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Composition of Secondary Organic Aerosols

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November, 2014

Composition of secondary organic aerosols

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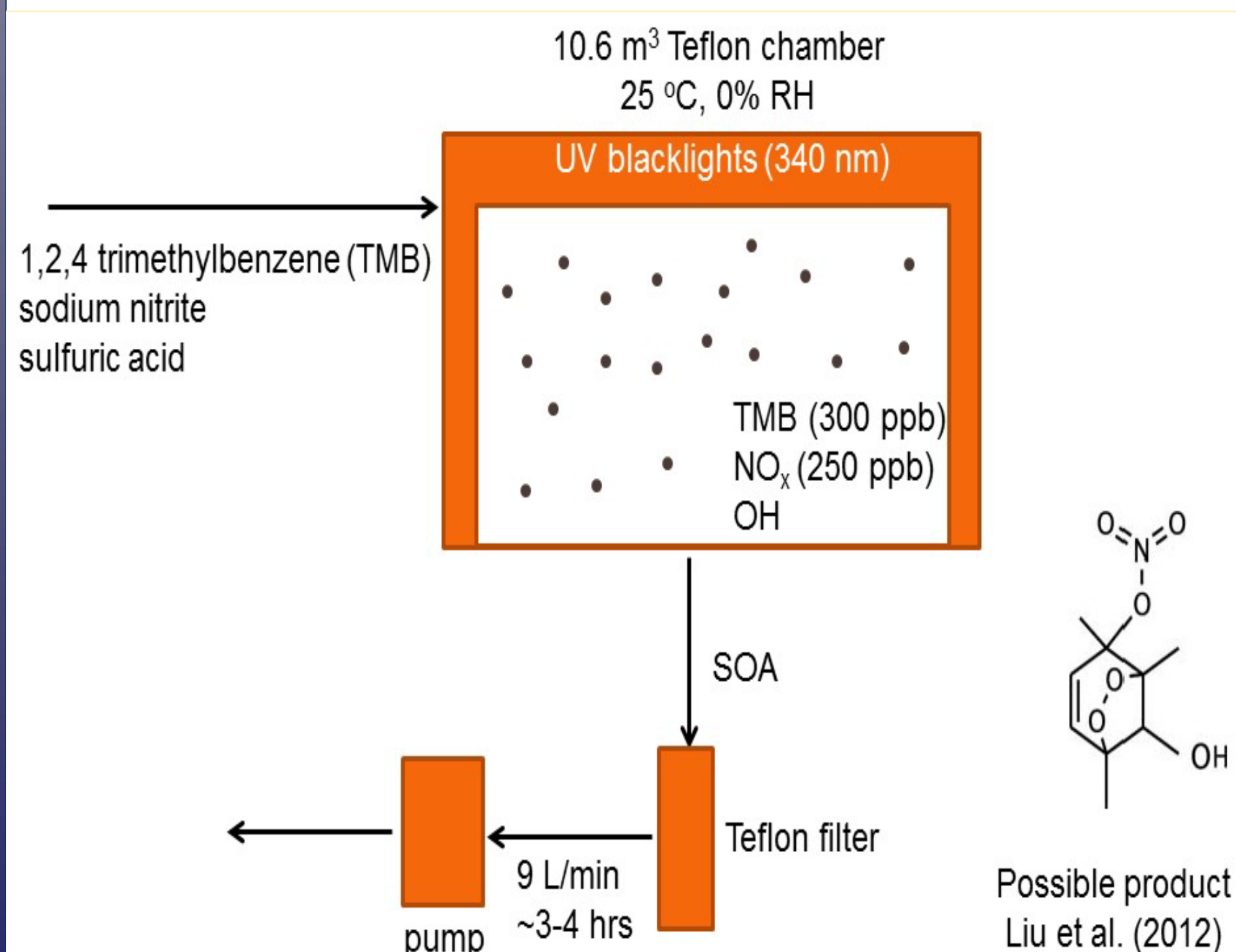
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Abstract

The enhanced greenhouse effect is considered one of our greatest global environmental problems. The amount of radiation absorbed by greenhouse gases is known to high certainty. However, absorbance from atmospheric aerosols particles is not. This study was conducted to determine the chemical composition of secondary organic aerosol particles (SOA) and to determine the compositional effect on their optical properties. The SOA were created in a temperature controlled chamber at Pacific Northwest National Laboratory (PNNL) in Richland, WA and collected on filters. The SOA were then analyzed for chemical composition using Fourier Transform Spectroscopy (FTIR). Analysis of the IR spectra revealed specific chemical functional groups degraded during storage while others amplified. The area under select peaks was calculated and a relationship between storage time and peak area was modeled.

