



Polymer Sorption of VOCs for Indoor Air Quality & Atmospheric Sampling

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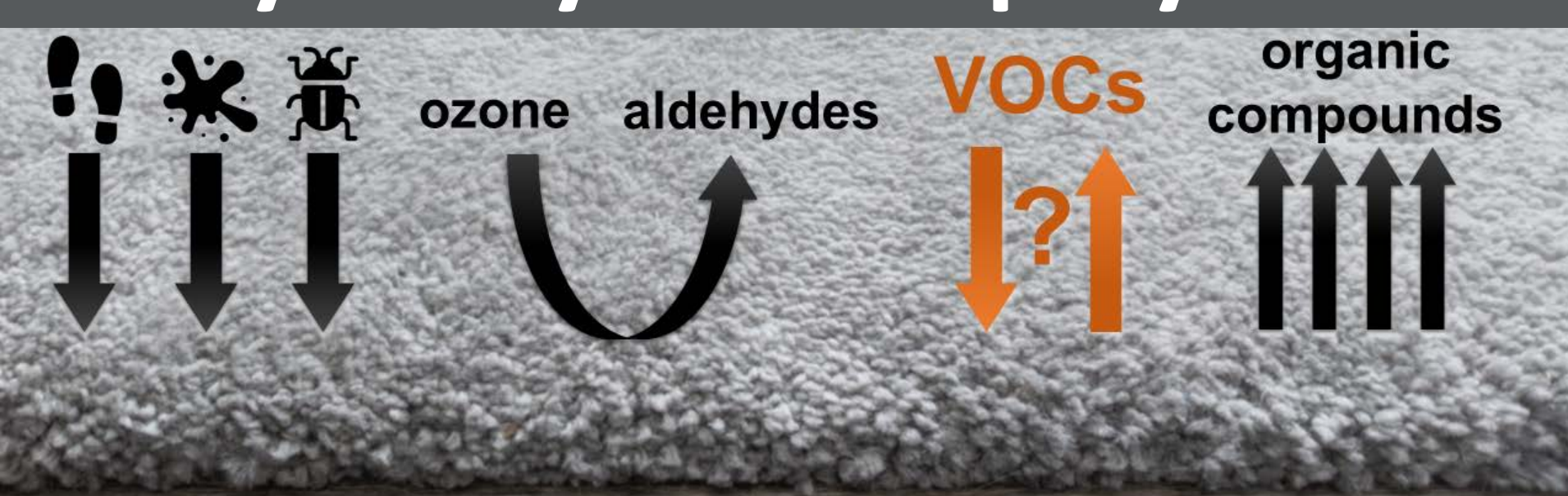
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Research Questions:

Main: How do carpets affect volatile organic compound (VOC) concentrations in indoor air?

Secondary: How can we apply knowledge of polymer sorption of VOCs to advance atmospheric sampling techniques?

