I. General Comments from Reviewer 1

This article characterizes secondary aerosol formation potential from vehicles and cooking that are two very important aerosol sources in urban areas. The secondary aerosol formation potential from these sources remains poorly characterized, so the topic is timely and important. Experiments done in laboratory and field seem to be comprehensive and novel in many aspects. The article is nicely written and relatively easy to follow, however it would be important to revise the English language. Also, the experiments done and instruments used need to be described better. Also, the PMF results (e.g. how the number of factors was decided, how they were identified, how many factor solutions were tested and why the were not chosen etc) needs to be described better in order to reader to understand the results.

> Reply: We appreciate the constructive comments from the reviewer on this manuscript. We have answered them point to point in the following paragraphs (the texts italicized are the reviewers' comments, the texts indented are the responses, and the texts in blue are revised parts in the new manuscript or supporting information). In addition, all changes made are marked in the revised manuscript.
>
> We used PMF to split aged cooking OA into two OA factors. Generally, there is at least one POA and one SOA (factor 1-POA; factor 2-SOA). When we chose three or more factors, we found the elemental ratios or mass spectra of additional OA factors are quite similar to factor 1 or factor 2, which means that we can't find another new OA factor. Therefore, we finally chose 2 OA factors, one for POA and another for SOA. As Figure S5-S8 shows, the SOA factor presents a larger fraction of oxygen-containing fragments (especially in m/z 28, 29, 43, 44) and higher O/C, which is different from those of POA factors.
>
> Revised text "The maximum SOA mass growth potentials of aged cooking SOA only ranged from 1.9-3.2 implying a mixture of POA and SOA, so its mass spectra needed to be deeply resolved by PMF in order to separate the POA and SOA (precisely, a kind of LO-OOA). Generally, there is at least one POA and one SOA (factor 1-POA; factor 2-SOA). When three or more factors were set, it was found that elemental ratios or mass spectra of additional OA factors are quite similar to factor 1 or factor 2, which means that two OA factor was the best choice (one for POA and another for SOA). As Figure S5-S8 shows, the SOA factors present a larger fraction of oxygen-containing fragments (especially in m/z 28, 29, 43, 44) and higher O/C, which is significantly different from those of POA factor."

II. Detailed comments from Reviewer 1

1. ***L20-21: is the source of SOA the traffic and cooking or city dwellers? please clarify sentence***

   The source of SOA is the traffic and cooking. Traffic and cooking are closed to the daily life of city dwellers. We have revised this ambiguous sentence.

   > Revised text: "Vehicle exhaust and cooking emission are closely related to the daily life of city dwellers. Here, we defined the secondary organic aerosol (SOA) derived from vehicle exhaust and cooking emission as "Urban Lifestyle SOA", and simulated their formation using a Gothenburg potential aerosol mass reactor (Go: PAM). "

2. ***L24: define POA***

   POA is the primary organic aerosol.

   > Revised text: "The SOA/POA (primary organic aerosol) mass ratios…… "

3. ***L24: what instrument was used to measure SOA/POA in this case? AMS or SMPS?***

   It was SMPS.

   > Revised text: "The SOA/POA (primary organic aerosol) mass ratios of vehicle groups (107) were 44 times larger than those of cooking groups (2.38) at about 2 days of equivalent photochemical age, according to the measurement of scanning mobility particle sizer (SMPS). "

4. ***L26: define "vehicle group" and "cooking group"***

   We have added the definition in the revised manuscript.

   > Revised text: "The vehicle exhaust and cooking emission were separately simulated, and their samples were defined as "vehicle group" and "cooking group", respectively. "

5. ***L35: replace could with can.***

   Thanks for the correction.

   > Revised text: "The OA can be divided into the primary organic aerosol (POA) and the secondary organic aerosol (SOA). "

6. ***L36: I propose reformulating: POA is directly emitted into ambient air through several sources such as coal combustion, biomass burning, vehicle exhaust, cooking procedure.***

We agree with the reviewer and modify our expression.

> Revised text: *"*There are many potential sources of POA, such as coal combustion, biomass burning, vehicle exhaust, cooking procedure and so forth.*"*

7. ***L39: change to: but models typically fail to simulate.***

Thanks for the correction.

> Revised text: *"*Significant SOA formation has been observed in several urban areas, but models typically fail to simulate this phenomenon accurately.*"*

8. ***L47-49: Please reformulate by changing "would -> can be".***

Thanks for the correction.

> Revised text: *"*they can be oxidized, distributed into particle phase and finally become the part of POA or SOA.*"*

9. ***L52: I am not sure if Manchester meets the definition of a Megacity. please check.***

We have carefully checked the population of Manchester, and it is about half a million. Therefore, Manchester is not a megacity. We have removed Manchester from the new manuscript.