Materials and Methods



Results

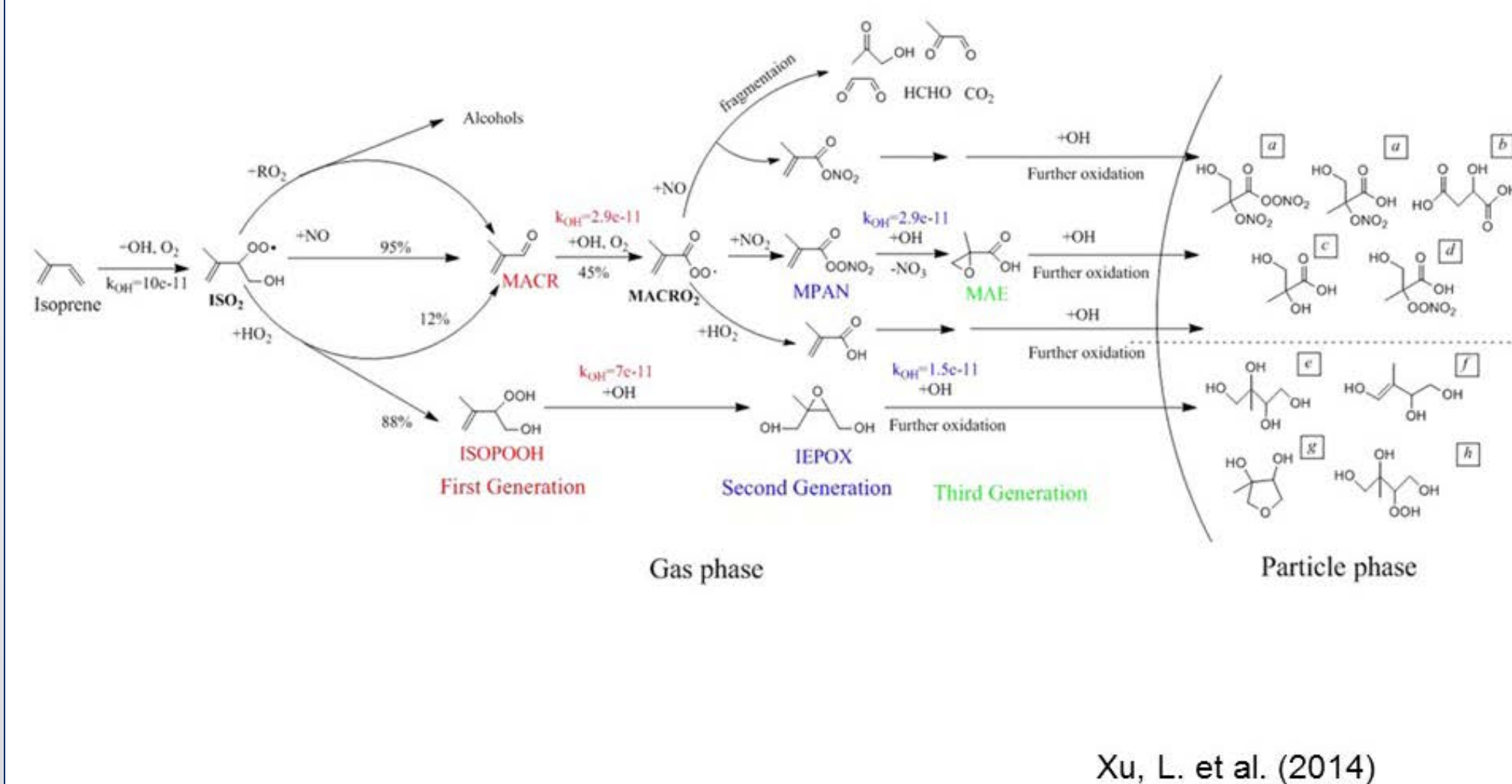


Figure 1. Possible reaction mechanisms for the formation of SOA.

