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International Water Resources Association
IWRA

XIX WORLD WATER CONGRESS
International Water Resources Association (IWRA)
Marrakech, Morocco | 1-5 December 2025

Kingdom of Morocco
Ministry of Equipment and Water

Innovative Sensing Technology for Monitoring PFAS Contamination of Groundwater

Hamidreza Sharifan
Assistant Professor
Department of Chemistry and Biochemistry
hsharifan@utep.edu

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Fort Bliss
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Central
East Side
South
El Paso
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Far East
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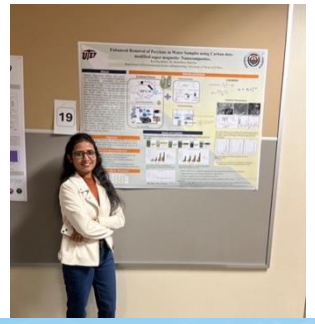
Sharifarm Lab

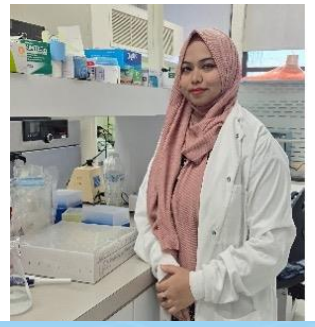
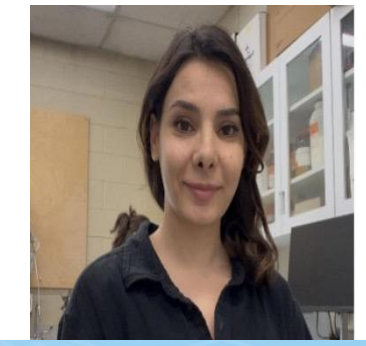
Bioinnovation for Sustainability

- Phycoremediation
- Nano-Enabled
- Photosynthetic Efficiency
- Controlled Environment Systems

Water Quality & Environmental Remediation

- PFAS Detection & Removal
- Nanomaterial–Plant–Soil
- Biochar Systems


Sharifarm Progress in PFAS Research

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International Water Resources Association (IWRA)
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Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Review

Fate and transport of per- and polyfluoroalkyl substances (PFASs) in the vadose zone

Hamidreza Sharifan [a], Majid Bagheri [b], Dan Wang [c], Joel G. Burken [b], Christopher P. Higgins [d], Yanna Liang [e], Jinxia Liu [c], Charles E. Schaefer [f], Jens Blotevogel [a,*]

Environmental Science & Technology

pubs.acs.org/est

Article

PFAS Analysis with Ultrahigh Resolution 21T FT-ICR MS: Suspect and Nontargeted Screening with Unrivaled Mass Resolving Power and Accuracy

Robert B. Young,[#] Nasim E. Pica,[#] Hamidreza Sharifan, Huan Chen, Holly K. Roth, Greg T. Blakney, Thomas Borch, Christopher P. Higgins, John J. Kornuc, Amy M. McKenna, and Jens Blotevogel*

ACS OMEGA

http://pubs.acs.org/journal/acsodf

Article

Differential Impacts of Perfluorooctanoic Acid (PFOA) on Soil Microbial Communities in Aerobic and Anaerobic Agricultural Soils

Nusrat Easmin, Parikrama Sapkota, Kelly S. Ramirez, Yasaman Mohammadi, Mahesh Narayan, and Hamidreza Sharifan*

analytical chemistry

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Article

Fluorescent Sodium Alginate Hydrogel–Carbon Dots Sensor for Detecting Perfluorooctanoic Acid in Potable Water

Somayeh Mohammadi, Christian Sandoval-Pauker, Zayra N. Dorado, Thomas P. Senftle, Robert Pankow, and Hamidreza Sharifan*

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Article

Nanoscale Fluorinated Carbon Dots for the Detection of Perfluorooctanoic Acid in Aqueous Systems: A Fluorescence Assay Enhanced by Fluorophilic Interactions

Somayeh Mohammadi,* Zayra N. Dorado, and Hamidreza Sharifan*

Cite This: ACS Appl. Nano Mater. 2024, 7, 21410–21419 Read Online

ELSEVIER

Water Research

Volume 288, Part B, 1 January 2026, 124698

Exploring the fluorinome of PFAS-impacted groundwater using 21 tesla FT-ICR mass spectrometry

U.S. DEPARTMENT OF HOMELAND SECURITY

USDA

Ongoing News about PFAS:

gle PFAS

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The Guardian

Study links higher PFAS levels to 'superfund' sites and limited fresh-food access

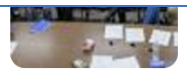
Findings highlight how built environment in low-income neighborhoods presents multiple PFAS exposure routes.

13 hours ago

Times Union

Fort Edward residents raise concerns about PFAS removal project

Locals are concerned that the project could inadvertently introduce more of the "forever chemicals" into the environment.