> Revised text: *"*take the megacity for example, in London, these two urban lifestyle sources contributed 50% of OA in average*"*

10. ***L52: replace lifestyle source with SOA source.***

Original Text: *"Vehicle and cooking emissions are important sources of OA in urban areas (Rogge et al., 1991;Rogge et al., 1993;Hu et al., 2015;Hallquist et al., 2016;Crippa et al., 2013;Mohr et al., 2012;Guo et al., 2013;Guo et al., 2012), take a megacity for example, in London, these two urban lifestyle sources contributed 50% of OA in average (Allan et al., 2010)."*

Thanks for the reviewer's comment. However, it is not very appropriate to use "SOA source" here, because vehicle and cooking are both POA and SOA sources. Furthermore, as for the study in London, these two urban lifestyle sources can contribute 50% of OA when only considering POA, and it was not sure how much SOA was generated from these two sources according to that study. Therefore, it is better to use “urban lifestyle source” instead of “SOA source”.

11. L65: replace Lab with laboratory all through the manuscript

We have replaced the lab with laboratory all through the manuscript as the reviewer suggested.

12. L83, 102: define China V

More description about China V was added to the revised manuscript as the following text shows:

> Revised text “The commercial China Phase V gasoline was used as the fuel, which has equivalent octane number 92 level (RON 92), 10 ppm (v/v, max) sulfur, 25% (v/v, max) olefin, about 40% (v/v, max) aromatics, 2 mg/L Mn and no oxygenates.” (Yinhui et al., 2016).

Yinhui, W., Rong, Z., Yanhong, Q., Jianfei, P., Mengren, L., Jianrong, L., Yusheng, W., Min, H., and Shijin, S.: The impact of fuel compositions on the particulate emissions of direct injection gasoline engine, Fuel, 166, 543-552, 10.1016/j.fuel.2015.11.019, 2016.

13. L102: Is this vehicle or engine that you are using to produce the exhaust? describe the engine/vehicle (manufacturer, model, engine size, aftertreatment, mileage, year, fuel, lubricant oil) in detail. All these have a major impact to SOA formation. Also, if engine, maybe add information that this is not exactly same as vehicle, assuming there is no catalysts (like nowadays almost all have). Please add discussion about the differences between engine produced SOA and vehicle produced SOA.

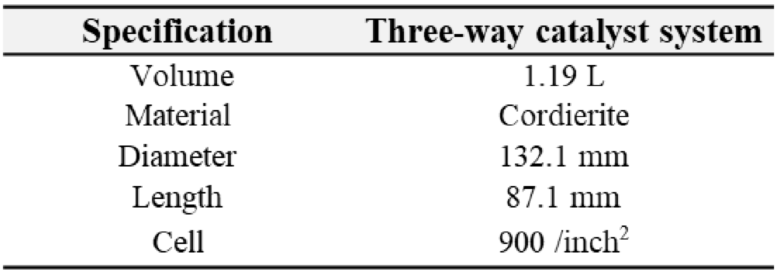
It is the Gasoline direct injection engine instead of a vehicle. The detailed information of test GDI engine equipped with catalyst system has been added in Table S2-S3.

> Revised text: “More information about GDI engine can be found in Table S2-S3.”

Table S2. Test engine information.

Specification	GDI
Displaced Volume	998 cc
Stoke	78.6 mm
Bore	73.4 mm
Compression ratio	9.6
Max power / engine speed	100 kW / 6000 rpm
Max torque / engine speed	205 N·m / 2000-3000 rpm

Table S3. Catalyst system information.



Specification	Three-way catalyst system
Volume	1.19 L
Material	Cordierite
Diameter	132.1 mm
Length	87.1 mm
Cell	900 /inch^2

There is a three-way catalyst system after our GDI engine. Our engine condition is indeed different from those of vehicle experiments. The main difference is that engine experiments can hold fixed speed and torque conditions, while vehicle experiments often focus on run cycles with dynamic speed and torque conditions. Unfortunately, there are few studies that directly used the GDI engine instead of the vehicle to study the SOA formation in detail, so we just compared our results with those from vehicle experiments equipped with gasoline or diesel engine.

14. ***L102. Accronym GDI should be Gasoline direct injection***

We have revised it to “Gasoline direct injection”.

