



Supplement of

Combined application of online FIGAERO-CIMS and offline LC-Orbitrap mass spectrometry (MS) to characterize the chemical composition of secondary organic aerosol (SOA) in smog chamber studies

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1. Discussion about the calculated \overline{OS}_C for CHOS and CHONS species

In this study, we assumed the carbon oxidation states (\overline{OS}_C) for the CHOS and CHONS species was determined by Eq. 1: $\overline{OS}_C \approx 2 \times O/C - H/C$ (See assumption column in Table S1). In order to confirm the uncertainty of this assumption to the calculated \overline{OS}_C , for the CHONS species, we assumed N (NO_3^- , $OS_N = +5$) and S (SO_4^{2-} , $OS_S = +6$) are fully oxidized to obtain the lower limit of calculated \overline{OS}_C by Eq. 2: $\overline{OS}_C = 2 \times O/C - H/C - 5 \times N/C - 6 \times S/C$ ($nO \geq 7$). We assumed the N ($-NO_2^-$, $OS_N = +3$) and S (SO_3^{2-} , $OS_S = +4$) are reduced, so the upper limit of \overline{OS}_C was determined by Eq. 3 $\overline{OS}_C = 2 \times O/C - H/C - 3 \times N/C - 4 \times S/C$ ($nO \geq 5$). For the CHOS species, the lower and upper limits of calculated \overline{OS}_C were determined by Eq. 4: $\overline{OS}_C = 2 \times O/C - H/C - 6 \times S/C$ ($nO \geq 4$) and Eq. 5: $\overline{OS}_C = 2 \times O/C - H/C - 4 \times S/C$ ($nO \geq 3$), respectively. The calculated \overline{OS}_C for other compounds without sufficient oxygen numbers was determined by Eq. 1 in the two groups. The calculated \overline{OS}_C was weighted to the normalised peak areas and the results are shown in Table S1. The results suggest that the influence of S or NS on the calculation of \overline{OS}_C is negligible owing to the low fractions of the two species in the oxidation products. Thus, it is reasonable to calculate the \overline{OS}_C for CHOS and CHONS species according to Eq. 1 (as shown in Eq. 3 in the paper) in this study.

Table S1. Results of calculated \overline{OS}_C for compounds in the CHOS and CHONS groups.

Unique compounds				Common compounds		
Negative mode						
	Assumption	Upper limit	Lower limit	Assumption	Upper limit	Lower limit
Sum of CHOS and CHONS	-0.037	-0.082	-0.084	-0.018	-0.034	-0.078
The gap between the assumption and upper limit or lower limit		-0.044	-0.046		-0.016	-0.061
Positive mode						
	Assumption	Upper limit	Lower limit	Assumption	Upper limit	Lower limit
Sum of CHOS and CHONS	-0.272	-0.286	-0.304	-0.083	-0.151	-0.177
The gap between the assumption and upper limit or lower limit		-0.014	-0.032		-0.069	-0.094

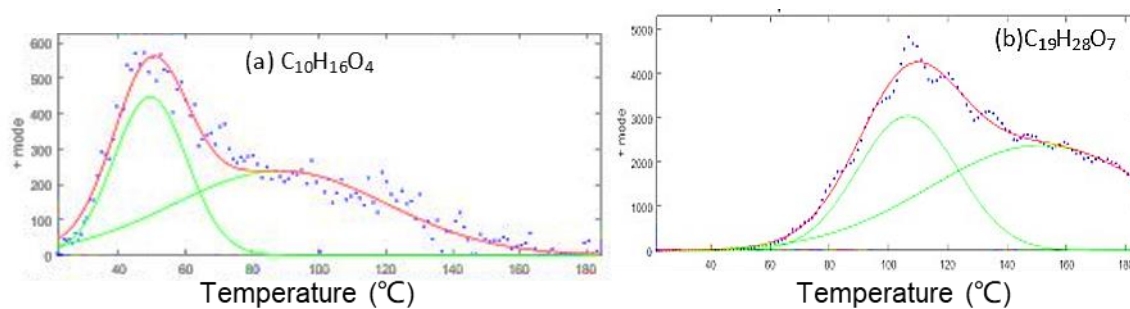


Figure S1. Two examples of an ion having more than a single desorption peak. Here the peaks at the lower desorption temperature were assigned to monomer $C_{10}H_{16}O_4$ (a) and $C_{19}H_{28}O_7$ (b) generated from α -pinene directly and the broader higher temperature peaks being a fragment of another ion at the same mass.

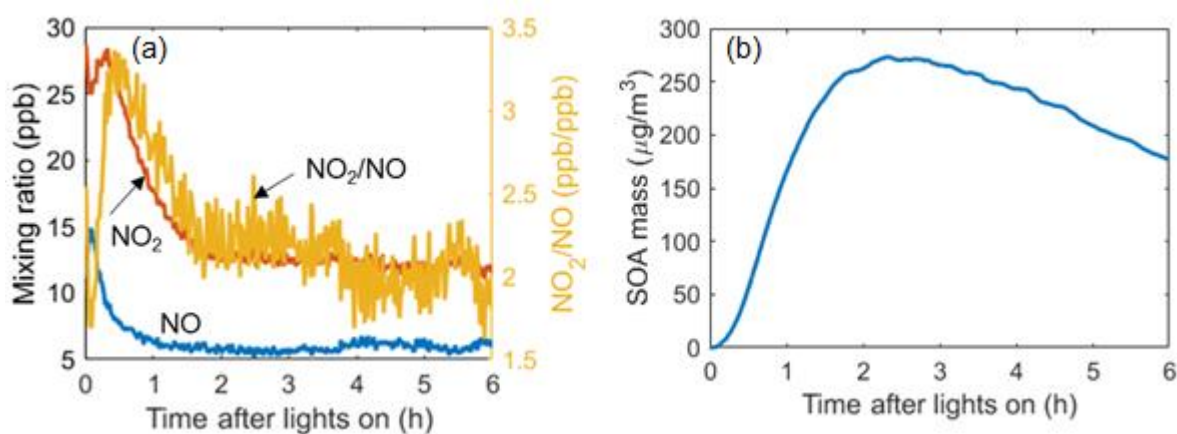


Figure S2. Results from the representative experiment. (a) mixing ratios of NO, NO₂ and NO₂/NO ratio. (b) SOA mass over time.

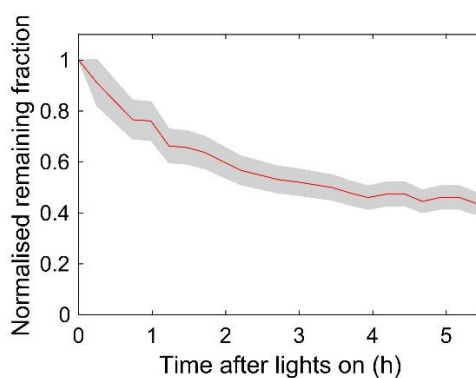


Figure S3. Decay rates of α -pinene. The shaded areas represent the variability of the experiments.

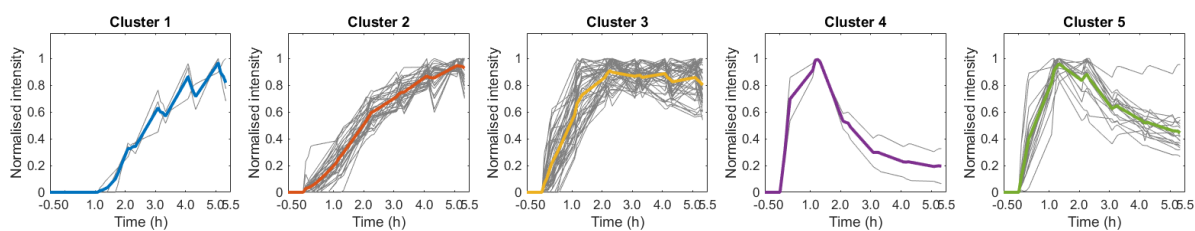


Figure S4. Time series of ions in each cluster in the gas phase.

Table S2. Compounds in the gas phase in each cluster for the representative experiment, ranking by ion's contribution in each cluster. All ions are reported as iodide clustered species.

