

Interactive comment on “Technical Note: New methodology for measuring viscosities in small volumes characteristic of environmental chamber particle samples” by L. Renbaum-Wolff et al.

L. Renbaum-Wolff et al.

lrenbaum@chem.ubc.ca

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Comment #1)

In Sect. 3.7, you mention that the technique “currently” suffers from fairly poor accuracy. Do you already have any suggestions on how to improve its accuracy? Are the limitations due to fact that you only resolve the 2D projected path of the beads and that you only consider an average of the location dependent speeds of the beads?

Response:

Factors that may limit the accuracy of this technique including: 1) Only the 2D pro-

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jected path is resolved in the experiments and 2) the uncertainty in the viscosities of the standard droplets used in the experiments is relatively large. It is possible that by using pure viscosity standards with well-established viscosities under dry conditions, a calibration curve with smaller uncertainties may be constructed. However, for the purposes of this manuscript, it was desired to ensure the technique was reliable under changing relative humidity conditions and to use viscosity standards with a wide variety of O:C values, surface tensions, molecular weights, and contact angles in order to show that the technique is applicable to secondary organic aerosol generated in environmental chambers. This information is not available for most certified viscosity standards available for purchase.

To address the referee's comment the information above has been added to the manuscript (see Section 3.7, paragraph 1).

Comment #2a)

How large are the error bars of the mean bead speeds for the standard compounds plotted in Fig. 6a?

Response:

We have revised Figures 6a and 6b to include the error bars ($\pm 1\sigma$).

Comment #2b)

For a deposited droplet of a given compound, you have traced the paths of 3 – 10 beads over 50 – 100 frames to obtain a mean bead speed. Have you performed this analysis for several deposited droplets of the same compound – and if so, how large is the scatter of the deduced mean bead speeds from these individual measurements?

Response:

The speed of individual beads in a single particle vary by a factor of roughly 2-4 depending at least in part on their location within the particle. The average bead speed

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varies by less than a factor of 2 when the average bead speeds of multiple beads are considered and multiple droplets are compared. This information is included in Section 3.1, Paragraph 2, to address the referee's comment.

Comment #3)

I would suggest moving Figure S1 into the main manuscript text. I found it interesting to see these data – it also gives some idea about the spread in the results for the mean bead speeds from repeated measurements with the same compound (see comment above).

Response:

Figure S1 has been moved into the main manuscript (Figure 8) to address the referee's comments.

Comment #4)

In Sect. 3.7, I found it slightly confusing that you first described it as a limitation/ disadvantage that the technique is only applicable to viscosities from 0.001 to 1000 Pa s, i.e., relatively fluid particles (page 27034, line 12), only later clarifying that this is nonetheless “a very wide viscosity range compared to existing microviscometry techniques” (line 20). To get a better idea of this wide range, you could add a reference to Fig. 1 in Koop et al. (2011), which in my opinion is very illustrative as it shows the viscosities of familiar substances as a comparison.

Response:

At the end of Section 3.7, paragraph 2, a sentence has been added reading: “While this is considered a wide range of viscosities compared to existing microviscometry techniques (Han et al., 2007; Lin et al., 2007; Srivastava et al., 2005; Srivastava and Burns, 2006; Silber-Li et al., 2004), it should be noted that secondary organic matter from chamber oxidation of pinene may potentially range from the viscosity of water (10–3 Pa s) at 100% RH to the viscosity of glasses ($\geq 10^{12}$ Pa s) under dry conditions at or

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near room temperature (Koop et al. 2011)”

Additionally, the wording in Section 3.7 has been rearranged in order to make the strengths and limitations of the technique more clear.

Technical Comments:

We thank the referee for the careful review of the paper. The technical comments have been addressed in the new version.

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