Revised text: “The vehicle exhaust was emitted from a Gasoline direct engine (GDI)…… ”

15. ***L104: please, describe the used sampling and dilution setup in detail. How the dilution air was cleaned? dirty dilution air can be major source of SOA. Was the vehicle exhaust taken directly from tailpipe? and cooking fumes from the room air? if so, what it the influence of this extra dilution/aging in the room air in the case of cooking fumes? For the cooking, maybe explain how the boiling water acts as a blank. Was a blank/zero measurements done for the vehicle? Also, I find it hard to find how these measurement points were taken. According to table there was 6 points with different OH concentrations, and 3-5 repetitions for each. Please clarify how long each point was, were the results of repetitions averaged? if so, maybe give standard deviations to values in figures/tables to describe the variability between repetitions.***

Thank the reviewer for reminding us to supply necessary details. The dilution air was ambient air (clean period), which was firstly filtered by a particle filter system (including a dryer, a filter, and an ultrafilter, SMC Inc.) to remove the particles and water. Then the dilution air was filtered by an activated carbon adsorption device to remove the VOCs. As the results of dilution air groups in Table S1, the dilution air just made a minor influence on the SOA concentration.

Vehicle exhaust from the tailpipe was first diluted by a gradient heated dilution system (6 fold) and then diluted by an unheated dilution system (5 fold). The temperature of sample flow was near indoor temperature after secondary dilution systems.

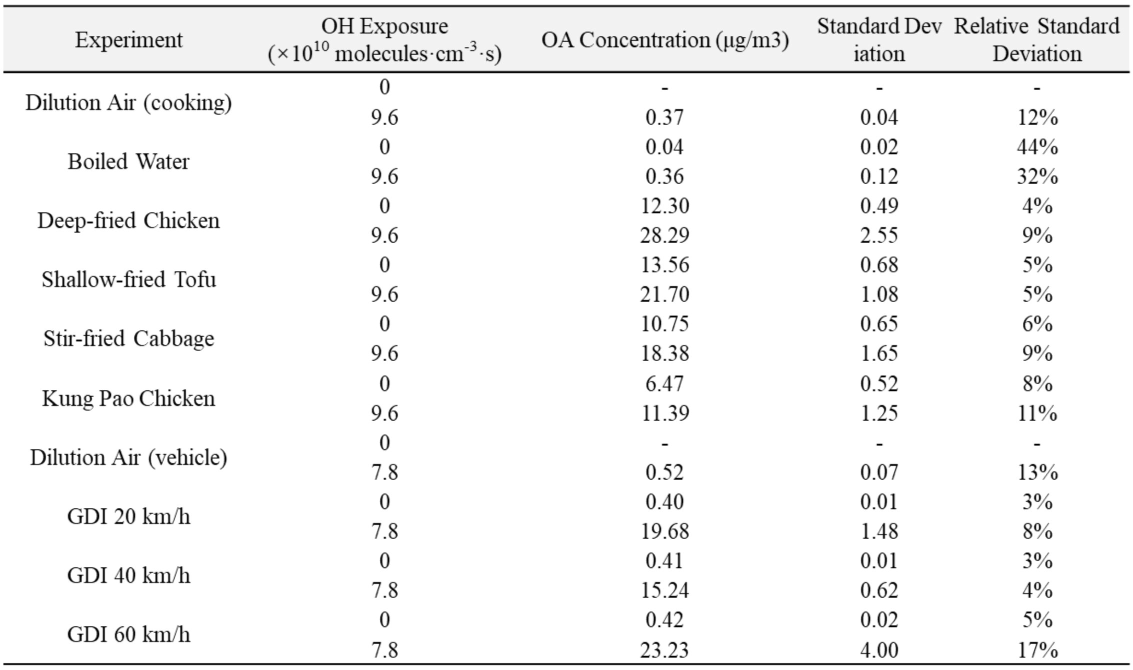
The cooking fumes were collected through the kitchen ventilator. The boiled water can be a background sample influenced by indoor air, iron wok, and ventilator.

A blank/zero measurement of vehicle experiment have also been done as following Table S1 shows. Among different OH exposure, we have done 3-5 repetitions, the results showed in the figure are their average values. Every repetition point took 2 min, which was equal to the time resolution of AMS and SMPS. The deviations have been shown in figure 2-3 in the form of an error bar. We have noted these details in figure captions.

The detailed formation has been added in Section S1, Table S1, and Figure 2-3 captions:

> Revised text "The dilution air was ambient air (clean period), which was firstly filtered by a particle filter system (including a dryer, a filter and an ultrafilter, SMC Inc.) in order to remove the particles and water. Then the dilution air was filtered by an activated carbon adsorption device, in order to remove the VOCs. Vehicle exhaust from tailpipe was first diluted by a gradient heated dilution system (6 fold) and then diluted by a unheated dilution system (5 fold). The temperature of sample flow was near indoor temperature after secondary dilution systems. The cooking fumes was collected through the kitchen ventilator. The boiled water can be a background sample influenced by indoor air, iron wok and ventilator. As the results of blank groups in Table S1, the dilution air and background interference just made minor influence to the SOA concentration."