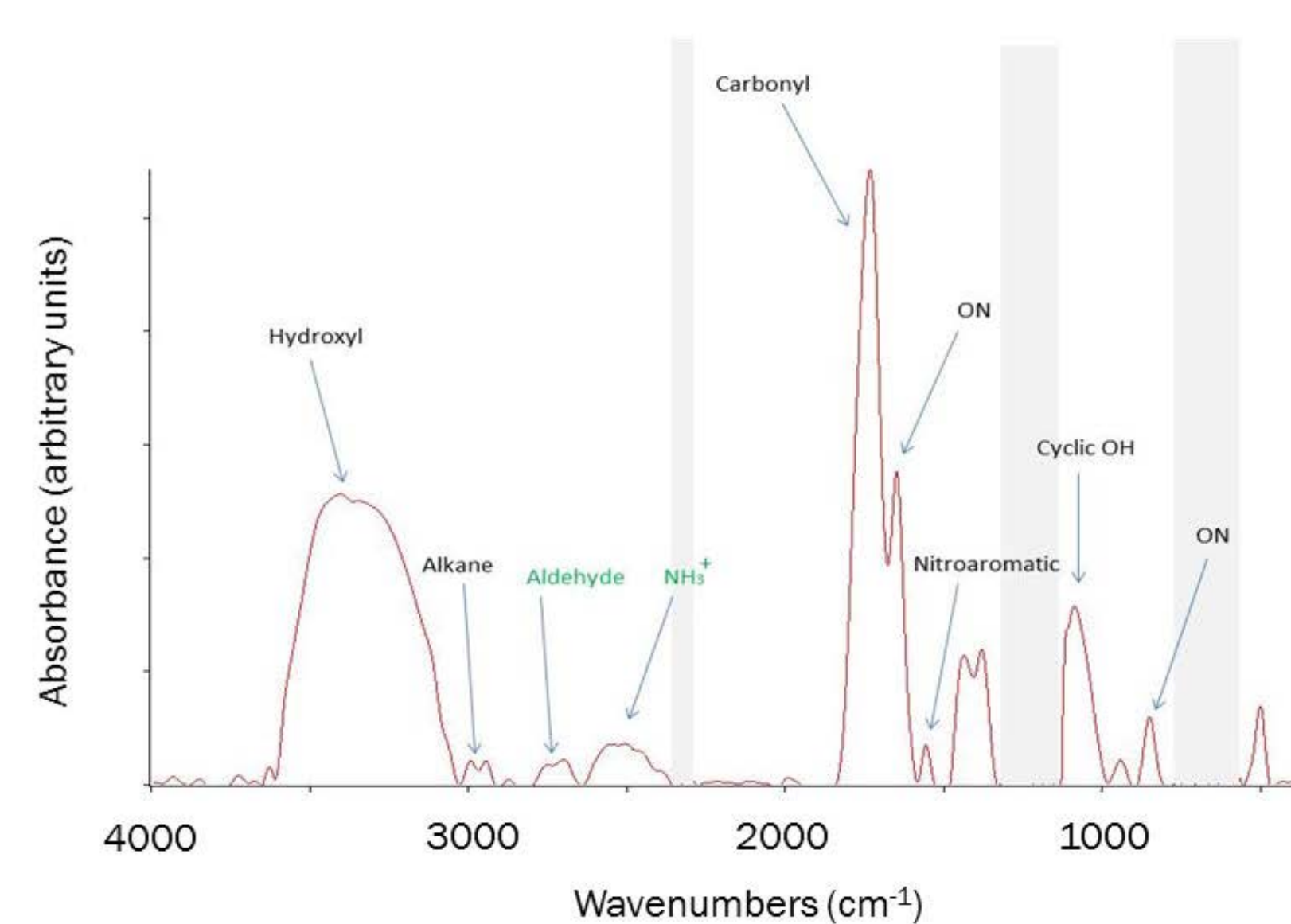


Figure 2. IR spectrum of SOA. The SOA was analyzed immediately after collection.