Cluster 1		Cluster 3		Cluster 4	
MW	Formula	MW	Formula	MW	Formula
298.978031	C ₈ H ₁₂ O ₄	371.994409	C ₁₀ H ₁₅ NO ₆	355.999494	C ₁₀ H ₁₅ NO ₅
256.967466	C ₆ H ₁₀ O ₃	329.960035	C ₈ H ₁₁ O ₆	403.984238	C ₁₀ H ₁₅ NO ₈
312.944719	C ₇ H ₈ NO ₅	298.806598	CH ₂ O ₂		
Cluster 2		214.920516	C ₃ H ₄ O ₃	Cluster 5	
MW	Formula	317.983844	C ₇ H ₁₃ NO ₅	MW	Formula
315.968194	C ₇ H ₁₁ NO ₅	343.975685	C ₉ H ₁₃ O ₆	357.978759	C ₉ H ₁₃ NO ₆
303.968194	C ₆ H ₁₁ NO ₅	343.963109	C ₈ H ₁₁ NO ₆	246.097762	C ₁₀ H ₁₆ NO ₆
283.006926	C ₈ H ₁₄ NO ₂	229.107599	C ₁₁ H ₁₇ O ₅	232.082112	C ₉ H ₁₄ NO ₆
301.96512	C ₇ H ₁₁ O ₅	234.073953	C ₉ H ₁₄ O ₇	215.091949	C ₁₀ H ₁₅ O ₅
275.936894	C ₄ H ₇ NO ₅	403.012799	C ₁₁ H ₁₈ NO ₇	289.928735	C ₅ H ₇ O ₆
312.993681	C ₉ H ₁₄ O ₄	345.991335	C ₉ H ₁₅ O ₆	387.989324	C ₁₀ H ₁₅ NO ₇
270.983116	C ₇ H ₁₂ O ₃	231.923256	C ₃ H ₅ O ₄	373.98625	C ₁₀ H ₁₅ O ₇
282.97054	C ₇ H ₁₀ NO ₃	303.931809	C ₅ H ₇ NO ₆	361.98625	C ₉ H ₁₅ O ₇
242.951816	C ₅ H ₈ O ₃	317.947459	C ₆ H ₉ NO ₆	389.968588	C ₉ H ₁₃ NO ₈
284.998766	C ₈ H ₁₄ O ₃	311.014416	C ₁₀ H ₁₆ O ₃	361.937288	C ₇ H ₉ NO ₈
268.967466	C ₇ H ₁₀ O ₃	327.009331	C ₁₀ H ₁₆ O ₄	385.98625	C ₁₁ H ₁₅ O ₇
199.92085	C ₂ H ₃ NO ₂	296.998766	C ₉ H ₁₄ O ₃	341.99642	C ₁₀ H ₁₅ O ₅
299.014416	C ₉ H ₁₆ O ₃	343.004245	C ₁₀ H ₁₆ O ₅	375.952938	C ₈ H ₁₁ NO ₈
324.993681	C ₁₀ H ₁₄ O ₄	328.988595	C ₉ H ₁₄ O ₅	232.118498	C ₁₀ H ₁₈ NO ₅
228.936166	C ₄ H ₆ O ₃	284.962381	C ₇ H ₁₀ O ₄	388.936954	C ₉ H ₁₀ O ₉
300.981105	C ₇ H ₁₂ NO ₄	359.994409	C ₉ H ₁₅ NO ₆	247.905594	C ₂ H ₃ NO ₅
329.99642	C ₉ H ₁₅ O ₅	340.988595	C ₁₀ H ₁₄ O ₅	340.00458	C ₁₀ H ₁₅ NO ₄
345.019896	C ₁₀ H ₁₈ O ₅	314.972945	C ₈ H ₁₂ O ₅		
286.978031	C ₇ H ₁₂ O ₄	344.012071	C ₁₀ H ₁₇ O ₅		
327.98077	C ₉ H ₁₃ O ₅	358.99916	C ₁₀ H ₁₆ O ₆		
230.951816	C ₄ H ₈ O ₃	230.915431	C ₃ H ₄ O ₄		
316.988595	C ₈ H ₁₄ O ₅	308.998766	C ₁₀ H ₁₄ O ₃		
258.946731	C ₅ H ₈ O ₄	226.920516	C ₄ H ₄ O ₃		
302.972945	C ₇ H ₁₂ O ₅	388.984573	C ₉ H ₁₄ N ₂ O ₇		
331.975685	C ₈ H ₁₃ O ₆	315.009331	C ₉ H ₁₆ O ₄		
212.928675	C ₃ H ₄ NO ₂	345.942374	C ₇ H ₉ NO ₇		

313.952544	C ₇ H ₉ NO ₅	390.004974	C ₁₀ H ₁₇ NO ₇		
272.998766	C ₇ H ₁₄ O ₃	344.98351	C ₉ H ₁₄ O ₆		
272.949805	C ₅ H ₈ NO ₄	356.994743	C ₉ H ₁₄ N ₂ O ₅		
301.030066	C ₉ H ₁₈ O ₃	314.001506	C ₉ H ₁₅ O ₄		
289.96512	C ₆ H ₁₁ O ₅	330.991669	C ₈ H ₁₄ NO ₅		
288.957295	C ₆ H ₁₀ O ₅	341.960035	C ₉ H ₁₁ O ₆		
		355.015479	C ₁₀ H ₁₆ N ₂ O ₄		
		261.93382	C ₄ H ₇ O ₅		
		373.002234	C ₁₀ H ₁₆ NO ₆		
		376.0019	C ₁₀ H ₁₇ O ₇		
		326.001506	C ₁₀ H ₁₅ O ₄		
		331.9393	C ₇ H ₉ O ₇		
		387.005308	C ₁₀ H ₁₆ N ₂ O ₆		
		338.996755	C ₁₀ H ₁₄ NO ₄		
		370.986584	C ₁₀ H ₁₄ NO ₆		

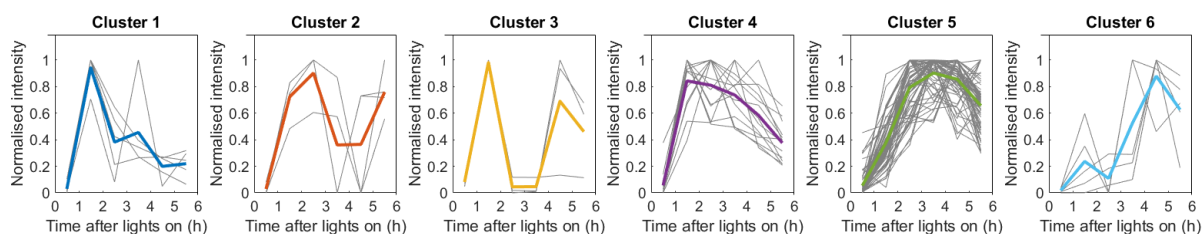


Figure S5. Time series of ions in each cluster in particle phase.

Table S3. Compounds in the particle phase in each cluster for the representative experiment, ranking by ion's contribution in each cluster. All ions are reported as iodide clustered species.

Cluster 1		Cluster 5	
MW	Formula	MW	Formula
328.988595	C ₉ H ₁₄ O ₅	312.993681	C ₉ H ₁₄ O ₄
284.962381	C ₇ H ₁₀ O ₄	298.978031	C ₈ H ₁₂ O ₄
258.946731	C ₅ H ₈ O ₄	327.009331	C ₁₀ H ₁₆ O ₄
405.999888	C ₁₀ H ₁₇ NO ₈	358.99916	C ₁₀ H ₁₆ O ₆
355.999494	C ₁₀ H ₁₅ NO ₅	371.994409	C ₁₀ H ₁₅ NO ₆
Cluster 2		Cluster 5	
		340.988595	C ₁₀ H ₁₄ O ₅
MW	Formula	345.019896	C ₁₀ H ₁₈ O ₅
403.984238	C ₁₀ H ₁₅ NO ₈	356.994743	C ₉ H ₁₄ N ₂ O ₅
400.997149	C ₁₁ H ₁₆ NO ₇	344.98351	C ₉ H ₁₄ O ₆
319.9393	C ₆ H ₉ O ₇	300.981105	C ₇ H ₁₂ NO ₄
391.996814	C ₁₀ H ₁₇ O ₈	374.994075	C ₁₀ H ₁₆ O ₇
Cluster 3		302.972945	C ₇ H ₁₂ O ₅
MW	Formula	300.932143	C ₅ H ₆ N ₂ O ₅
270.983116	C ₇ H ₁₂ O ₃	256.931081	C ₅ H ₆ O ₄
268.918505	C ₅ H ₄ NO ₄	328.017156	C ₁₀ H ₁₇ O ₄
242.915431	C ₄ H ₄ O ₄	314.001506	C ₉ H ₁₅ O ₄
Cluster 4		330.942708	C ₆ H ₈ N ₂ O ₆