Table S1. Comparison of results between blank and experimental groups (Dilution air and boiled water are two kinds of blank groups. The others are experimental groups.).



Experiment	OH Exposure ($\times 10^{10}$ molecules·cm^{-3}·s)	OA Concentration (μg/m3)	Standard Deviation	Relative Standard Deviation
Dilution Air (cooking)	0	-	-	-
	9.6	0.37	0.04	12%
Boiled Water	0	0.04	0.02	44%
	9.6	0.36	0.12	32%
Deep-fried Chicken	0	12.30	0.49	4%
	9.6	28.29	2.55	9%
Shallow-fried Tofu	0	13.56	0.68	5%
	9.6	21.70	1.08	5%
Stir-fried Cabbage	0	10.75	0.65	6%
	9.6	18.38	1.65	9%
Kung Pao Chicken	0	6.47	0.52	8%
	9.6	11.39	1.25	11%
Dilution Air (vehicle)	0	-	-	-
	7.8	0.52	0.07	13%
GDI 20 km/h	0	0.40	0.01	3%
	7.8	19.68	1.48	8%
GDI 40 km/h	0	0.41	0.01	3%
	7.8	15.24	0.62	4%
GDI 60 km/h	0	0.42	0.02	5%
	7.8	23.23	4.00	17%

Figure 2. Secondary mass growth potentials for two urban lifestyle SOA. The mass growth potentials were represented by SOA/POA mass ratios. The SMPS-1 determined the mass concentration of POA, while the SMPS-2 determined the mass concentration of aged OA, and their mass difference could be regarded as the SOA. The average data and standard deviation bars are shown in the figure.

Figure 3. Evolution of O:C molar ratio for two urban lifestyle OA. The O:C molar ratios are determined by HR-Tof-AMS. The average data and standard deviation bars at each gradient are shown in the figure.

16. L117: This chapter is quite unclear and missing quite many details. Please, explain the AMS and GoPAM in more detail, e.g. in separate chapters and the rest shortly like it is now.

The details of HR-Tof-AMS have been added to section 2.2 as follows:

Revised text “The chemical compositions of OA were measured by a high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS, Aerodyne Research Inc.), in which the non-refractory particles including organics, sulfate, nitrate, ammonium, and chloride were instantly vaporized by a 600°C tungsten. Next, the vaporized compounds were ionized by an electron impact (EI) ionization with 70 ev. Finally, the fragment ions were pulsed to a time-of-flight MS chamber and detected by the multi-channel plate detector (MCP) (Nash et al., 2006;DeCarlo et al., 2006). In this study, its time resolution was 2 min (precisely, 1 min for a mass sensitive V-mode, and 1 min for a high mass resolution W-mode).”

We have also supplied other parameters of HR-Tof-AMS in section 2.3.1:

Revised text "A default value (1.4) of relative ionization efficiency (RIE) of OA was adopted. Another synchronous SMPS-2 was used to correct the collection efficiency (CE) of HR-ToF-AMS by comparing their mass concentrations (Gordon et al., 2014). Before the formal experiment, the IE and RIESO4 were calculated by the comparison of HR-Tof-AMS and SMPS, when the sampling flow was generated by 300 nm ammonium nitrate and 300 nm ammonium sulfate, respectively, with an Aerosol generator (DMT Inc.). The CE was a fluctuant value influenced by the emission condition, so it was estimated by the comparison of HR-Tof-AMS (sampling after Go: PAM) and SMPS-2 (sampling after Go: PAM) during the formal experiment. The CE and RIE_{Org} were theoretically different in every emission or oxidation condition, so we directly use the SMPS measurements to determine the aged OA mass concentration. As for the cooking experiment, the IE value was 7.77×10-8, the RIESO4 was 1.4, the RIE_{Org} was 1.4 (default value, the fluctuation of RIE_{Org} was included in CE), the average CE was about 0.55 (ranged from 0.3 to 0.7). As for the vehicle experiment, the IE value was 7.69×10-8, the RIESO4 was 1.3, the RIE_{Org} was 1.4 (default value, the fluctuation of RIE_{Org} was included in CE), the average CE was about 0.6 (ranged from 0.4 to 0.7).

The details of Go: PAM have been added to the manuscript and SI as follows:

Revised text "The internal structure of Go: PAM can be found in Figure S1."