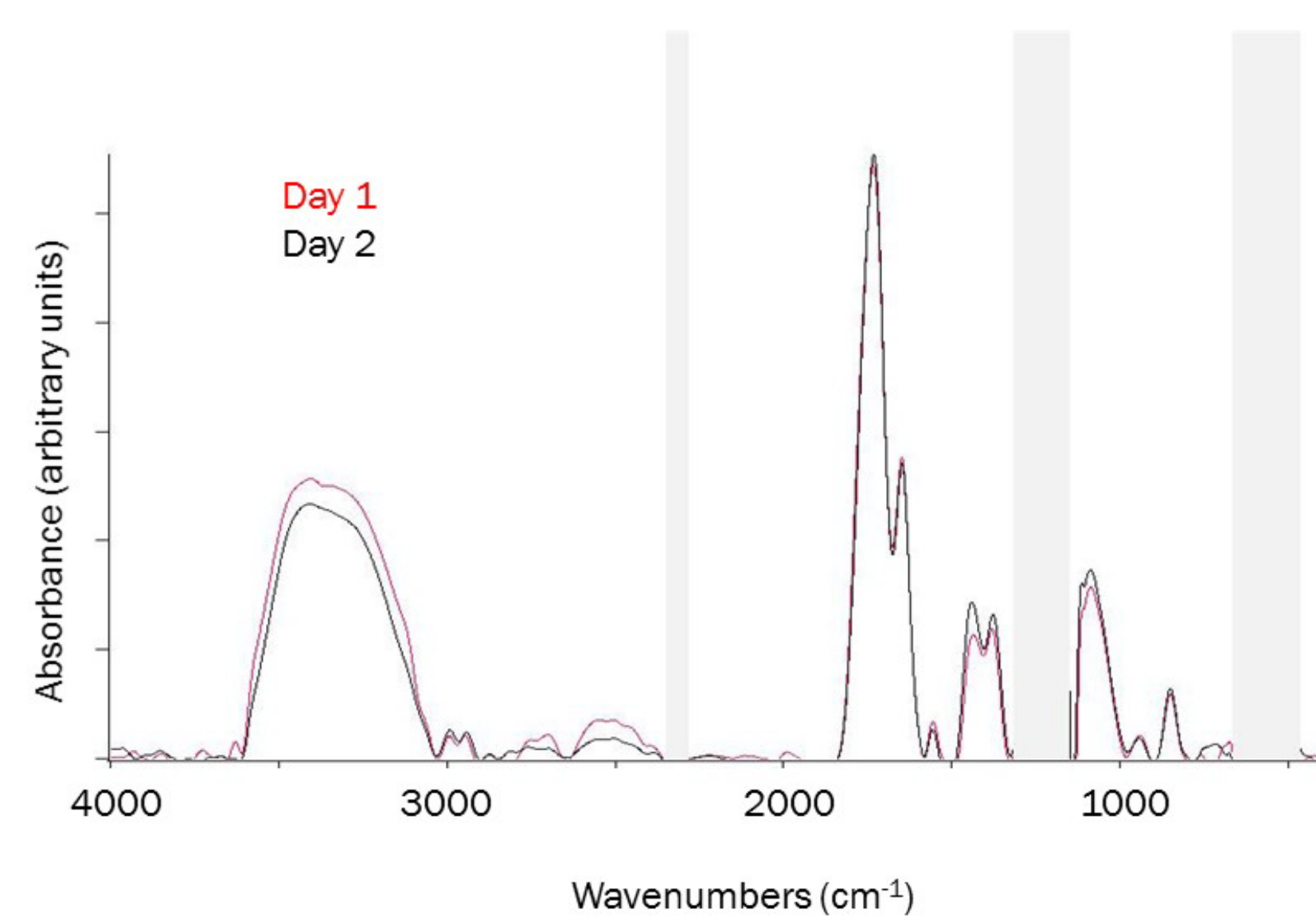


Figure 3. IR spectrum of SOA immediately after collection (red) and 25.5 hours after collection (black).