MW	Formula	282.97054	C ₇ H ₁₀ NO ₃
343.004245	C ₁₀ H ₁₆ O ₅	469.072325	C ₁₇ H ₂₆ O ₇
324.993681	C ₁₀ H ₁₄ O ₄	387.989324	C ₁₀ H ₁₅ NO ₇
296.998766	C ₉ H ₁₄ O ₃	344.012071	C ₁₀ H ₁₇ O ₅
390.004974	C ₁₀ H ₁₇ NO ₇	299.985856	C ₈ H ₁₃ O ₄
361.01481	C ₁₀ H ₁₈ O ₆	286.965455	C ₆ H ₁₀ NO ₄
388.984573	C ₉ H ₁₄ N ₂ O ₇	214.920516	C ₃ H ₄ O ₃
200.904866	C ₂ H ₂ O ₃	359.994409	C ₉ H ₁₅ NO ₆
316.95221	C ₇ H ₁₀ O ₆	316.988595	C ₈ H ₁₄ O ₅
361.98625	C ₉ H ₁₅ O ₇	495.087975	C ₁₉ H ₂₈ O ₇
341.99642	C ₁₀ H ₁₅ O ₅	373.002234	C ₁₀ H ₁₆ NO ₆
226.920516	C ₄ H ₄ O ₃	372.965849	C ₉ H ₁₂ NO ₇
228.936166	C ₄ H ₆ O ₃	299.014416	C ₉ H ₁₆ O ₃
202.920516	C ₂ H ₄ O ₃	346.99916	C ₉ H ₁₆ O ₆
449.091049	C ₁₄ H ₂₈ NO ₇	342.942708	C ₇ H ₈ N ₂ O ₆
Cluster 6		332.98351	C ₈ H ₁₄ O ₆
MW	Formula	216.936166	C ₃ H ₆ O ₃
314.972945	C ₈ H ₁₂ O ₅	312.944719	C ₇ H ₈ NO ₅
330.991669	C ₈ H ₁₄ NO ₅	283.006926	C ₈ H ₁₄ NO ₂
274.941645	C ₅ H ₈ O ₅	315.009331	C ₉ H ₁₆ O ₄
256.95489	C ₅ H ₈ NO ₃	373.98625	C ₁₀ H ₁₅ O ₇
230.951816	C ₄ H ₈ O ₃	451.070314	C ₁₃ H ₂₆ NO ₈
		370.986584	C ₁₀ H ₁₄ NO ₆
		360.965849	C ₈ H ₁₂ NO ₇
		481.072325	C ₁₈ H ₂₆ O ₇
		302.923984	C ₅ H ₆ NO ₆
		387.005308	C ₁₀ H ₁₆ N ₂ O ₆
		439.06176	C ₁₆ H ₂₄ O ₆
		345.991335	C ₉ H ₁₅ O ₆
		288.957295	C ₆ H ₁₀ O ₅
		287.00184	C ₇ H ₁₄ NO ₃
		356.947125	C ₉ H ₁₀ O ₇
		427.025375	C ₁₄ H ₂₀ O ₇
		441.028449	C ₁₄ H ₂₀ NO ₇
		467.056675	C ₁₇ H ₂₄ O ₇
		272.949805	C ₅ H ₈ NO ₄
		315.968194	C ₇ H ₁₁ NO ₅
		471.05159	C ₁₆ H ₂₄ O ₈
		355.015479	C ₁₀ H ₁₆ N ₂ O ₄
		376.0019	C ₁₀ H ₁₇ O ₇
		317.983844	C ₇ H ₁₃ NO ₅
		326.001506	C ₁₀ H ₁₅ O ₄
		399.005308	C ₁₁ H ₁₆ N ₂ O ₆
		298.006591	C ₉ H ₁₅ O ₃
		303.968194	C ₆ H ₁₁ NO ₅
		327.98077	C ₉ H ₁₃ O ₅
		338.972945	C ₁₀ H ₁₂ O ₅
		369.007319	C ₁₁ H ₁₆ NO ₅
		397.01481	C ₁₃ H ₁₈ O ₆
		296.949805	C ₇ H ₈ NO ₄

		308.998766	$C_{10}H_{14}O_3$
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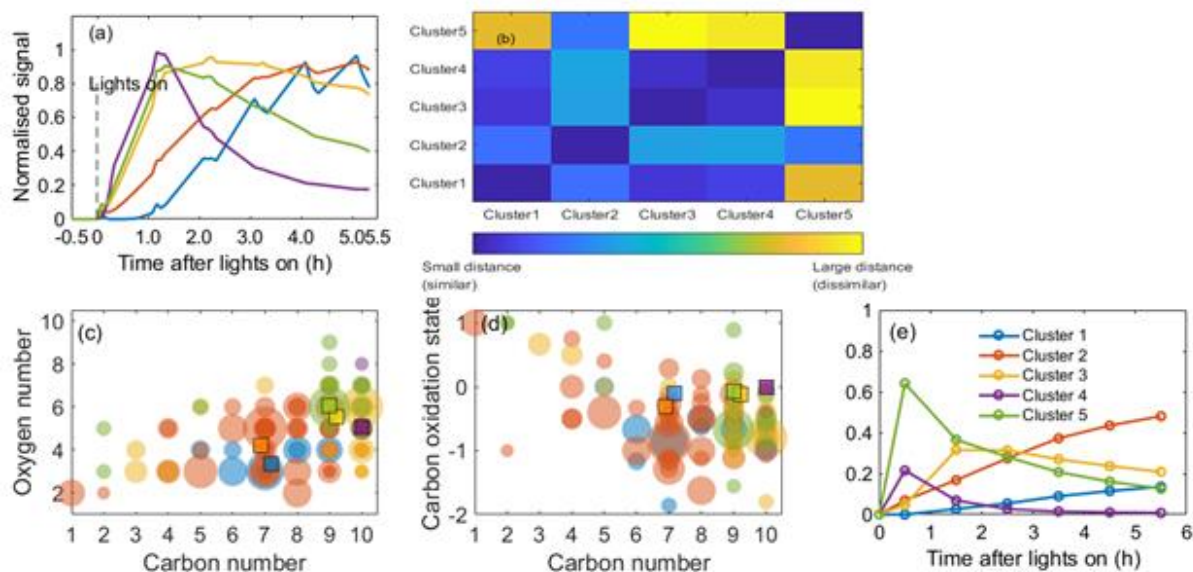


Figure S6. Hierarchical clustering of gas-phase oxidation products for the repeat α -pinene system. (a) Time series of each cluster normalized to the highest ions' intensity between 0 and 1. (b) Matrix showing the relative distance between clusters. (c) Carbon number vs oxygen number for each cluster. (d) Carbon number vs oxidation state for each cluster. (e) Time series of the sum of ions' normalized fractions to the total signal in each cluster. Note that the square symbols represent the contribution weighted average carbon numbers, oxygen numbers or and \overline{OS}_C in each cluster. The colors correspond to the ones in (e).

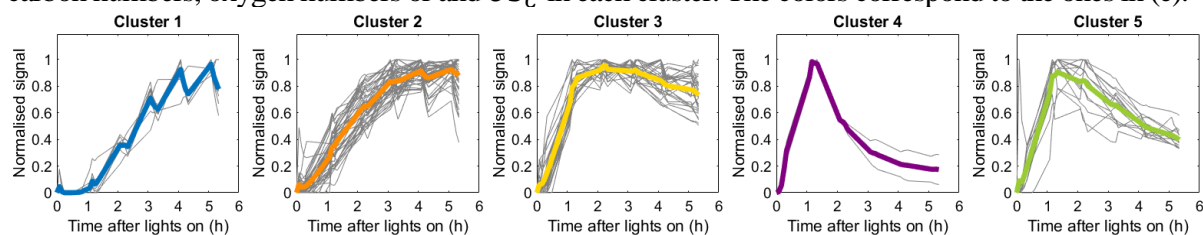


Figure S7. Time series of ions in each cluster in the gas phase for the repeat experiment.

Table S4. Compounds in the gas phase in each cluster for the repeat experiment, ranking by ion's contribution in each cluster. All ions are reported as iodide clustered species.