Revised text "As Figure S1 shows, the flow reactor of Go: PAM is made of quartz glass (1) (Raesh GmbH RQ 200), which is 100 cm long and 9.6 cm in diameter. About 84 cm of the flow reactor may be illuminated by either one or two Philips TUV 30 W fluorescent tubes (2), each radiating about 10 W at 254 nm. It is enclosed in a compartment of aluminum mirrors to reduce the inhomogeneity of the photon field inside the reactor. The fluorescent tubes and quartz tubes are surrounded by a parabolic trough mirror (3), 90 deg. flat mirror (4) and 45-90 deg. flat mirrors (5). The shell of Go: PAM is composed of a sheath metal cover (6) and square tubing support structure (7)."

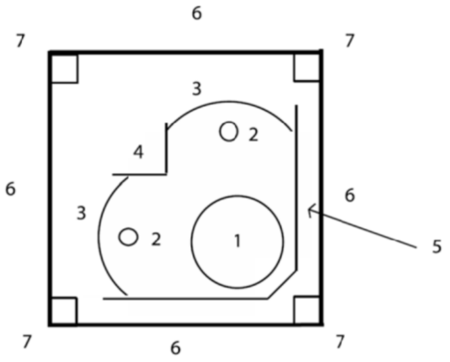


Figure S1. Profile of Go: PAM. (1) 9.6 cm quartz tube (2) fluorescent tube (3) parabolic trough mirror (4)90 deg. flat mirror (5) 45-90 deg. flat mirror (6) sheath metal cover (7) Square tubing support structure

17. ***L120: I think the reference describing Aerodyne instrument should be: DeCarlo, Peter F., Joel R. Kimmel, Achim Trimborn, Megan J. Northway, John T. Jayne, Allison C. Aiken, Marc Gonin, et al. "Field-Deployable, High-Resolution, Time-of-Flight Aerosol Mass Spectrometer." Analytical Chemistry 78, no. 24 (December 2006): 8281–89. https://doi.org/10.1021/ac061249n.***

    Thanks for the suggestion. We have added this reference to the related section.

    > Revised text: *"*A high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS, Aerodyne Research Inc.) was used to identify the chemical compositions of OA (DeCarlo et al., 2006; Nash, Baer, & Johnston, 2006).*"*

18. ***L128: I think this should state that the measured CO2 concentrations (Model 410i, Thermo Electron Corp.) were used to conduct CO2 correction for AMS data in order to reduce the CO2 interference to organic fragments in mass spectra of HR-ToF-AMS.***

    We agree with the correction.

    > Revised text: *"*The measured CO_2 concentrations (Model 410i, Thermo Electron Corp.) were used to conduct CO_2 correction for AMS data in order to reduce the CO_2 interference to organic fragments in mass spectra of HR-ToF-AMS.*"*

19. ***L125-126: You are saying that "The SMPS-1 determined the mass concentration of POA, while the SMPS-2 determined the mass concentration of aged OA, and their mass difference could be regarded as the SOA.". are these results shown in somewhere?***

    These data are shown in figure 2 in the form of SOA/POA. The vehicle exhaust and cooking fume were partly collected from the tailpipe and kitchen ventilator, which means we didn't focus on the total mass of source emission. We focused more on the relative properties and parameters, like SOA/POA, elemental ratios, and mass spectra which are independent of the total mass of OA.

20. ***L143: The ionization efficiency (IE), relative ionization efficiency (RIE) and collection efficiency (CE) were determined individually before data processing. How were these determined? please give the results.***

Before the formal experiment, the IE and RIE$_{SO4}$ were calculated by the comparison of HR-Tof-AMS and SMPS, when the sampling flow was generated by 300 nm ammonium nitrate and 300 nm ammonium sulfate, respectively, with an Aerosol generator (DMT Inc.). The CE was a fluctuant value influenced by the emission composition, so it was estimated by the comparison of HR-Tof-AMS (sampling after Go: PAM) and SMPS-2 (sampling after Go: PAM) during the formal experiment. The CE and RIE$_{Org}$ were theoretically different in every emission or oxidation condition, so we directly use the SMPS measurements to determine the aged OA mass concentration.

As for the cooking experiment, the IE value was 7.77×10^{-8}, the RIE$_{SO4}$ was 1.4, the RIE$_{Org}$ was 1.4 (default value, the fluctuation of RIE$_{Org}$ was included in CE), the average CE was about 0.55 (ranged from 0.3 to 0.7).