Results

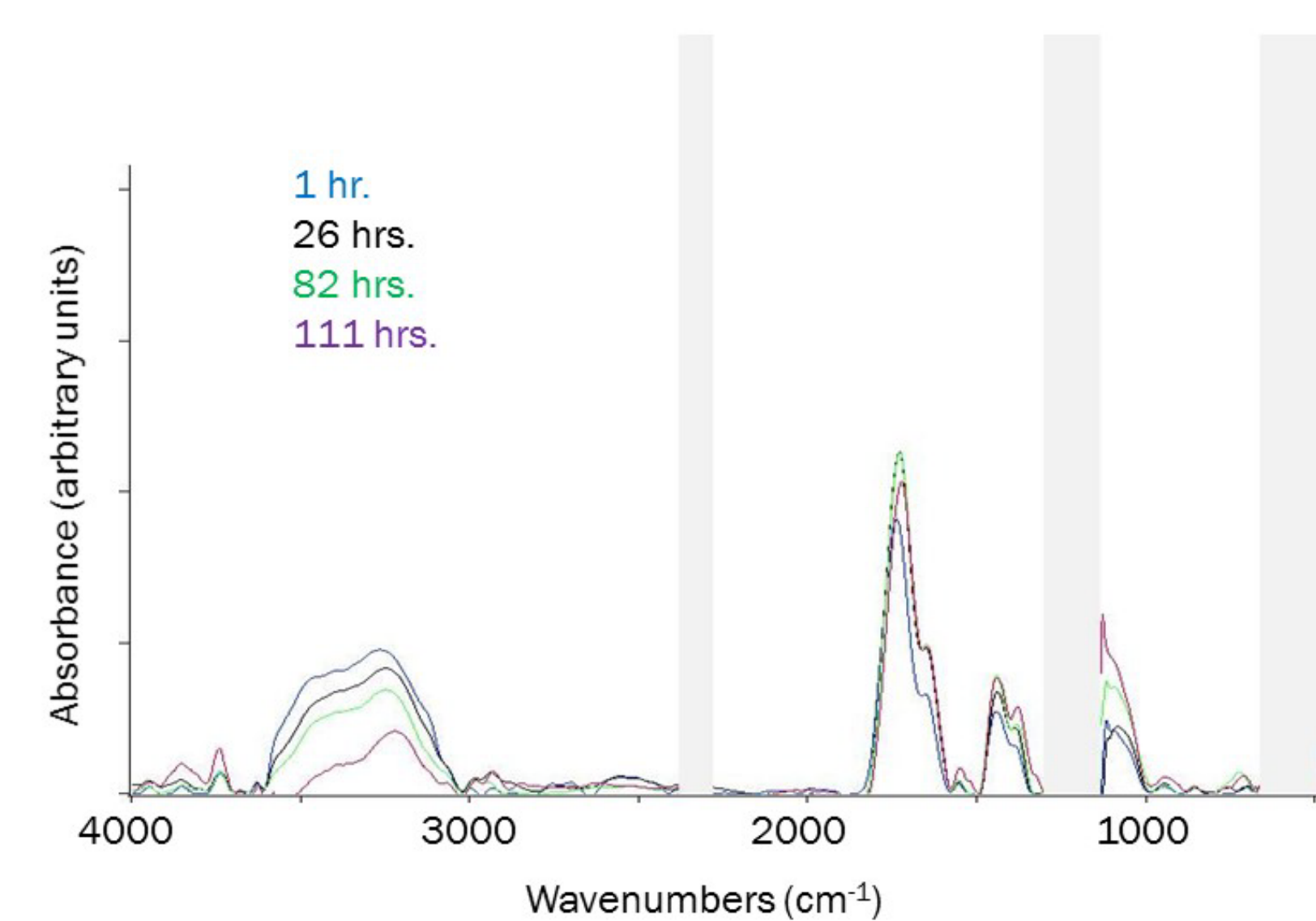


Figure 4. Comparison of IR spectra collected from the same SOA sample stored for 111 hours.