Truthout

Trump Withdraws Proposed PFAS Limitations, Giving "Green Light" to Polluters

The withdrawn proposal would limit the amount of PFAS chemical plants can dump into the water supply.

National

PFAS chemicals detected in 20% of Japanese tap water in gov't survey

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Nov. 30 | 06:05 am JST | 61 Comments

TOKYO — Chemicals potentially harmful to human health, collectively known as PFAS, were detected in about 20 percent of tap water in Japan, though no samples contained the maximum permissible amount tentatively set by the government, a survey showed Friday.

The New York Times

Trump Promises Clean Water. Will He Clean Up 'Forever Chemicals'?

Public health advocates worry that Donald Trump could unravel federal clean water efforts, including restrictions on lead pipes and...

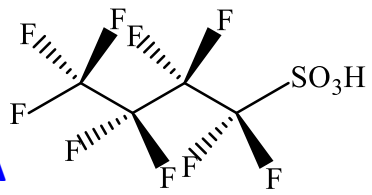
1 week ago

- Reproductive/ Developmental
  - Pregnancy-induced hypertension/ preeclampsia
  - Decreased fertility
  - Decrease in birth weight
  - Behavioral
- Increased risk of thyroid disease
- Immunologic effects
- Kidney and testicular cancer

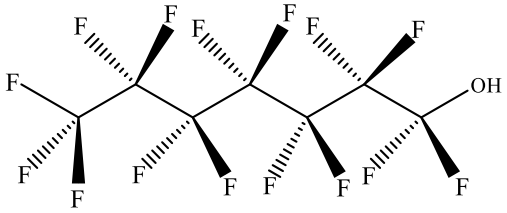
Poly- and Perfluoroalkyl Substances (PFAS)

- A group of more than 6,000 man-made chemicals.
- 6 million U.S. residents are facing PFAS pollution in drinking water.