As for the vehicle experiment, the IE value was 7.69×10^{-8}, the RIE$_{SO4}$ was 1.3, the RIE$_{Org}$ was 1.4 (default value, the fluctuation of RIE$_{Org}$ was included in CE), the average CE was about 0.6 (ranged from 0.4 to 0.7).

We have added a new part in section 2.3.1 as follows:

> Revised text: "Before the formal experiment, the IE and RIE$_{SO4}$ were calculated by the comparation of HR-Tof-AMS and SMPS, when the sampling flow were generated by 300 nm ammonium nitrate and 300 nm ammonium sulfate, respectively, with an Aerosol generator (DMT Inc.). The CE was a fluctuant value influenced by the emission composition, so it was estimated by the comparation of HR-Tof-AMS (sampling after Go: PAM) and SMPS-2 (sampling after Go: PAM) during the formal experiment. The CE and RIE$_{Org}$ were theoretically different in every emission or oxidation condition, so we directly use the SMPS measurements to determine the aged OA mass concentration. As for the cooking experiment, the IE value was 7.77×10^{-8}, the RIE$_{SO4}$ was 1.4, the RIE$_{Org}$ was 1.4 (default value, the fluctuation of RIE$_{Org}$ was included in CE), the average CE was about 0.55 (ranged from 0.3 to 0.7). As for the vehicle experiment, the IE value was 7.69×10^{-8}, the RIE$_{SO4}$ was 1.3, the RIE$_{Org}$ was 1.4 (default value, the fluctuation of RIE$_{Org}$ was included in CE), the average CE was about 0.6 (ranged from 0.4 to 0.7)."

21. L146-147: please give the range of CE values and average CE value

As for cooking experiment, the IE value was 7.77×10^{-8}, the RIE$_{SO4}$ was 1.4, the average CE was about 0.55 (ranged from 0.3 to 0.7).

As for vehicle experiment, the IE value was 7.69×10^{-8}, the RIE_{SO4} was 1.3, the average CE was about 0.6 (ranged from 0.4 to 0.7).

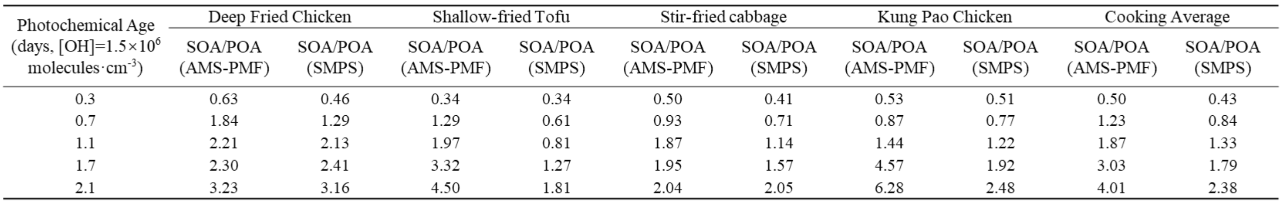
We have added new part in section 2.3.1 as follows:

> Revised text: “Before the formal experiment, the IE and RIE_{SO4} were calculated by the comparation of HR-Tof-AMS and SMPS, when the sampling flow were generated by 300 nm ammonium nitrate and 300 nm ammonium sulfate, respectively, with an Aerosol generator (DMT Inc.). The CE was a fluctuant value influenced by the emission composition, so it was estimated by the comparation of HR-Tof-AMS (sampling after Go: PAM) and SMPS-2 (sampling after Go: PAM) during the formal experiment. The CE and RIE_{Org} were theoretically different in every emission or oxidation condition, so we directly use the SMPS measurements to determine the aged OA mass concentration. As for cooking experiment, the IE value was 7.77×10^{-8}, the RIE_{SO4} was 1.4, the RIE_{Org} was 1.4 (default value, the fluctuation of RIE_{Org} was included in CE), the average CE was about 0.55 (ranged from 0.3 to 0.7). As for vehicle experiment, the IE value was 7.69×10^{-8}, the RIE_{SO4} was 1.3, the RIE_{Org} was 1.4 (default value, the fluctuation of RIE_{Org} was included in CE), the average CE was about 0.6 (ranged from 0.4 to 0.7).”

22. L147: SOA was defined earlier as SMPS2-SMPS1. How does this results gained from PMF compare to SMPS results?

The SMPS directly measured the concentration of POA and SOA, and PMF separated the POA and SOA by mathematical method. It is interesting to compare their results. We have been added this part in Table S4. As for deep-fried chicken and stir-fried cabbage, two methods tend to obtain similar results. As for relative lower photochemical age (less than 1.1 days), two methods tend to obtain the similar results. When it comes to the mass ratio, the direct measurement by two sets of SMPS seem to be more accurate than the estimation by the mathematical PMF.