Cluster 1		Cluster 2		Cluster 3	
MW	Formula	MW	Formula	MW	Formula
298.978	$C_8H_{12}O_4$	230.9518	$C_4H_8O_3$	214.9205	$C_3H_4O_3$
270.9831	$C_7H_{12}O_3$	315.9682	$C_7H_{11}NO_5$	232.0821	$C_9H_{14}NO_6$
312.9937	$C_9H_{14}O_4$	298.8066	CH_2O_2	234.074	$C_9H_{14}O_7$
256.9675	$C_6H_{10}O_3$	329.96	$C_8H_{11}O_6$	229.1076	$C_{11}H_{17}O_5$
299.9859	$C_8H_{13}O_4$	343.9631	$C_8H_{11}NO_6$	403.0128	$C_{11}H_{18}NO_7$
345.0199	$C_{10}H_{18}O_5$	317.9838	$C_7H_{13}NO_5$	371.9944	$C_{10}H_{15}NO_6$
286.9655	$C_6H_{10}NO_4$	303.9682	$C_6H_{11}NO_5$	311.0144	$C_{10}H_{16}O_3$
258.9467	$C_5H_8O_4$	296.9988	$C_9H_{14}O_3$	327.0093	$C_{10}H_{16}O_4$
287.0018	$C_7H_{14}NO_3$	282.9705	$C_7H_{10}NO_3$	373.0022	$C_{10}H_{16}NO_6$

		283.0069	C ₈ H ₁₄ NO ₂	358.9992	C ₁₀ H ₁₆ O ₆
Cluster 4		343.0042	C ₁₀ H ₁₆ O ₅	359.9944	C ₉ H ₁₅ NO ₆
MW	Formula	242.9518	C ₅ H ₈ O ₃	341.9964	C ₁₀ H ₁₅ O ₅
355.9995	C ₁₀ H ₁₅ NO ₅	343.9757	C ₉ H ₁₃ O ₆	312.0222	C ₁₀ H ₁₇ O ₃
403.9842	C ₁₀ H ₁₅ NO ₈	284.9988	C ₈ H ₁₄ O ₃	230.9154	C ₃ H ₄ O ₄
Cluster 5		268.9675	C ₇ H ₁₀ O ₃	340.9886	C ₁₀ H ₁₄ O ₅
MW	Formula	328.9886	C ₉ H ₁₄ O ₅	345.9913	C ₉ H ₁₅ O ₆
357.9788	C ₉ H ₁₃ NO ₆	199.9209	C ₂ H ₃ NO ₂	388.9846	C ₉ H ₁₄ N ₂ O ₇
246.0978	C ₁₀ H ₁₆ NO ₆	284.9624	C ₇ H ₁₀ O ₄	328.0172	C ₁₀ H ₁₇ O ₄
202.9205	C ₂ H ₄ O ₃	344.0121	C ₁₀ H ₁₇ O ₅	226.9205	C ₄ H ₄ O ₃
358.9628	C ₉ H ₁₂ O ₇	299.0144	C ₉ H ₁₆ O ₃	308.9988	C ₁₀ H ₁₄ O ₃
289.9287	C ₅ H ₇ O ₆	314.9729	C ₈ H ₁₂ O ₅	345.9424	C ₇ H ₉ NO ₇
215.0919	C ₁₀ H ₁₅ O ₅	329.9964	C ₉ H ₁₅ O ₅	341.96	C ₉ H ₁₁ O ₆
361.9863	C ₉ H ₁₅ O ₇	228.9362	C ₄ H ₆ O ₃	372.9658	C ₉ H ₁₂ NO ₇
373.9863	C ₁₀ H ₁₅ O ₇	344.9835	C ₉ H ₁₄ O ₆	303.9318	C ₅ H ₇ NO ₆
356.9947	C ₉ H ₁₄ N ₂ O ₅	316.9886	C ₈ H ₁₄ O ₅	355.0155	C ₁₀ H ₁₆ N ₂ O ₄
387.9893	C ₁₀ H ₁₅ NO ₇	300.9811	C ₇ H ₁₂ NO ₄	374.9941	C ₁₀ H ₁₆ O ₇
389.9686	C ₉ H ₁₃ NO ₈	324.9937	C ₁₀ H ₁₄ O ₄	311.9859	C ₉ H ₁₃ O ₄
388.937	C ₉ H ₁₀ O ₉	314.0015	C ₉ H ₁₅ O ₄	361.0148	C ₁₀ H ₁₈ O ₆
247.9056	C ₂ H ₃ NO ₅	298.0066	C ₉ H ₁₅ O ₃		
385.9863	C ₁₁ H ₁₅ O ₇	312.9447	C ₇ H ₈ NO ₅		
		327.9808	C ₉ H ₁₃ O ₅		
		275.9369	C ₄ H ₇ NO ₅		
		301.9651	C ₇ H ₁₁ O ₅		
		316.9522	C ₇ H ₁₀ O ₆		
		330.9917	C ₈ H ₁₄ NO ₅		
		302.9729	C ₇ H ₁₂ O ₅		
		390.005	C ₁₀ H ₁₇ NO ₇		
		313.9525	C ₇ H ₉ NO ₅		
		256.9311	C ₅ H ₆ O ₄		
		331.9757	C ₈ H ₁₃ O ₆		
		315.0093	C ₉ H ₁₆ O ₄		
		317.9475	C ₆ H ₉ NO ₆		
		326.0015	C ₁₀ H ₁₅ O ₄		
		272.9988	C ₇ H ₁₄ O ₃		
		285.9702	C ₇ H ₁₁ O ₄		
		261.9338	C ₄ H ₇ O ₅		
		346.9992	C ₉ H ₁₆ O ₆		

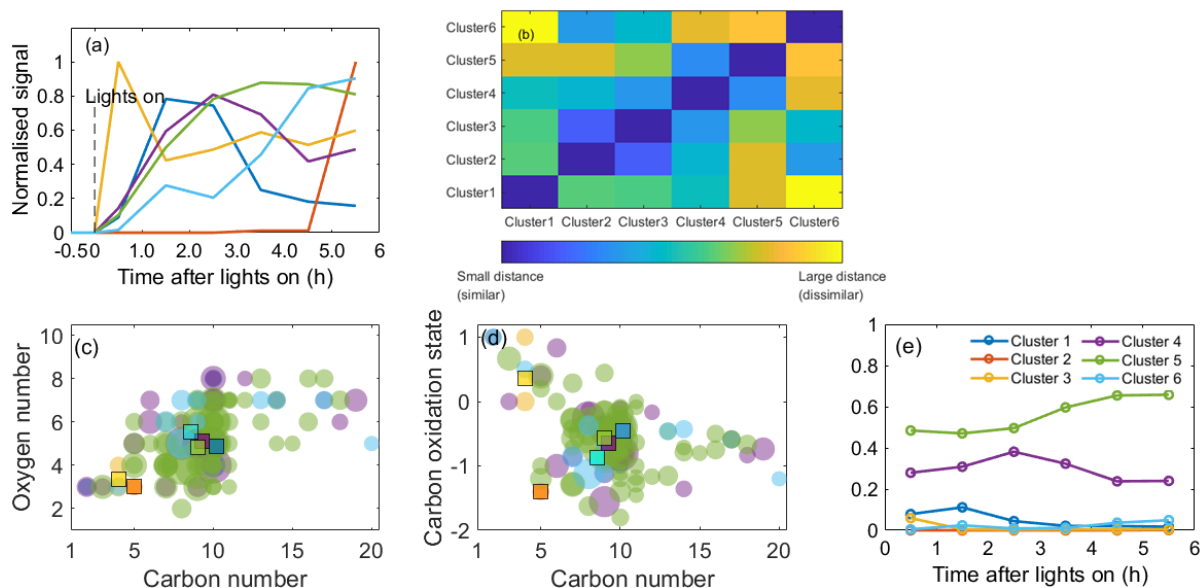


Figure S8. Hierarchical clustering of particle-phase oxidation products for the repeat α -pinene system. (a) Average time series of each cluster normalized to the highest ions' intensity between 0 and 1; (b) Matrix showing the relative distance between clusters. (c) Carbon number vs oxygen number for each cluster. (d) Carbon number vs oxidation state for each cluster. (e) Time series of the sum of ions' normalized fractions to the total signal in each cluster. Note that the square symbols represent the contribution weighted average carbon numbers, oxygen numbers or and OS_C in each cluster. The colors correspond to the ones in (a).

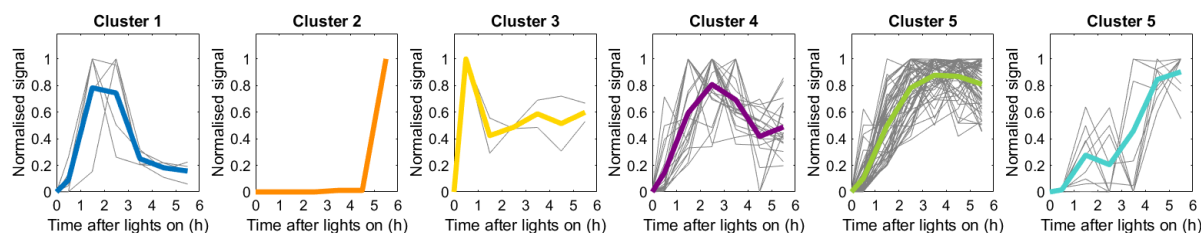


Figure S9. Time series of ions in each cluster in the particle phase for the repeat experiment.

Table S5. Compounds in the particle phase in each cluster for the repeat experiment, ranking by ion's contribution in each cluster. All ions are reported as iodide clustered species.

