Sunlight converts plastics into complex chemical mixtures

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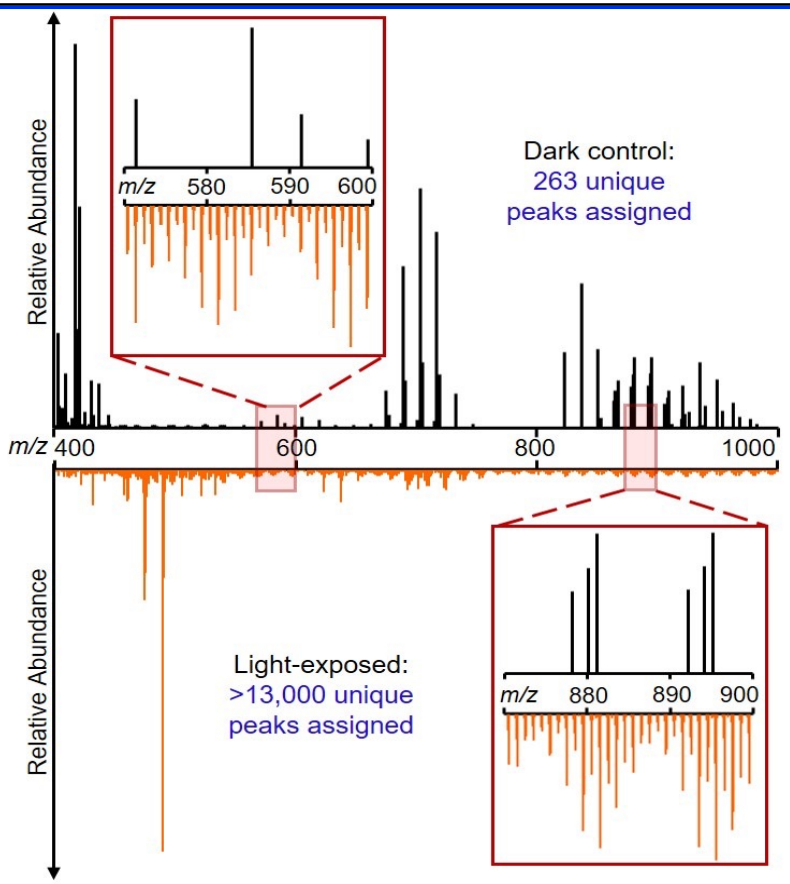
Plastics have long been assumed to be inert in the environment, with only physical fragmentation occurring. However, a growing body of evidence suggests that sunlight can chemically transform plastics into polymer-, dissolved-, and gas-phase products.

In this work, MagLab users studied the photochemical breakdown of four consumer polyethylene (PE) shopping bags from Target, Walmart, and CVS, as well as one pure PE film. *Characterization of the additives in the plastics was paired with measurements of the amount and composition of organic chemicals produced from the plastics in the presence and absence of sunlight*.

The MagLab's 21 Tesla Fourier transform ion cyclotron resonance mass spectrometer has superior resolving power and mass accuracy to the orbitrap mass spectrometers used in previous studies, enabling discovery of ten-fold greater complexity of photoproduced chemicals. *All plastics produced highly complex chemicals during sunlight exposure, but the amount and composition varied between the pure PE and consumer plastics. These findings challenge the long-held assumption that plastic is inert in the environment; instead, sunlight can break it down into a diverse suite of new compounds with unknown fates and impacts*. They also highlight that transformation by sunlight depends on the additives in the plastic. As such, pure polymers, on which the research has largely focused to date, may not be sufficiently representative of the real plastics leaked into the environment.

Facilities/ Instrumentation: 21T FT-ICR mass spectrometer at ICR



21 T FT-ICR mass spectra of chemicals unique to dark control (black, top) and photoproduced (orange, bottom) for a CVS plastic bag. Thousands of oxygenated compounds were produced by sunlight, compared to only a few hundred that leached in the dark. These results are representative of the trends observed for all plastics tested.

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