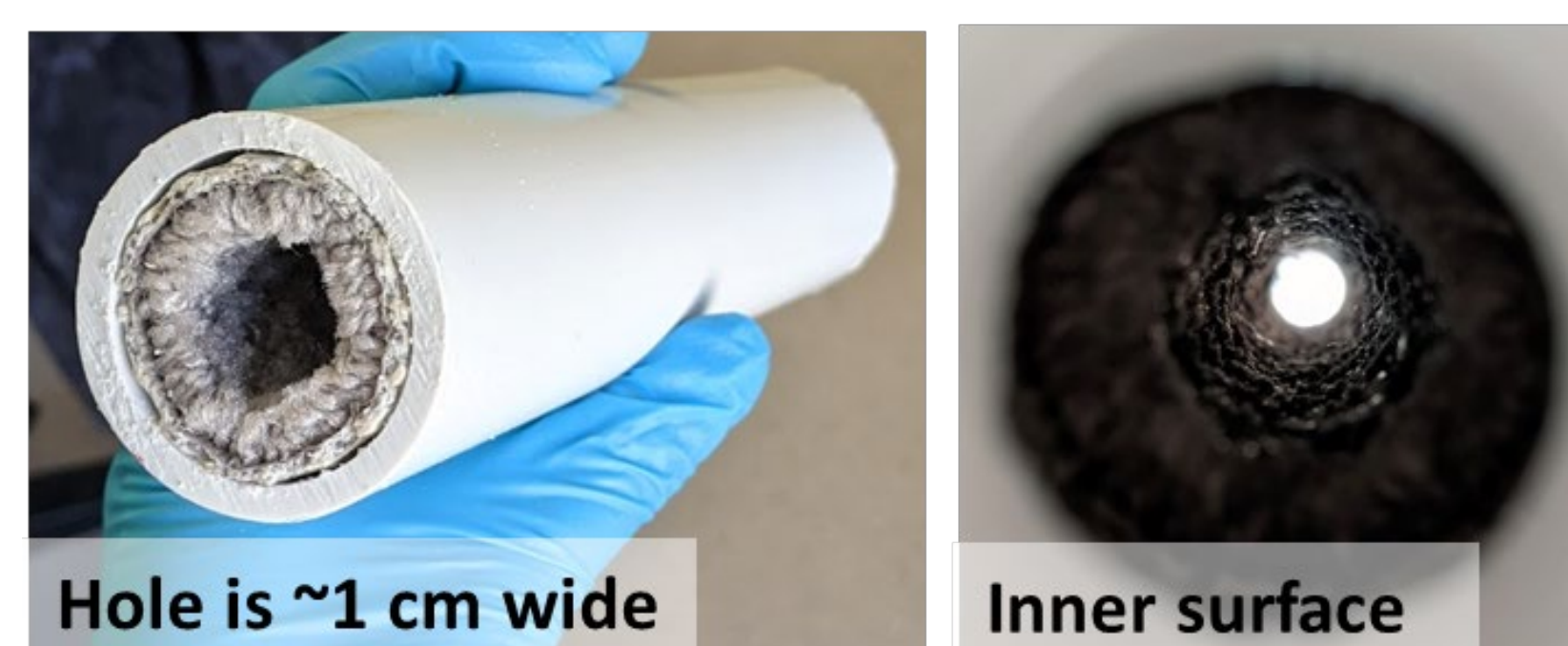
Why study indoor polymers?