Cluster 1		Cluster 4		Cluster 5	
MW	Formula	MW	Formula	MW	Formula
324.99368	$C_{10}H_{14}O_4$	327.00933	$C_{10}H_{16}O_4$	312.99368	$C_9H_{14}O_4$
467.05668	$C_{17}H_{24}O_7$	314.97295	$C_8H_{12}O_5$	298.97803	$C_8H_{12}O_4$
405.99989	$C_{10}H_{17}NO_8$	356.99474	$C_9H_{14}N_2O_5$	343.00425	$C_{10}H_{16}O_5$
202.92052	$C_2H_4O_3$	328.9886	$C_9H_{14}O_5$	358.99916	$C_{10}H_{16}O_6$
355.99949	$C_{10}H_{15}NO_5$	345.0199	$C_{10}H_{18}O_5$	371.99441	$C_{10}H_{15}NO_6$
Cluster 2		403.98424	$C_{10}H_{15}NO_8$	340.9886	$C_{10}H_{14}O_5$
MW	Formula	330.94271	$C_6H_8N_2O_6$	344.98351	$C_9H_{14}O_6$
256.95489	$C_5H_8NO_3$	390.00497	$C_{10}H_{17}NO_7$	296.99877	$C_9H_{14}O_3$
Cluster 1		495.08798	$C_{19}H_{28}O_7$	374.99408	$C_{10}H_{16}O_7$

MW	Formula	387.98932	C ₁₀ H ₁₅ NO ₇	256.93108	C ₅ H ₆ O ₄
228.93617	C ₄ H ₆ O ₃	274.94165	C ₅ H ₈ O ₅	302.97295	C ₇ H ₁₂ O ₅
242.91543	C ₄ H ₄ O ₄	299.01442	C ₉ H ₁₆ O ₃	300.98111	C ₇ H ₁₂ NO ₄
Cluster 6		200.90487	C ₂ H ₂ O ₃	214.92052	C ₃ H ₄ O ₃
MW	Formula	270.98312	C ₇ H ₁₂ O ₃	284.96238	C ₇ H ₁₀ O ₄
330.99167	C ₈ H ₁₄ NO ₅	319.9393	C ₆ H ₉ O ₇	316.9886	C ₈ H ₁₄ O ₅
342.94271	C ₇ H ₈ N ₂ O ₆	216.93617	C ₃ H ₆ O ₃	282.97054	C ₇ H ₁₀ NO ₃
360.96585	C ₈ H ₁₂ NO ₇	449.09105	C ₁₄ H ₂₈ NO ₇	286.97803	C ₇ H ₁₂ O ₄
427.02538	C ₁₄ H ₂₀ O ₇	466.08524	C ₁₈ H ₂₇ O ₆	315.00933	C ₉ H ₁₆ O ₄
415.02538	C ₁₃ H ₂₀ O ₇	417.00464	C ₁₂ H ₁₈ O ₈	300.93214	C ₃ H ₆ N ₂ O ₅
388.98457	C ₉ H ₁₄ N ₂ O ₇	391.99681	C ₁₀ H ₁₇ O ₈	387.00531	C ₁₀ H ₁₆ N ₂ O ₆
226.92052	C ₄ H ₄ O ₃	331.97569	C ₈ H ₁₃ O ₆	332.98351	C ₈ H ₁₄ O ₆
357.97876	C ₉ H ₁₃ NO ₆			373.00223	C ₁₀ H ₁₆ NO ₆
481.1451	C ₂₀ H ₃₄ O ₅			372.96585	C ₉ H ₁₂ NO ₇
				346.99916	C ₉ H ₁₆ O ₆
				451.07031	C ₁₃ H ₂₆ NO ₈
				312.94472	C ₇ H ₈ NO ₅
				370.98658	C ₁₀ H ₁₄ NO ₆
				283.00693	C ₈ H ₁₄ NO ₂
				481.07233	C ₁₈ H ₂₆ O ₇
				316.95221	C ₇ H ₁₀ O ₆
				439.06176	C ₁₆ H ₂₄ O ₆
				441.02845	C ₁₄ H ₂₀ NO ₇
				485.06724	C ₁₇ H ₂₆ O ₈
				356.94713	C ₉ H ₁₀ O ₇
				373.98625	C ₁₀ H ₁₅ O ₇
				471.05159	C ₁₆ H ₂₄ O ₈
				399.00531	C ₁₁ H ₁₆ N ₂ O ₆
				302.92398	C ₅ H ₆ NO ₆
				355.01548	C ₁₀ H ₁₆ N ₂ O ₄
				288.9573	C ₆ H ₁₀ O ₅
				400.99715	C ₁₁ H ₁₆ NO ₇
				272.94981	C ₅ H ₈ NO ₄
				397.01481	C ₁₃ H ₁₈ O ₆
				312.02224	C ₁₀ H ₁₇ O ₃
				338.97295	C ₁₀ H ₁₂ O ₅
				376.0019	C ₁₀ H ₁₇ O ₇
				361.98625	C ₉ H ₁₅ O ₇
				340.00458	C ₁₀ H ₁₅ NO ₄
				369.00732	C ₁₁ H ₁₆ NO ₅
				429.01587	C ₁₂ H ₁₈ N ₂ O ₇
				296.94981	C ₇ H ₈ NO ₄
				341.99642	C ₁₀ H ₁₅ O ₅
				353.01241	C ₁₁ H ₁₆ NO ₄
				409.0512	C ₁₅ H ₂₂ O ₅
				311.98586	C ₉ H ₁₃ O ₄

