainty affects the final conclusion of the paper.

4) Figure 11 and Figure 9: More discussion is required to interpert the continuous increase of K and C3 signals as SOA mass increased. In particular, it is expected that Cx and K signals become saturated when BC particles are thickly coated and become spherical shape if particle beam width is the major factor that governs overall collection efficiency (Willis et al., 2014). However, the mobilitiy diameters of size-selected particles may fall in the dva region (i.e. < 150 nm) that the lens transimssion efficiency of particle is less than 1. This may explain why the experiments with smaller BC cores show steeper slopes in Figure 9a and e. Please discuss if the effects of lens transmission efficiceny can be ruled out in this study and how may this uncertainty affects the final conclusion. Furthermore, what is the major purpose of Figure 11? I think Figure 9 already provides the same information in a more quantative manner. Please clarify.

Minor comments:

1) Introduction: It is recommended to change the subtitle of Section 1.1 to “Characterization of carbonaceous aerosol by SP-AMS” and add another subtitle to Page 4, line 9 for LDI-SP-MS.

2) Section 2.4 and Figure 4: It is more appropriate to put the text and figure to the Section of Results and Discussion.

3) Figure 8 and page 15, line 15: OM fragment at m/z 43 ($C_2H_3O^+$) was not clearly observed in Figure 8. Is this fragment frequently observed in other particles?

Technical corrections:

1) Page 9, line 23: AMS chopper has 2% throughput.

References:

Lee, A. K. Y., Willis, M. D., Healy, R. M., Wang, J. M., Jeong, C.-H., Wenger, J. C., Evans, G. J. and Abbatt, J. P. D.: Single-particle characterization of biomass burning organic aerosol (BBOA): evidence for non-uniform mixing of high molecular weight organics and potassium, Atmos. Chem. Phys., 16(9), 5561–5572, doi:10.5194/acp-16-5561-2016, 2016.

Willis, M. D., Lee, A. K. Y., Onasch, T. B., Fortner, E. C., Williams, L. R., Lambe, A. T., Worsnop, D. R. and Abbatt, J. P. D.: Collection efficiency of the soot-particle aerosol mass spectrometer (SP-AMS) for internally mixed particulate black carbon, Atmos. Meas. Tech., 7(12), 4507–4516, doi:10.5194/amt-7-4507-2014, 2014.

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