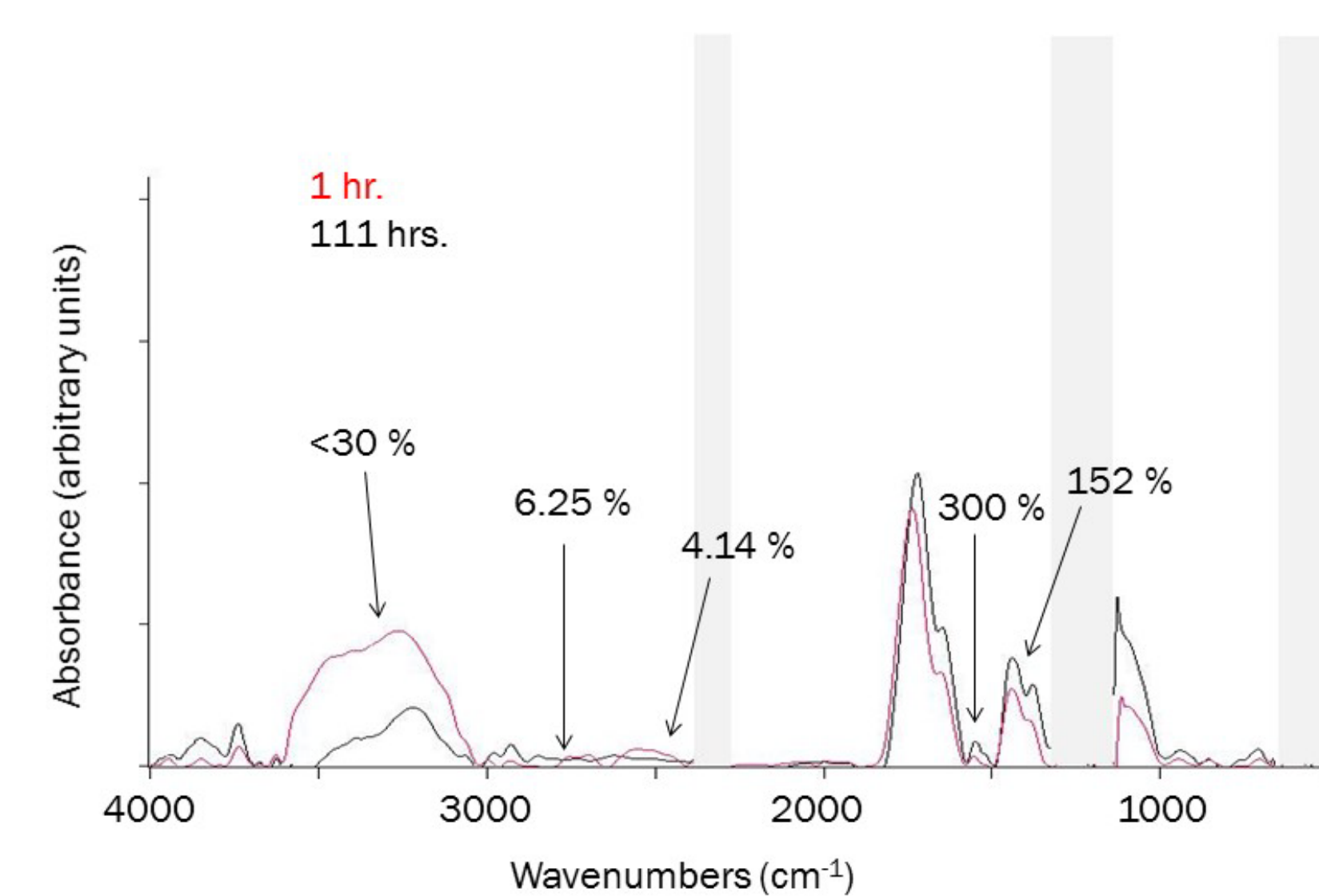


Figure 5. IR spectra collected 1 hour after SOA generation compared to 111 hours after generation.