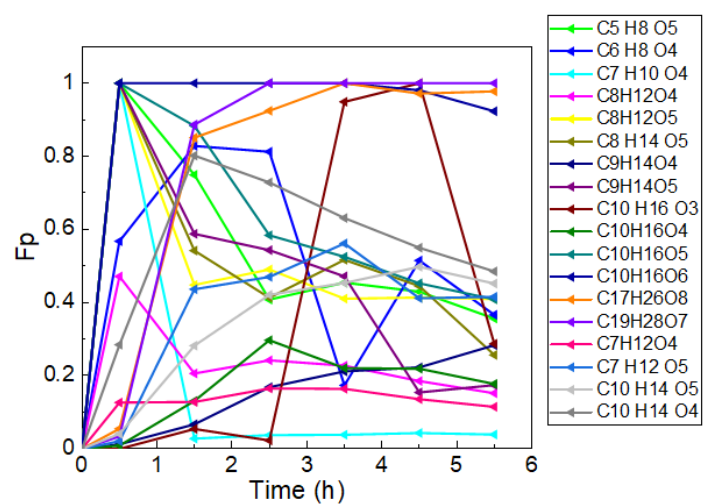
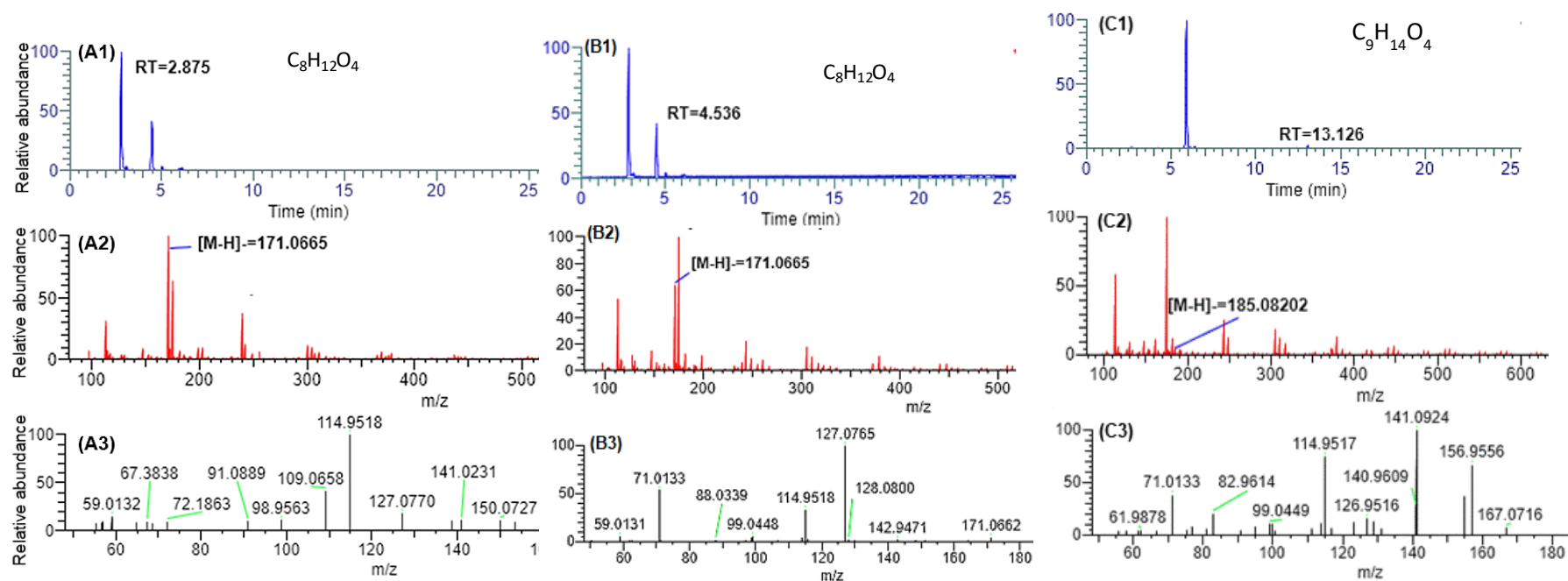
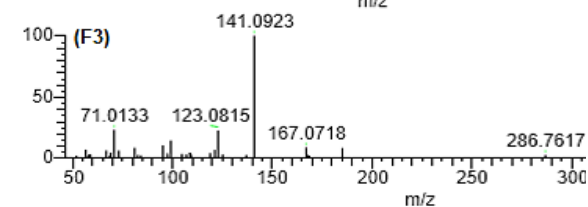
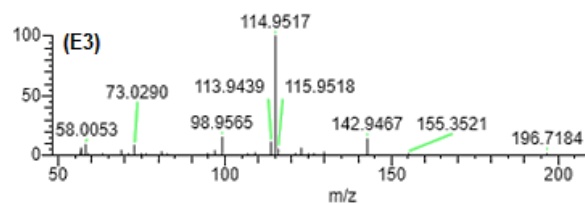
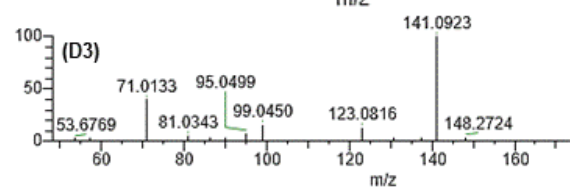
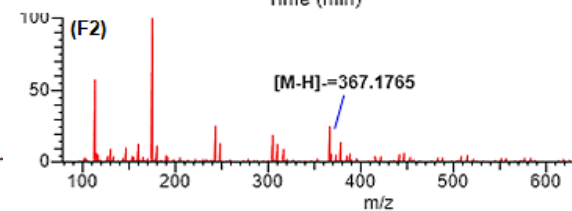
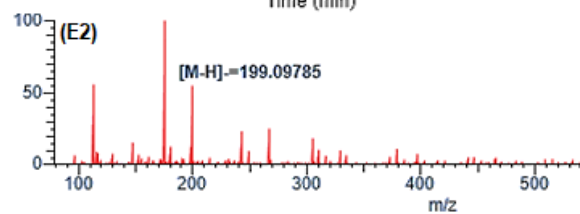
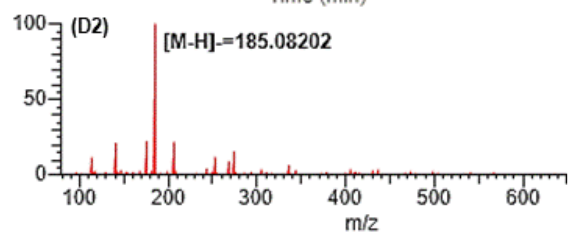
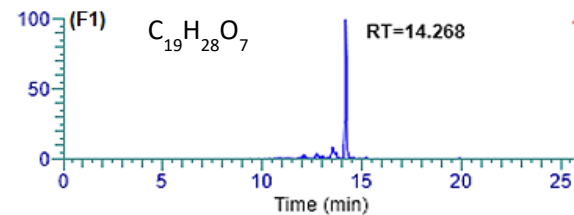
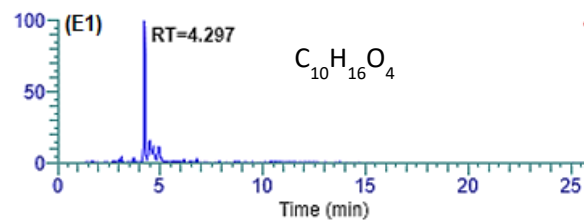
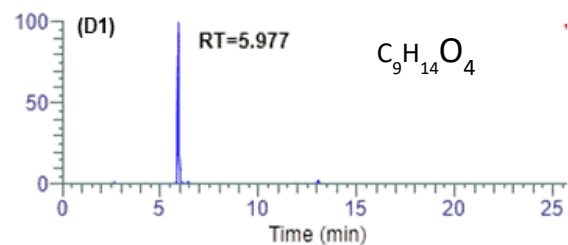
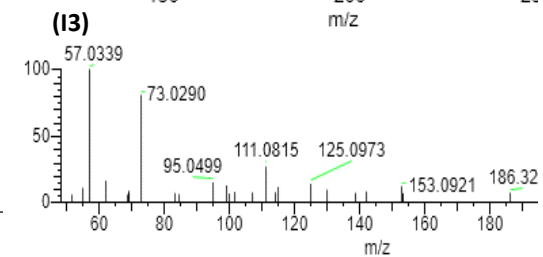
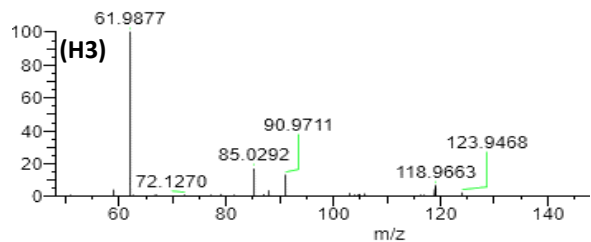
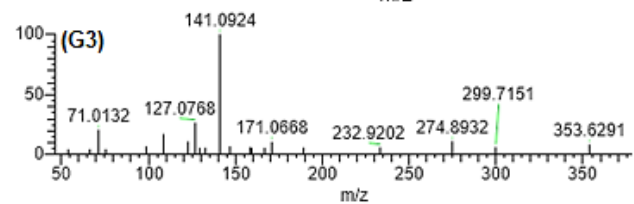
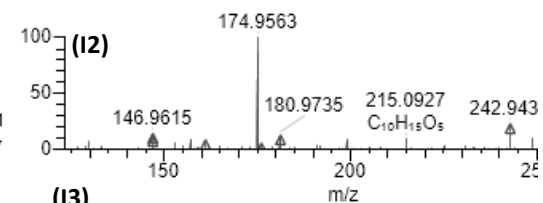
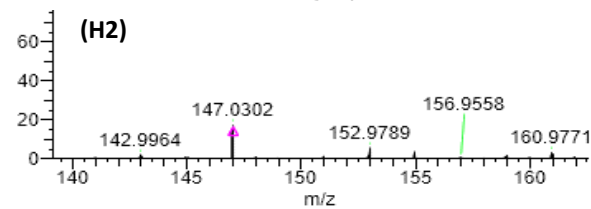
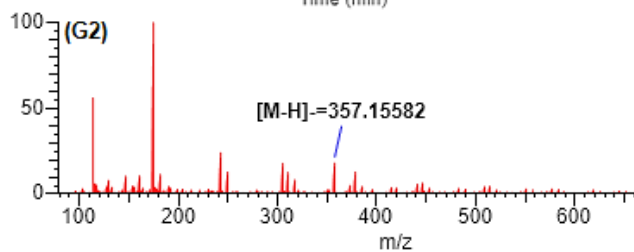
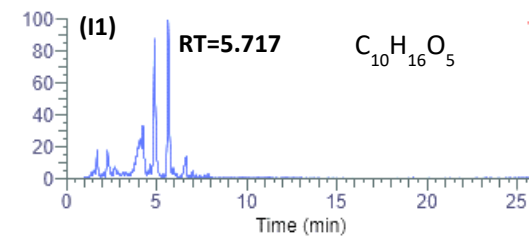
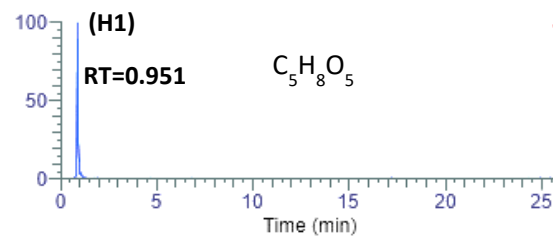
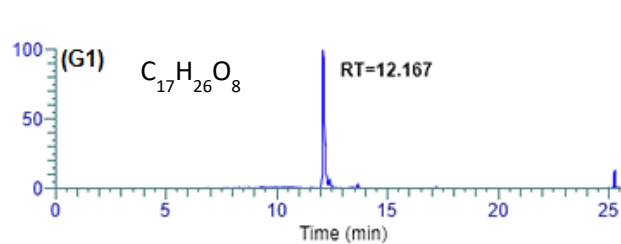
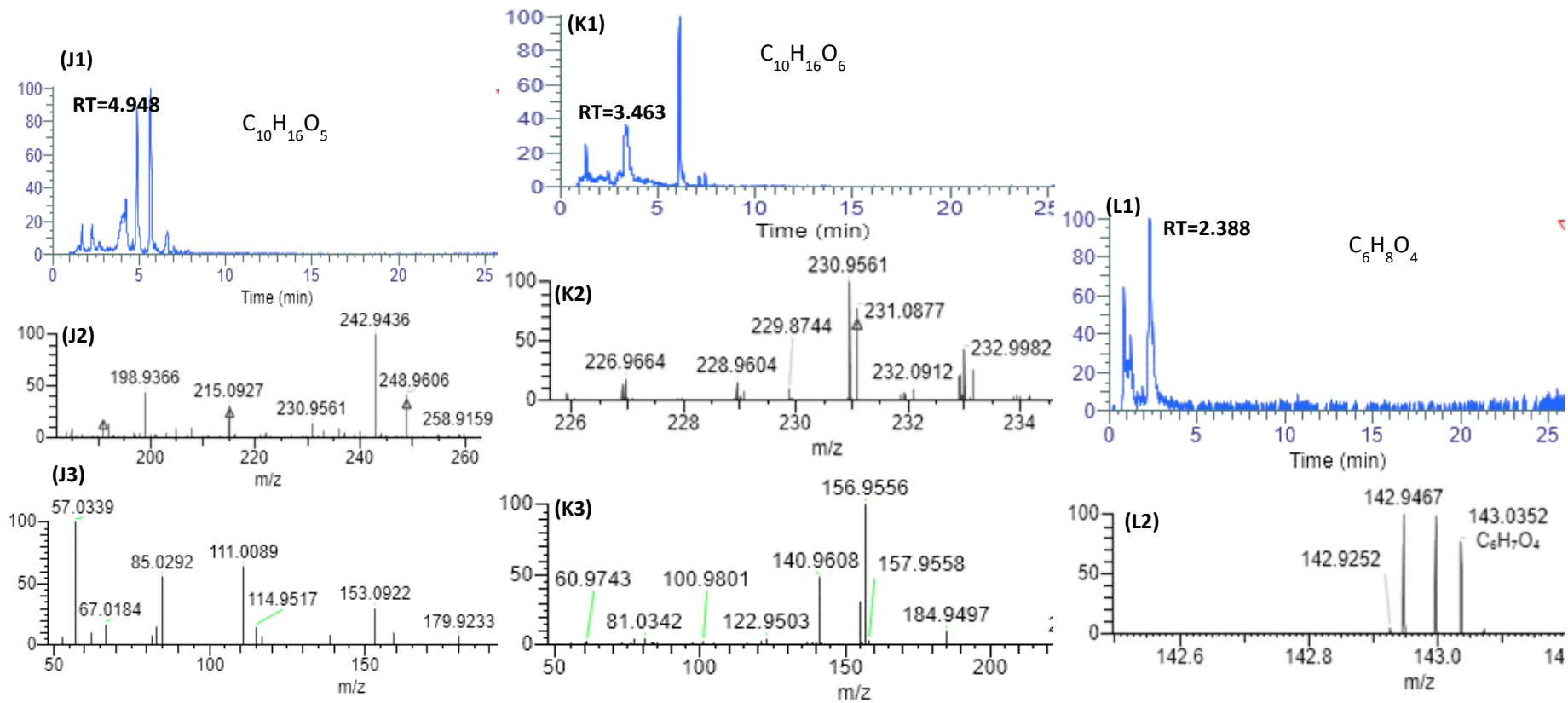