Table S4. The comparison of SOA/POA between SMPS and AMS-PMF results. “SOA/POA (SMPS)” means the mass ratio gained from SMPS-1 and SMPS-2. “SOA/POA (AMS-PMF)” means the mass ratio gained from PMF analysis of aged OA measured by HR-Tof-AMS.



Photochemical Age (days, [OH]=1.5×10^6 molecules·cm^{-3})	Deep Fried Chicken		Shallow-fried Tofu		Stir-fried cabbage		Kung Pao Chicken		Cooking Average	
	SOA/POA (AMS-PMF)	SOA/POA (SMPS)	SOA/POA (AMS-PMF)	SOA/POA (SMPS)	SOA/POA (AMS-PMF)	SOA/POA (SMPS)	SOA/POA (AMS-PMF)	SOA/POA (SMPS)	SOA/POA (AMS-PMF)	SOA/POA (SMPS)
0.3	0.63	0.46	0.34	0.34	0.50	0.41	0.53	0.51	0.50	0.43
0.7	1.84	1.29	1.29	0.61	0.93	0.71	0.87	0.77	1.23	0.84
1.1	2.21	2.13	1.97	0.81	1.87	1.14	1.44	1.22	1.87	1.33
1.7	2.30	2.41	3.32	1.27	1.95	1.57	4.57	1.92	3.03	1.79
2.1	3.23	3.16	4.50	1.81	2.04	2.05	6.28	2.48	4.01	2.38

23. L177: I don’t really understand what this means. Please clarify the sentence: “The mixing and wall loss conditions have already met our experiment needs.”

We are sorry that this is a meaningless sentence. We have removed this sentence now. The detailed evaluation of Go: PAM could be found in Figure S4.

24. L183: should this be secondary aerosol formation potential?

Yes, it is the secondary aerosol formation potential. The previous expression is a bit unclear. The revised expressions are as follows:

Revised text: “3.1 Secondary Formation Potential of the Urban Lifestyle SOA.”

Revised text: “As Figure 2 shows, the mass growth potentials of two urban lifestyle SOA were quite different. The mass growth potentials were represented by SOA/POA mass ratios.”

25. L184: How do you know the functionalization increased as the photochemical age increased?

Original text “Their SOA/POA mass ratios both increased gradually through functionalization reactions and finally reached the peak after 2-3 days of equivalent photochemical age” .

Thanks for the careful reading. We didn’t emphasize “*functionalization increased as the photochemical age increased*”. We wanted to state that SOA/POA mass ratios increased gradually and finally **reached the peak** after 2-3 days of equivalent photochemical age. In this process, SOA may form through functionalization reactions. We’d like to remove the word “functionalization” to avoid misunderstanding.

Revised text: “Their SOA/POA mass ratios both increased gradually and finally reached the peak after 2-3 days of equivalent photochemical age…...”

26. L184-185: How the SOA is defined here? is this all mass (POA+SOA) after the go:PAM or is it the SOA separated by PMF or calculated from the SMPS? please, define the terms you use and use them systematically. Include the same information to the figure captions.

Thanks for the advice. Here, SOA is the SMPS-2 (aged OA)-SMPS-1(POA). We have defined the measured SOA in section 2.2. In section 3.1, we need to define it again to make the article easy to follow. The additional definition is as follows:

> Revised text: “The SMPS-1 determined the mass concentration of POA, while the SMPS-2 determined the mass concentration of aged OA, and their mass difference could be regarded as the SOA.”

27. L186: define term “mass growth potential”

The additional explanation of this term is as follows:

> Revised text: “The mass growth potentials were represented by SOA/POA mass ratios. The SMPS-1 determined the mass concentration of POA, while the SMPS-2 determined the mass concentration of aged OA, and their mass difference could be regarded as the SOA.”

28. L191-194: are these aromatics, cycloalcanes, fatty acids etc compounds you measured or found from literature? if literature, please formulate the sentences so that it is clear that this is information found from literature.

These compounds are found from other works. We didn’t provide the direct measurements of gaseous precursors, we have removed these further speculations to avoid misunderstanding.

29. L219: please define f43 and f44

f 43 and *f* 44 are the signal fraction of organic fragments. We have defined them in the new manuscript:

> Revised text: “As shown in Figure 5, the signal fraction of organic fragments at m/z 43 (*f*43) and m/z 44 (*f*44) has been widely adopted to represent the oxidation process of OA.”

30. L222: remove apparently

As the reviewer suggested, the word “apparently” was removed.