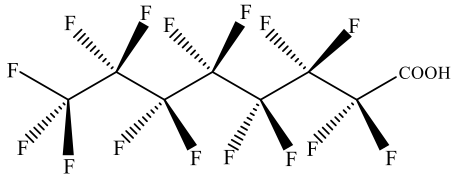
PFBS



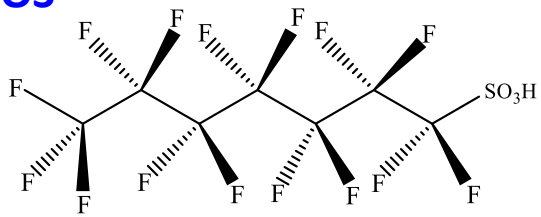
PFOH



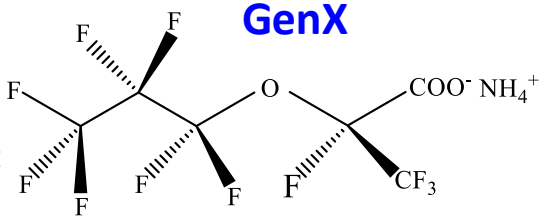
PFOA



PFOS



GenX



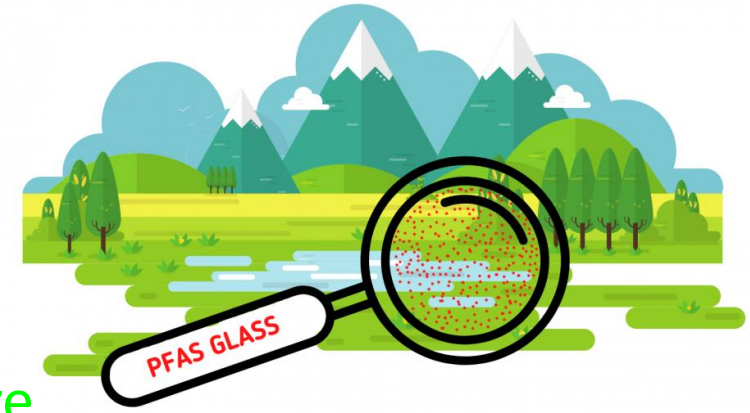
PFAS

Persistent

Hazardous

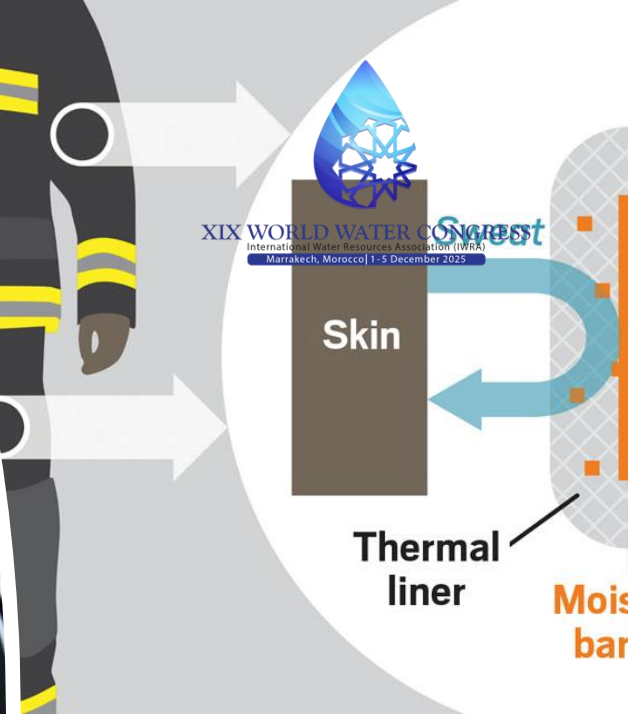
Accumulative

Toxic



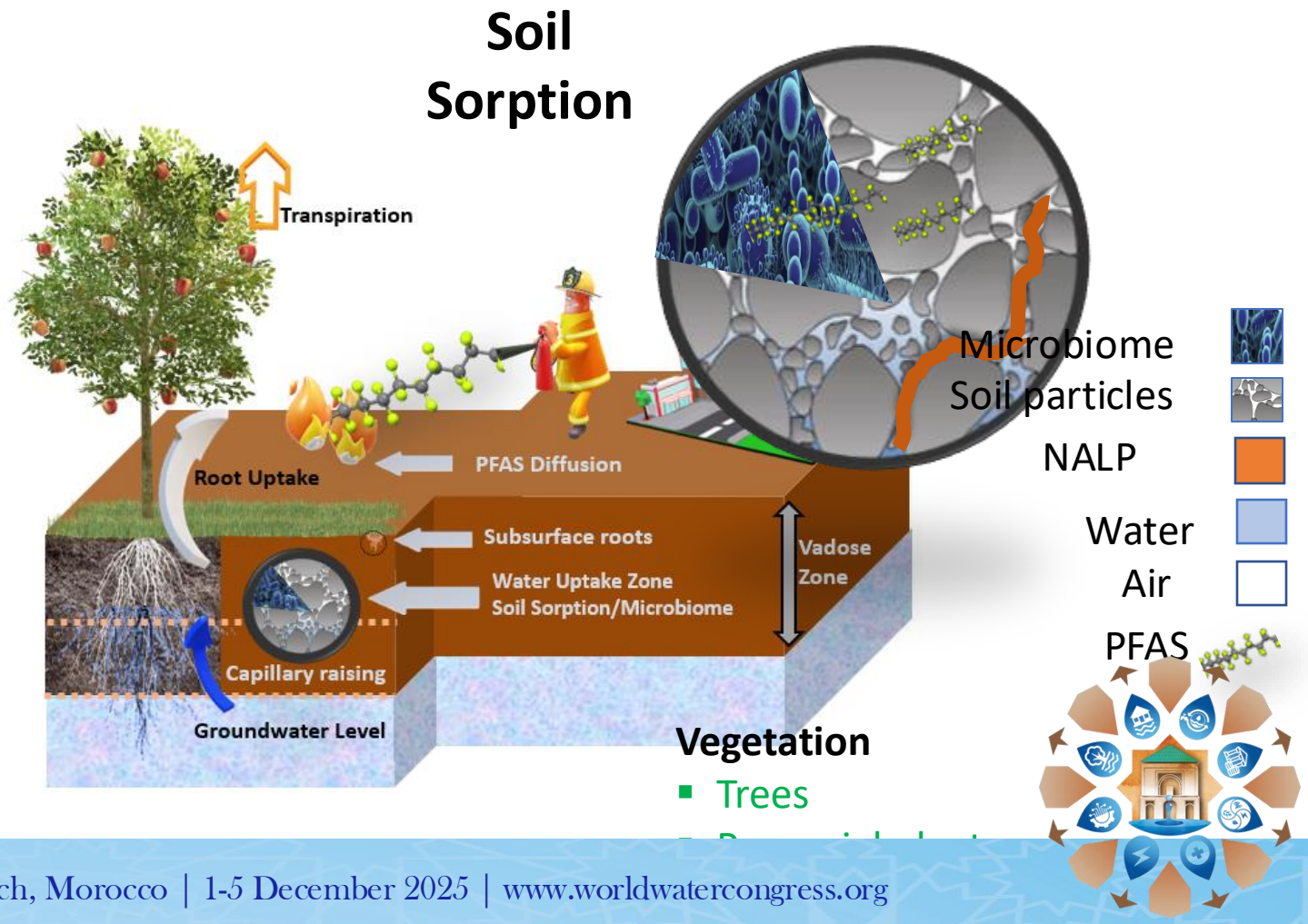
Diverse Application

- Heat Resistant
- Not Readily Biodegradable
- Bioaccumulative
- Some PFAS include oxygen, hydrogen, sulfur, and/or nitrogen atoms, creating a polar end