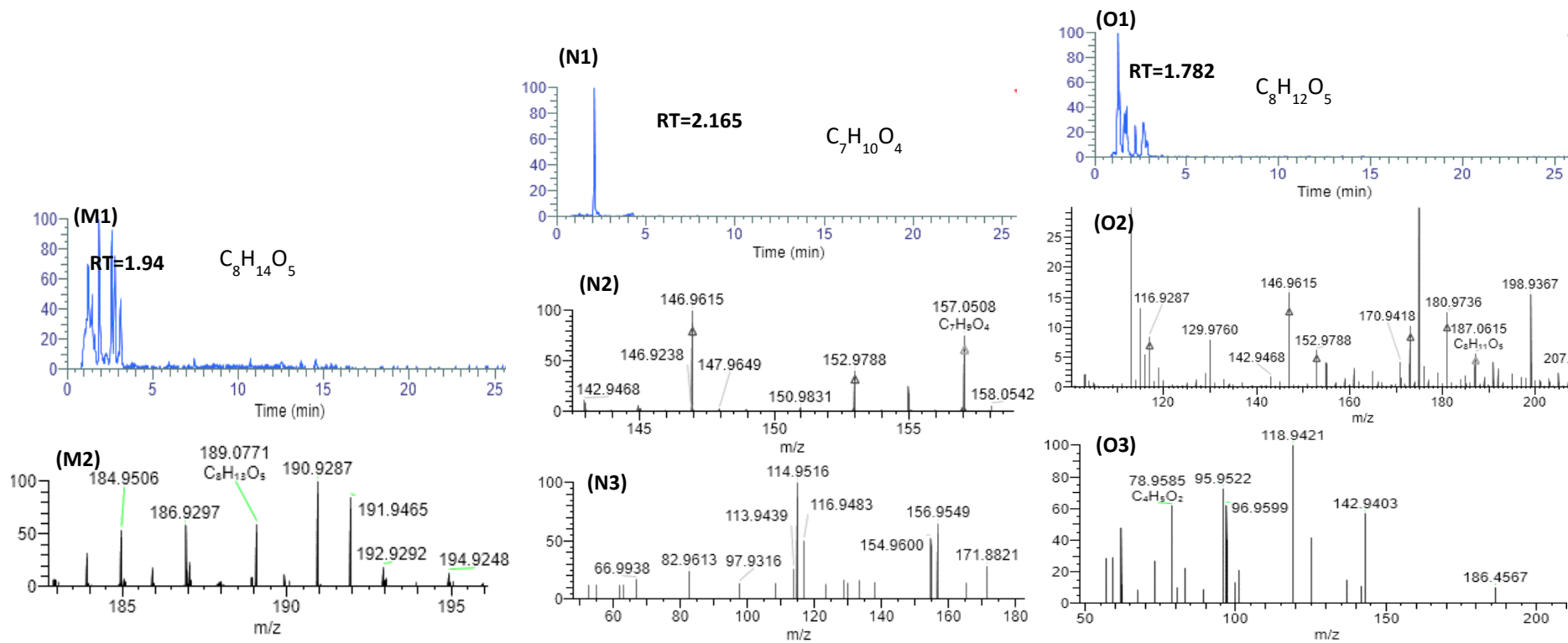
Figure S10. Temporal profiles of particle fractions for the selected identified organic molecules generated from α -pinene photooxidation reactions.