> Revised text: “The datasets of vehicle and cooking groups fell along in different regions and showed different variations in the plot.”

31. L247-249: are the fx fractions average fractions for all measurement points with different OH-exposure and different speeds? maybe give range or standard deviation to describe the variation within the dataset.

Yes, it is the average fractions, and the standard deviations have been added as the following text shows:

Revised text "For average vehicle LO-OOA mass spectra, the prominent peaks were m/z 43 (f_{43}=0.133±0.003), 44 (f_{44}=0.077±0.001), 29 (f_{29}=0.076±0.003), 28 (f_{28}=0.066±0.001), 41 (f_{41}=0.051±0.005), 55 (f_{55}=0.043±0.004) dominated by $C_2H_3O^+$, $C_3H_7^+$, CO_2^+, CHO^+, $C_2H_5^+$, CO^+, $C_3H_5^+$, $C_3H_3O^+$ and $C_4H_7^+$ respectively, while the prominent peaks of average vehicle MO-OOA were m/z 44 (f_{44}=0.146±0.060), 28 (f_{28}=0.134±0.062), 43 (f_{43}=0.117±0.033), 29 (f_{29}=0.071±0.014), 45 (f_{45}=0.032±0.007), 27 (f_{27}=0.030±0.009) dominated by CO_2^+, CO^+, $C_2H_3O^+$, CHO^+, $C_2H_5^+$, CHO_2^+, $C_2H_5O^+$ and $C_2H_3^+$ respectively."

Revised text: "For average cooking LO-OOA, it was less oxidized than those from vehicle groups, whose prominent peaks were m/z 43 (f_{43}=0.097±0.008), 44 (f_{44}=0.065±0.010), 29 (f_{29}=0.065±0.013), 41 (f_{41}=0.058±0.008), 55 (f_{55}=0.056±0.006), 28 (f_{28}=0.053±0.011) dominated by $C_2H_3O^+$, $C_3H_7^+$, CO_2^+, CHO^+, $C_2H_5^+$, $C_3H_5^+$, $C_3H_3O^+$, $C_4H_7^+$ and CO^+ respectively."

32. Figure/table captions: please, add all necessary information to figure/table caption. E.g. is the shown data average values, are the shown bars standard deviations, which instrument was used to measure data, etc.

We have modified the caption of Figure 2-7 as the reviewer suggested.

Revised text:

Figure 2. Secondary mass growth potentials for two urban lifestyle SOA. The mass growth potentials were represented by SOA/POA mass ratios. The SMPS-1 determined the mass concentration of POA, while the SMPS-2 determined the mass concentration of aged OA, and their mass difference could be regarded as the SOA. The average data and standard deviation bars are shown in the figure.

Figure 3. Evolution of O:C molar ratio for two urban lifestyle OA. The O:C molar ratios are determined by HR-Tof-AMS. The average data and standard deviation bars at each gradient are shown in the figure.

Figure 4. Van Krevelen diagram of OA from various sources. The O:C and H:C are determined by HR-Tof-AMS. The average data at each gradient are shown in the figure.

Figure 5. Fractions of entire organic signals at m/z 43 (f_{43}) vs. m/z 44 (f_{44}) from various sources as well as Ng triangle plot. The f_{43} and f_{44} are determined by HR-Tof-AMS. The average data at each gradient are shown in the figure.

Figure 6. Average mass spectra of OA from two urban lifestyle sources. The numbered symbols represent the m/z values with relatively large fractions. The gray symbols represent the fragments that mainly come from

hydrocarbon-like fragments and the green symbols represent those mainly come from oxygen-containing fragments. The mass spectra are determined by HR-Tof-AMS. The average data are shown in the figure.

Figure 7. Correlation coefficients (Pearson r) between the laboratory aged OA and published ambient PMF-OA factors with growing photochemical ages. Ambient PMF-OA factors are the average results from two field studies in Beijing (Measured at a typical urban site during autumn and winter; Autumn: Oct. 1st, 2018 – Nov. 15th, 2018; Winter: Jan. 5th, 2019 – Jan. 31st, 2019). The unit mass resolution mass spectra are determined by HR-Tof-AMS.

33. Figure 2. Define what data was used for SOA/POA in the figure.

It is the SMPS data. We have modified the caption of figure 2.

Revised text: **"Figure 2.** Secondary mass growth potentials for two urban lifestyle SOA. The mass growth potentials were represented by SOA/POA mass ratios. The SMPS-1 determined the mass concentration of POA, while the SMPS-2 determined the mass concentration of aged OA, and their mass difference could be regarded as the SOA. The average data and standard deviation bars are shown in the figure."