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Plasmas for Clean Water: Elucidation of Radical Species in an Electrolytic Non-equilibrium Plasma-Water System

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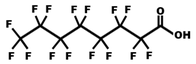
Title: Plasmas for Clean Water

Subtitle: *Elucidation of Radical Species in an Electrolytic Non-equilibrium Plasma-Water System*

PRESENTER:
Kevin Pataroque

BACKGROUND: Perfluorooctanoic Acid (PFOA) has been used by major chemical corporations and is labelled as an emerging contaminant by the EPA. Because of its chemical inertness, PFOA cannot be degraded in wastewater treatment facilities. *Water treatment must evolve to keep the general public safe.*

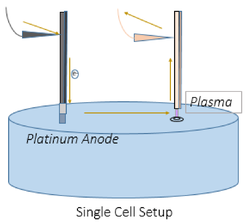


PFOA molecule

Microplasmas are a leading treatment technology that uses little energy, attacks surfactants directly, and does not produce additional chemicals.

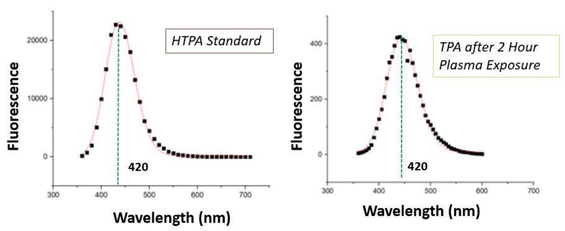
APPROACH

1. Can microplasmas degrade PFOA?
2. How do microplasmas degrade contaminants?
3. What byproducts are left after this reaction?
4. What pre-existing processes can be paired with microplasmas to fully eradicate PFOA?



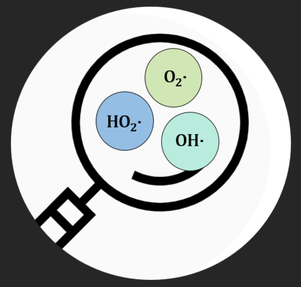
Single Cell Setup

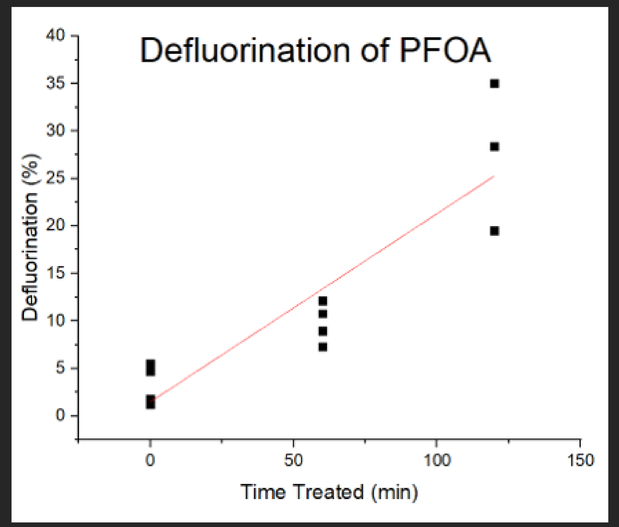
Schematic of plasma-water system. By using an applied current, argon gas is ionized into a plasma



Treating TPA with a plasma generates an equal emission spectra to HTPA. Hydroxyl radicals are being produced.

Microplasmas use energetic **hydroxyl radicals** to degrade inert **emerging contaminants.**





Increased plasma exposure leads to higher rates of degradation of the PFOA molecule

$$Defluorination = \frac{[F-]_{actual}}{[F-]_{theoretical}} * dilution * 100$$

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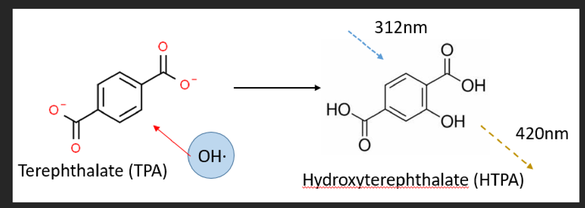
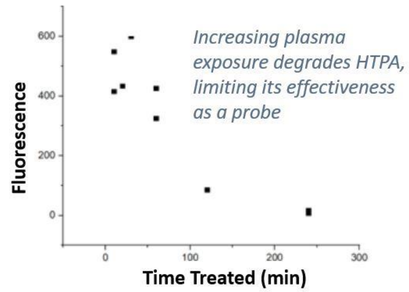


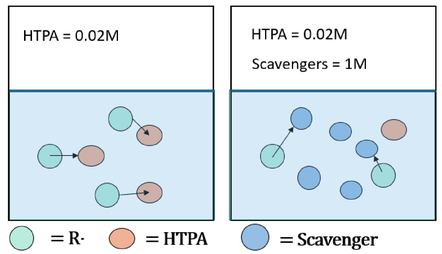
DEGRADATION OF HTPA INDICATOR

Our studies demonstrate HTPA is being degraded by the microplasma. In the broader field of radical chemistry, this could affect studies that use fluorescent-indicators.



Increasing plasma exposure degrades HTPA, limiting its effectiveness as a probe

FUTURE WORK



Scavenger particles can be selectively paired to individual radical species to measure their impact on HTPA degradation.

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References: Thagard, "Plasma-Based Water Treatment: Efficient Transformation of Perfluoroalkyl Substances in Prepared Solutions and Contaminated Groundwater," Clarkson University, 2017 [Online]
Barreto, "Terephthalic Acid: A Dosimeter for the Detection of Hydroxyl Radicals In Vitro," University of Texas, 1995