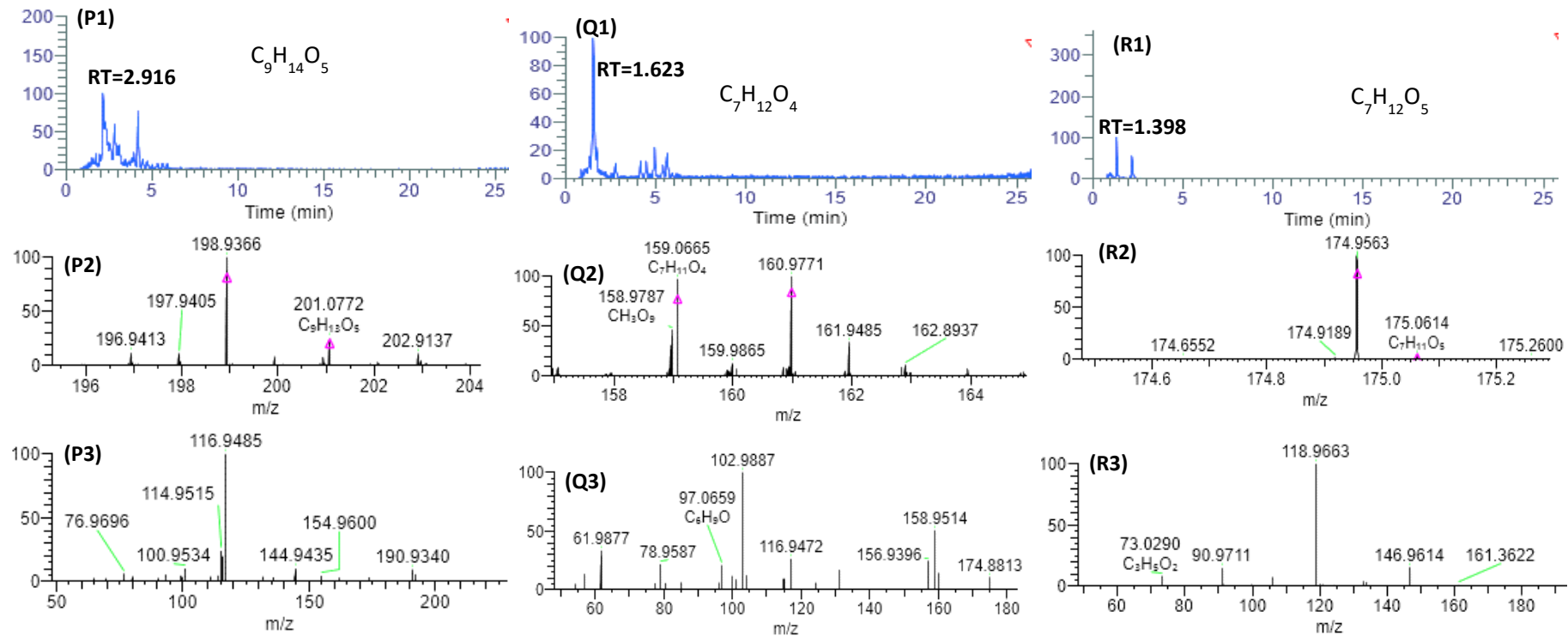


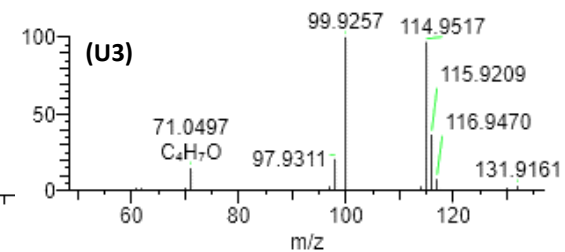
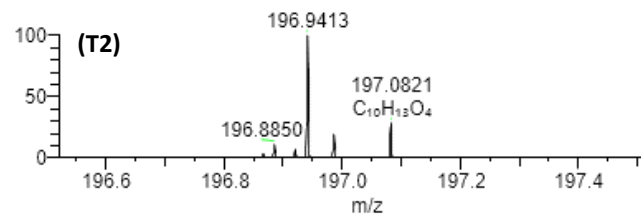
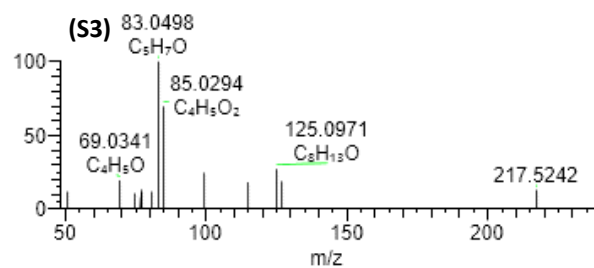
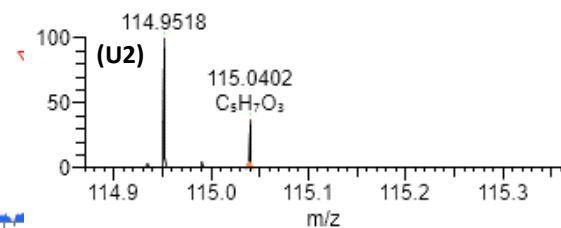
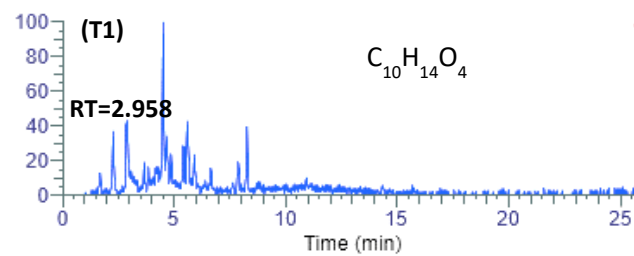
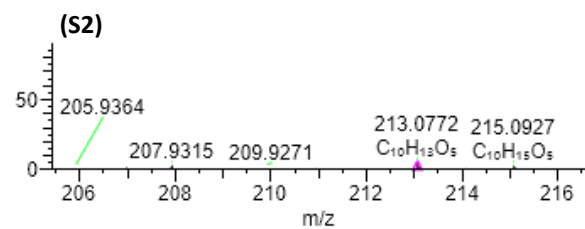
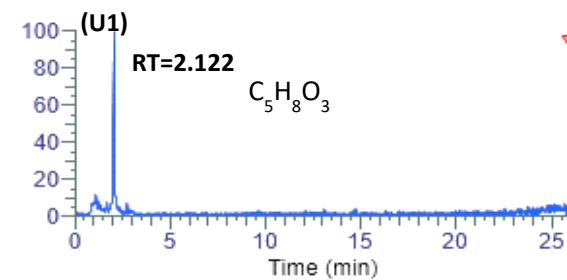
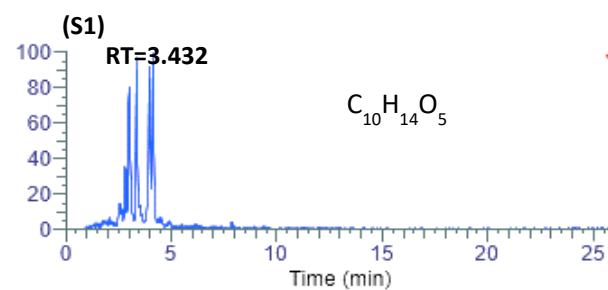












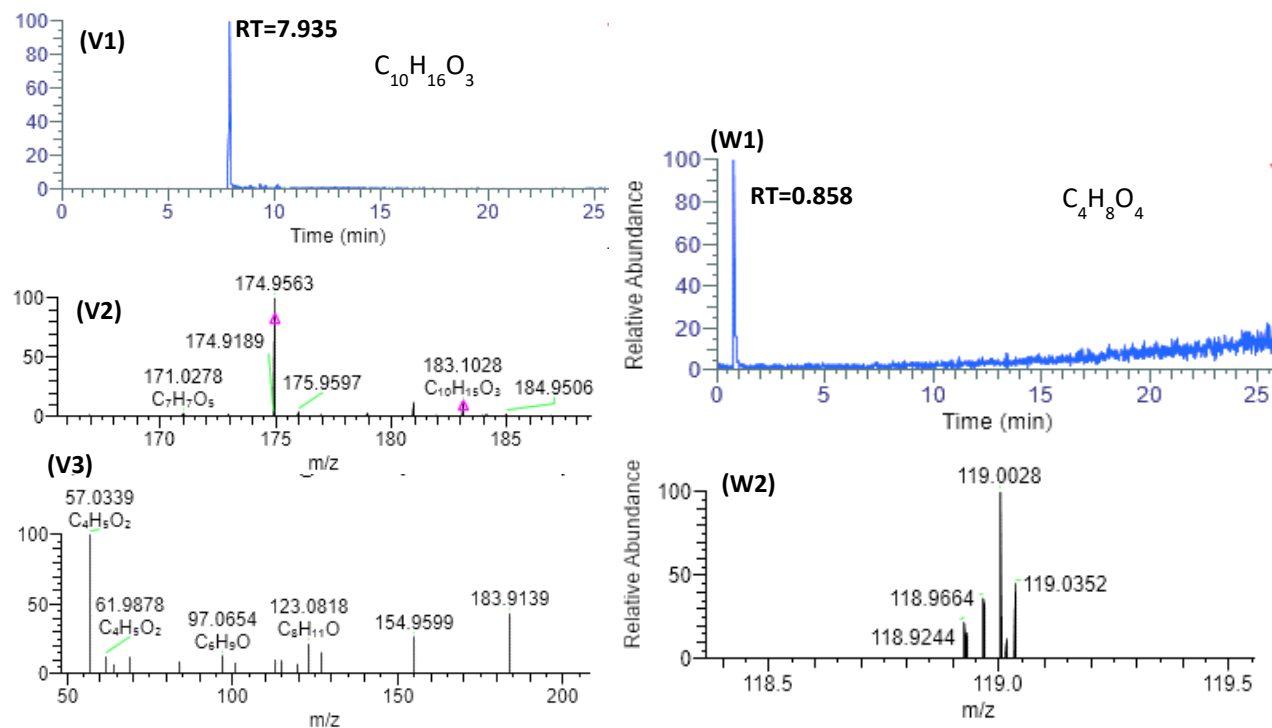


Figure S11 LC-MS chromatographs and mass spectrum of particle phase from a-pinene oxidation products. Subplot (A1-W1): the retention time from liquid chromatograph for each component; subplot (A2-W2): corresponding mass spectra for the peaks in A1-W1. Ions are detected in the negative mode by the loss of one hydrogen atom ($[M-H]^-$); subplot (A3-W3): corresponding mass spectra for the product ions produced from the parent ions in A2-W2. Note that mass spectra of products generated from their parent ions for a few compounds cannot be identified likely due to their very low concentrations.