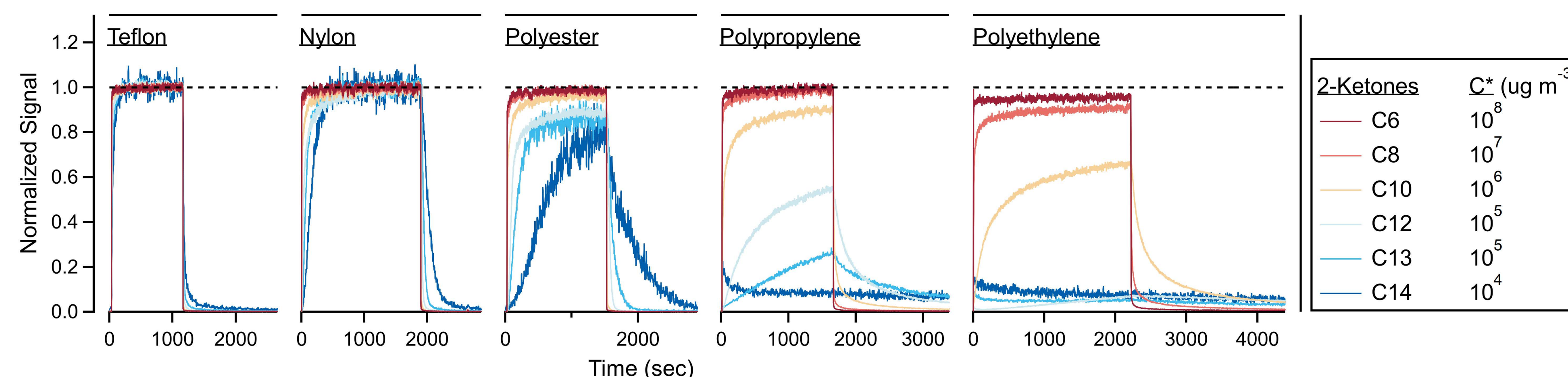
Carpet Impacts on Indoor Air Quality

- Carpet is ubiquitous as a flooring material and acts as a large indoor reservoir of VOCs.
- Literature reports carpet as an *adsorptive* material, as opposed to an *absorptive* material.
- If carpet absorbs VOCs, the quantity of VOCs that carpet can regulate will increase by orders of magnitude.

