

Interactive comment on “Particle mass yield in secondary organic aerosol formed by the dark ozonolysis of α -pinene” by J. E. Shilling et al.

J. E. Shilling et al.

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We thank the reviewer for the helpful comments. We address the specific concerns of the reviewer in the responses below.

Reviewer Comment: 1) I was under the impression that it is standard practice to correct AMS field data using a collection efficiency of 0.5 due to bounce. Why should it be different here, especially considering that these particles are a mix of organics and ammonium sulfate, as in the atmosphere?

Response: The reviewer is correct in that AMS field data often needs to be corrected for a variety of factors, including particle bounce from the heater, imperfect focusing of the particle beam on the heater, and incomplete transmission of particles through the aerodynamic lens (Huffman *et al.* 2005). The net collection efficiency (CE), which

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combines all these factors, is often ~ 0.5 for dry ammonium sulfate particles (Zhang *et al.* 2005). We observe a CE of 0.35 to 0.5 for dry ammonium sulfate in our system. However, as SOA begins to coat the particles, we observe an increase in the CE of the particles. The interpretation is that the organic coating suppresses the bounce of the particles from the heater. Studies have shown that particle phase is an important factor in determining the CE, with liquid particles having larger CE than dry particles (Allan *et al.* 2004). Furthermore, liquid organic particles have been observed to have CEs of ~ 1 (Allan *et al.* 2004). Based on these studies and on the agreement of SMPS and AMS data (e.g., Figure 5) we apply a CE of 1. In fact, comparison of AMS and SMPS data provides a direct measurement of the CE. In light of this evidence, we are confident that applying a CE of 1.0 for the SOA in this study is valid.

Reviewer Comment: 2) Although the discrepancy between the SOA yields from these and other experiments is probably not due to OH radical scavengers, since many use the same scavenger, butanol, it would be worthwhile for someone to look at possible SOA formation from the OH scavenging reaction. For example, one could react butanol with OH radicals formed from the ozonolysis of a small alkene such as dimethyl butene that has a high OH yield and probably does not make aerosol itself. Also, it would be worthwhile to run this alpha-pinene experiment with methanol, which is a lighter alcohol with simpler OH chemistry and usually has fewer impurities than butanol.

Response: The use of different OH scavenger molecules has the potential to alter the SOA mass yield by changing the gas-phase chemistry, specifically the ratio of organic peroxy radicals to hydroperoxy radicals (Docherty and Ziemann, 2003; Keywood *et al.*, 2004). As the reviewer points out, most studies have used 2-butanol as the OH radical scavenger. Therefore, to maintain consistency with the majority of the literature data, we also chose to use butanol. Previous work has found nearly 100% mass closure between reacted butanol and gas-phase products (Cavalli *et al.*, 2002). Therefore, we are confident that no SOA is formed directly from the reaction of OH and butanol, though we acknowledge that it could possibly become incorporated into the aerosol

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through reaction with Stabilized Criegee Intermediates produced from the ozonolysis of alpha-pinene (Docherty and Ziemann, 2003). Finally, very recent data for this system from Chan and Seinfeld (2007) and Song et al. (2007), which will be included in the revised manuscript, agree well with the data presented in this work. Thus, we feel that differences other than the OH radical scavenger are responsible for the discrepancy.

Using methanol is an interesting suggestion, and a few researchers have done so (Docherty and Ziemann, 2003). However the rate of the OH/methanol reaction ($9.3 \times 10^{-13} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$) is ~ 10 x slower than the rate of the OH/butanol reaction ($8.2 \times 10^{-13} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$) (Calvert *et al.*, 2000; Cavalli *et al.* 2002) Thus, to obtain and the same OH scavenging efficiency with methanol, we would have to add 2.5 times the carbon into the system.

Reviewer Comment: Technical Comments: 1) Page 17934, line 22: I believe this should be $\times 10(9)$ not $\times 10(-9)$.

Response: The reviewer is correct, page 17934, line 22 should indeed read $0.68 \times 10^9 \text{ nm}^3$ -particles cm^3 -air. We have corrected this error in the revised manuscript.

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