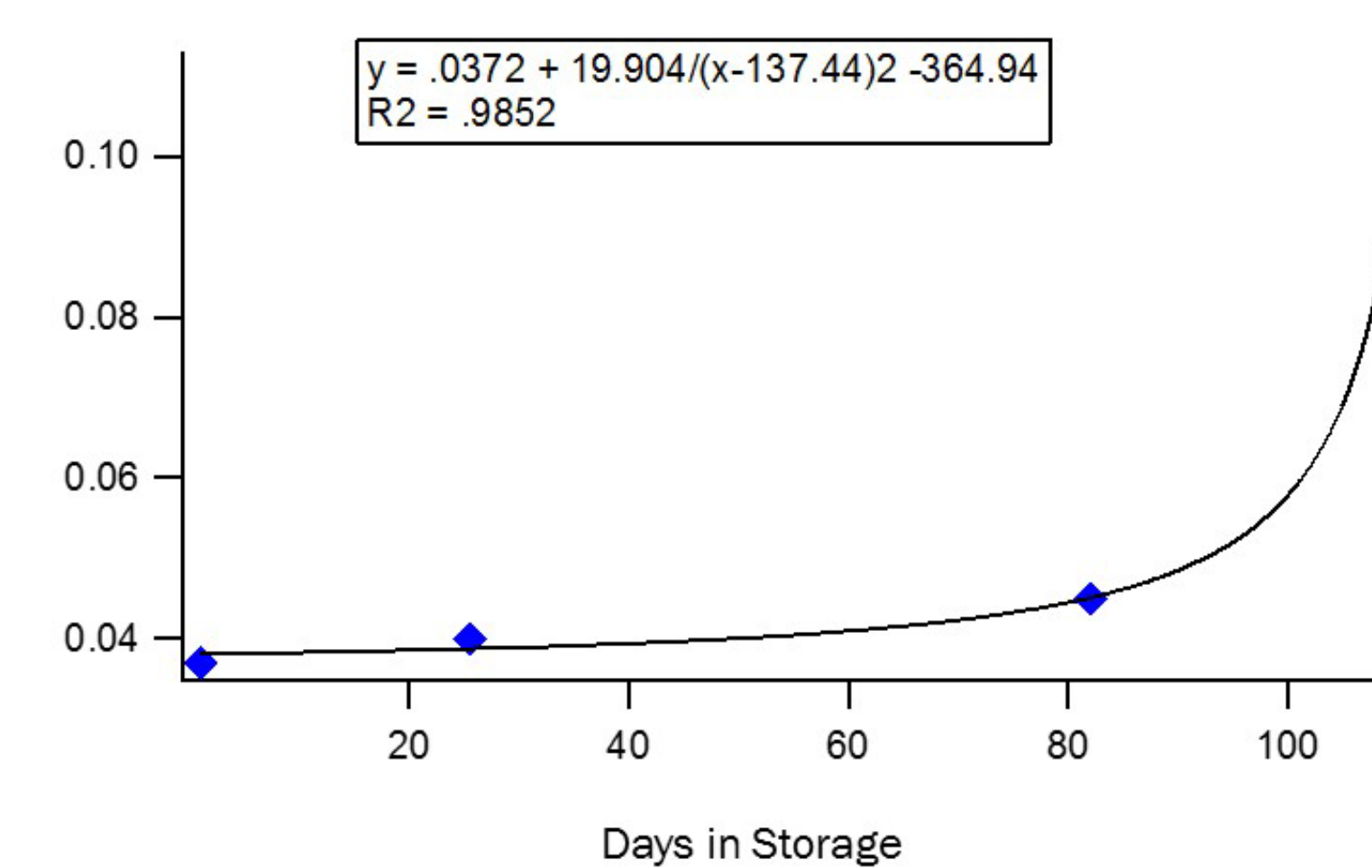


Figure 6. Integrated peak area (1300-1500 cm⁻¹) versus time.

Conclusions

Climate models do not currently incorporate optical properties of SOA. Therefore, recent studies involving SOA focus on how they are formed and how they interact with solar radiation. The optical properties of SOA are dependent on their chemical composition. To our knowledge there are no studies concerning the effect storage has on the chemical composition of SOA. This study raises concerns about how SOA are stored prior to the determination of their optical properties. The data presented here prove significant changes in the chemical composition of SOA occur during storage. This suggests that chemical reactions on the SOA may occur for days after they are initially generated. If the SOA lose or gain the ability to absorb radiation while in storage, climate models which utilize SOA optical constants can be affected.

Future Work

- Determination of SOA optical properties after storage over specific time intervals.
- Determination of the effects different precursors have on the chemical composition and optical properties of SOA.

References

Xu, L., Kollman, M. S., Song, C., Shilling, J. E., & Ng, N. L. (2014). *Environmental Science & Technology*, 48(4), 2253-2262. doi: 10.1021/es4048429.

Acknowledgements

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