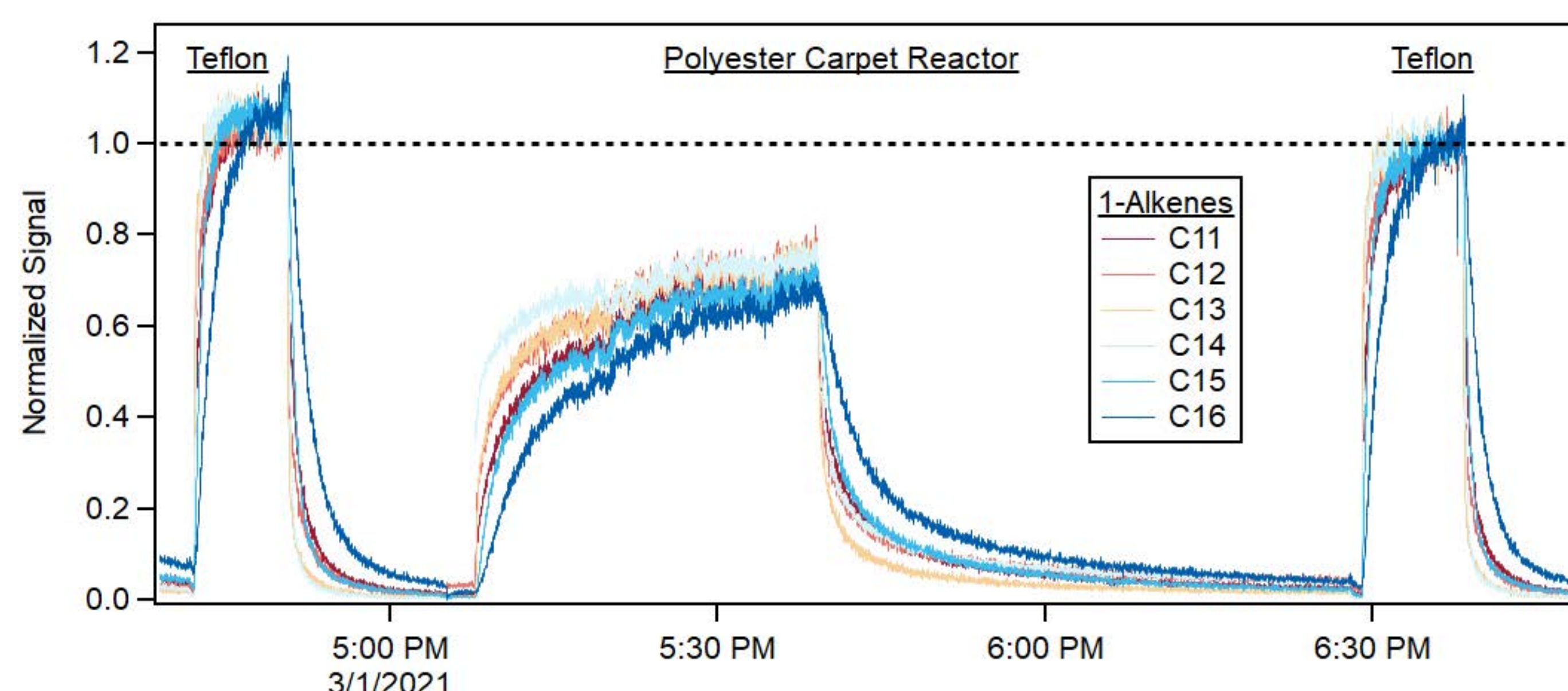
Carpet Reactor Design



Polymer Sorption of VOCs Results

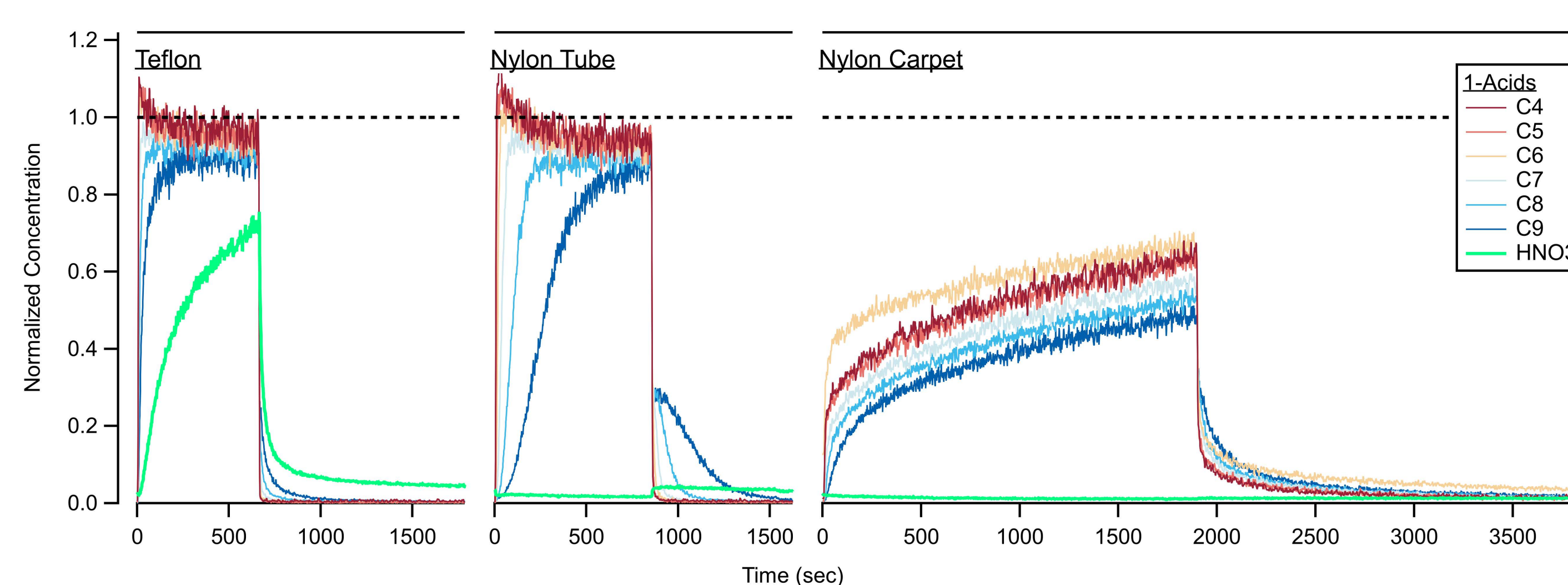


(Above) Time series showing absorption and desorption of 2-ketones in several polymer tubes which are relevant to carpet (nylon & polyester in carpet fibers, polypropylene & polyethylene in carpet backing). In the absence of gas-polymer partitioning, these waves would appear as square waves, where sampling from the chamber brought concentrations up to one, and sampling clean air brought concentrations down to zero.



(Left) Time series of 1-alkenes absorbing and desorbing into polyester carpet. After a half hour of sampling, compound concentrations have only come up to 75% of the chamber concentrations. In other words, the carpet has absorbed 25% of compounds flowing in for a half hour.

