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Atmospheric Measurement Techniques Discussions

Interactive comment on "Novel Aerosol Flow Reactor to Study Secondary Organic Aerosol" *by* Kelly L. Pereira et al.

Anonymous Referee #4

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This paper described the setup of a custom-built aerosol flow reactor, which was designed to generate large amount of secondary organic aerosols (above 10^2 mg) from different VOCs precursors using continuous flow mode. The RH, VOCs mixing ratio and VOCs/NOx condition can be controlled independently in the flow reactor. A series of offline analytical techniques was used to determine the chemical information of generated SOA including: CHNS elemental analyzer, nuclear magnetic resonance spectroscopy (NMR), ultra-performance liquid chromatography ultra-high resolution mass spectrometry (UHRMS) etc. Brief measurement results from those techniques were shown. After reading the paper, I have two major comments about the novelty and logic of this paper. Based on those comments, I recommend a major revision of this paper Major comments ïijĹ1ïijL'I was puzzled by the novelty of this continuous flow re-

actor (CFR), as titled in this paper. The common major advantages of CFR are (1) to achieve the intermediate NO chemical region as illustrated in Zhang et al. (Zhang et al., 2018) and (2) less wall losses, although similar wall losses between continuous flow-mode chamber and batch-mode chamber were found in some studies. The authors address the novelty of CFR in this study is its ability to generate much higher SOA concentrations compared to a normal batch-mode chamber. However, high SOA mass concentrations also can be achieved by many other types of already widely-used flow reactors e.g., commercialized oxidation flow reactor (or named potential aerosol mass flow reactor) (Kang et al., 2007) or some custom-built flow reactors e.g., (Huang et al., 2017). Additionally, the offline techniques mentioned in this study have already been applied to analyze SOA generated in normal chamber. E.g. two-dimensional heteronuclear NMR spectroscopy to (Maksymiuk et al., 2009), CHNS elemental analyzer (Kroll et al., 2011), HPLC-ITMS (Hamilton et al., 2011;Pereira et al., 2014) and Volatility measurement (Huffman et al., 2009). Those results suggest SOA formed from normal chamber with higher precursor concentrations and longer reacting times can also meet the detection limit of those offline techniques mentioned in this paper. If the advantage of CFR in this study is only to provide more SOA masses, I do not think it is a novel method.

ïijĹ2ïijL' The title of the paper is "Novel Aerosol Flow Reactor to Study Secondary Organic Aerosol", whereas the authors did not really show much basic characterization information from this aerosol flow reactor. e.g., what the OH concentration (or OH exposure) ranges can be achieved in CFR, how much photon flux of lamps at different light settings (which is crucial of SOA photolysis), What are the wall losses. The measurement results from different techniques are not the characteristics of flow reactors. One or two measurement examples from those offline techniques should be enough if the story in this study is really to show the flow reactor.

Other comments: Page 7 Line 12-14, I did not see the difference of this CFR with the current used oxidation flow reactor e.g., (Kang et al., 2007;Lambe et al., 2011;Huang

et al., 2017). While emphasizing the merits of the CFR, could the authors show the advantage of this CFR compared to other flow reactors used in the lab and field studies. Page 7 line 30: dilution can be made to measure the NOx and VOCs. Page 7 Line 31-32: What kind of separate experiments were done ? Page 8 Line 16-18: SOA mass concentration was quite high for background concentrations in a chamber. Will these background SOA contaminate the newly formed SOA in new experiments? Page 8 line 32: What the OH concentration can be achieved in the CFR? Page 13 line 6: Was the reactor temperature controlled manually or only influenced by room temperature? The description in this sentence was not consistent with the actually measured temperatures listed in the Table 1. Page 13 line 17: Unit should be added Page 14 line 31-32: Without considering OH exposure in the CFR during different experiments, the oxidation state of different type of SOAs vary significantly. I do not think the O/C range reported from different experiments can be used to support the accuracy of CHNS method.

Page 15 line 8-11: Similarly, OH exposure should be considered. And much higher H/C ratios of a-pinene SOA from CFR were found in Fig. 5 compared to literature results.

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