(Right) Time series of nitric acid and 1-carboxylic acids absorbing and desorbing into Teflon, a nylon tube, and nylon carpet. Nitric acid is perfectly denuded by the repeating basic sites of the nylon polymer, while the weaker acids are sorbed to varying degrees.

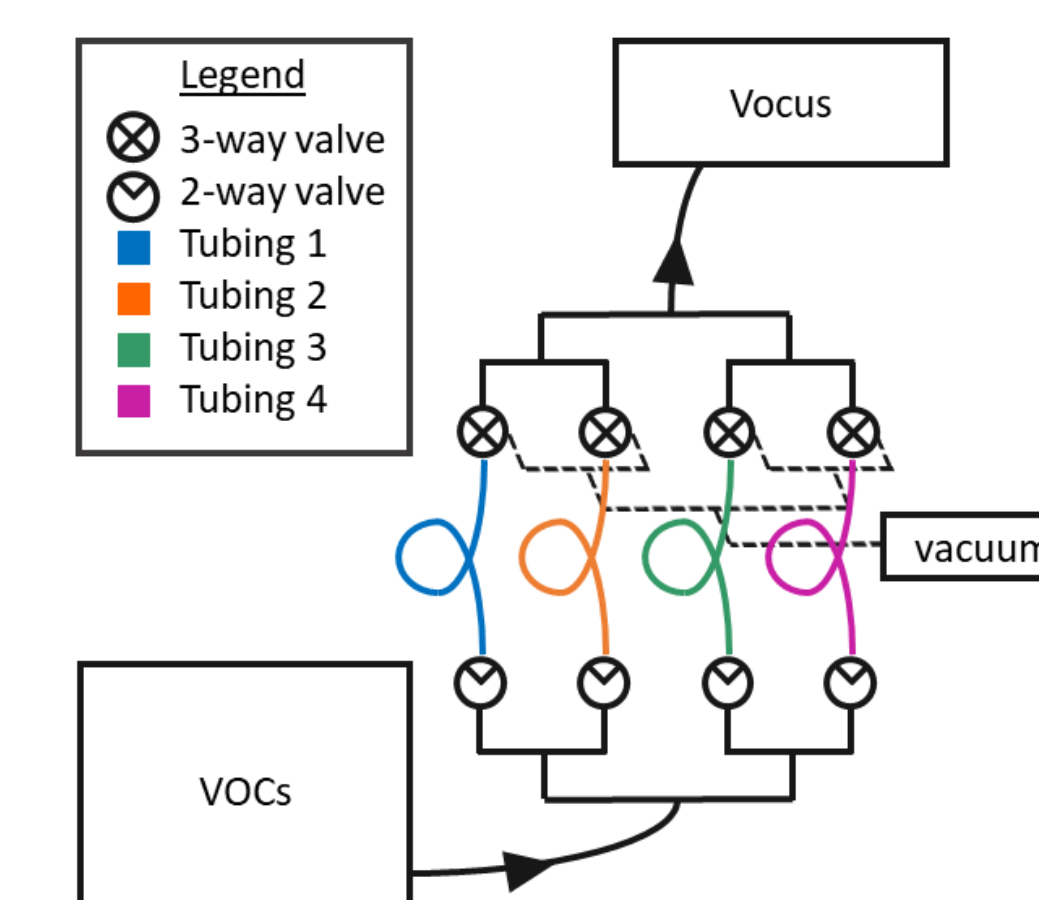


Main Takeaway: Carpets absorb volatile organic compounds (VOCs) in indoor environments, and act as large reservoirs for VOCs, extending the lifetime of pollutants indoors. They can also serve as sites for chemistry to occur; for example, nylon carpet denudes strong acids from indoor air.

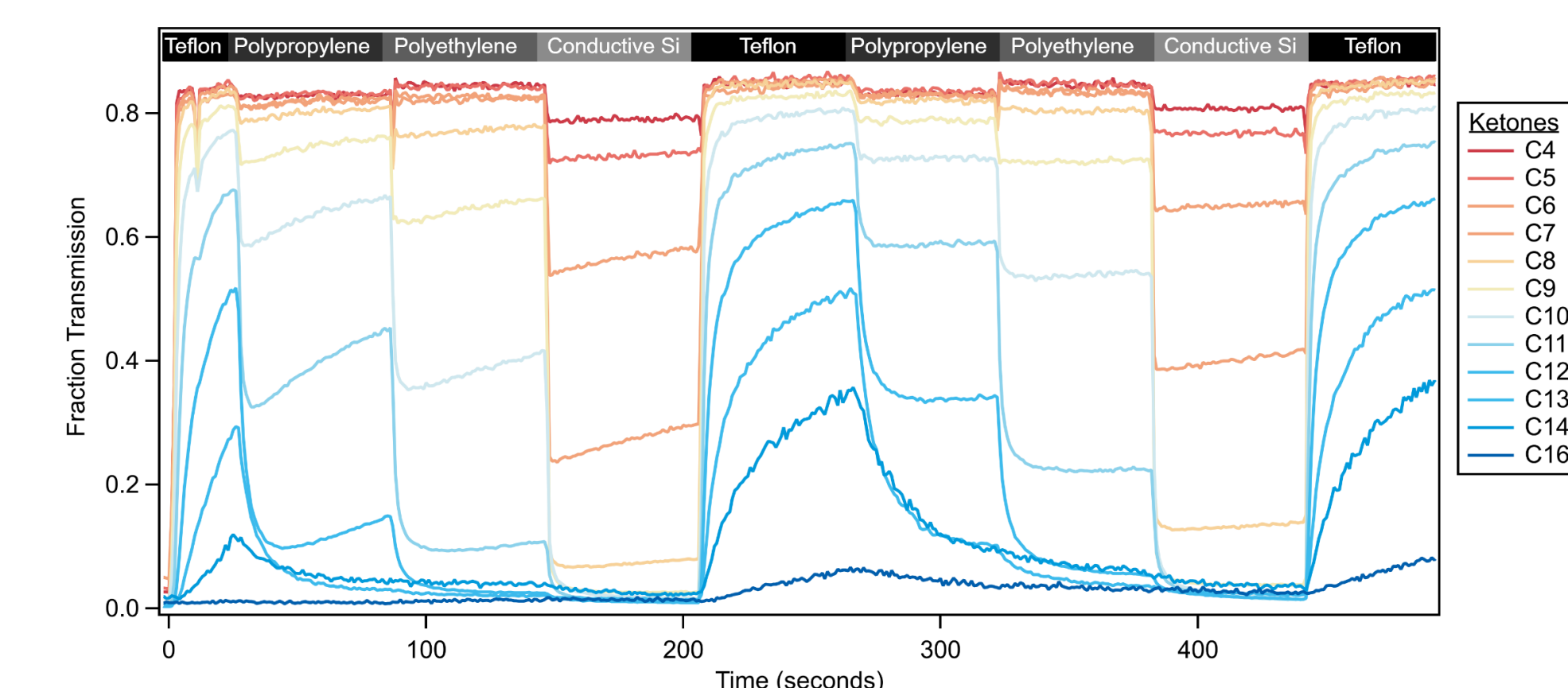
Application for Sampling

- Since polymer tubing denudes VOCs according to volatility, we take advantage of this phenomenon for atmospheric gas sampling.
- By installing polymer tubes of varying sorptive capacities in front of a mass spectrometer, we can quantify volatility information about a mixture of gases.

Multi-tube Inlet Design



Volatility Separation Results



- Separation by volatility bins is achieved on the minute time scale by using 4 different inlet tubes.
- Future work will use this separation technique with an OFR to probe volatility-based contributions to secondary organic aerosol formation.

Acknowledgements

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