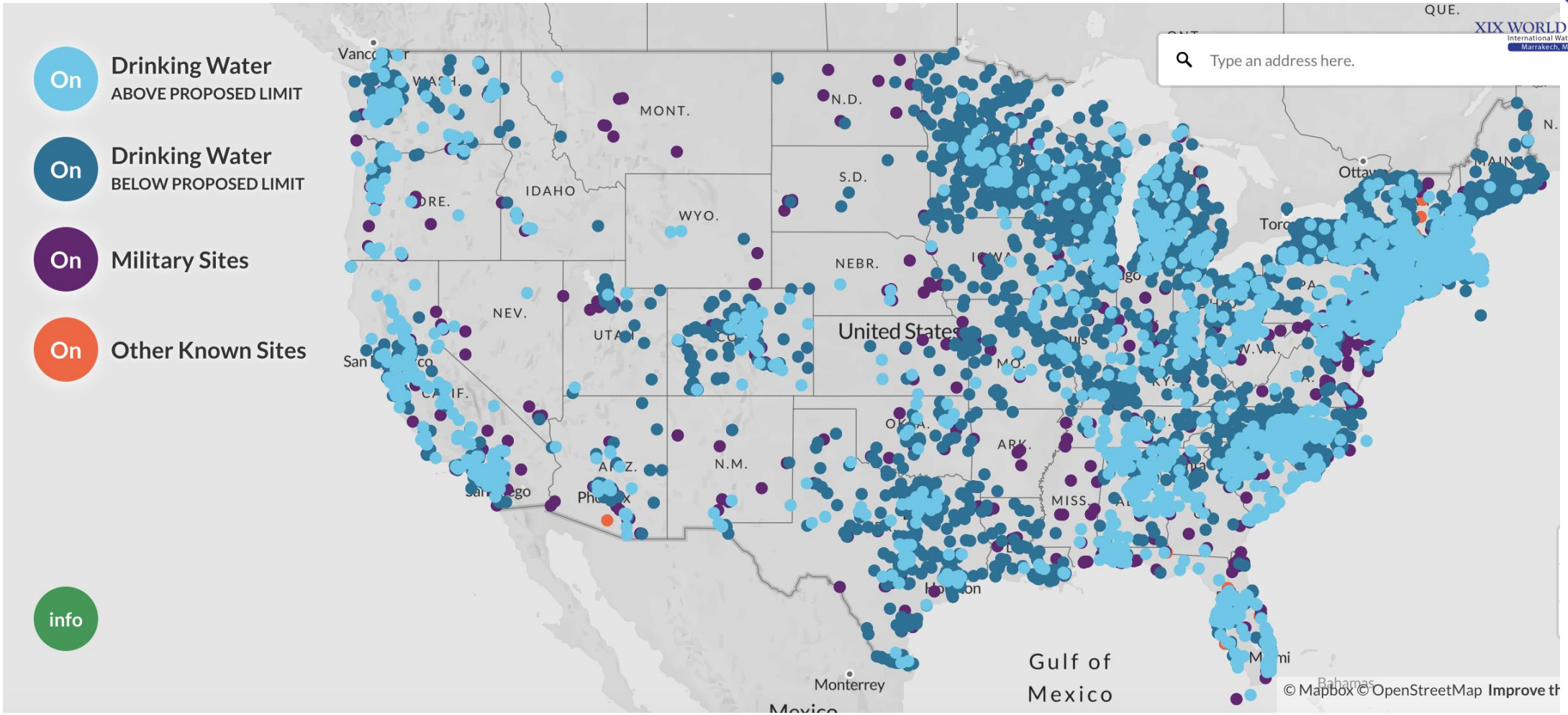


PFASs in Aqueous Film Forming Foam (AFFF)

- Low volatilities
- Relatively high aqueous solubilities
- Low transformation potential



Military Activities and PFAS Concerns



Sources: CNN, Al-Jazeera, Conversation, Smithsonian Magazine

Updated till December 2021

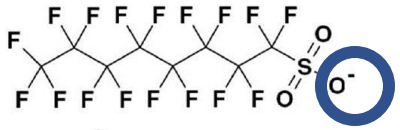
IIGSA INTERNATIONAL INSTITUTE FOR GLOBAL STRATEGIC ANALYSIS

WWW.IIGSA.ORG

Complexity of PFAS

Chemical

Anionic



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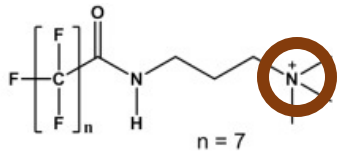
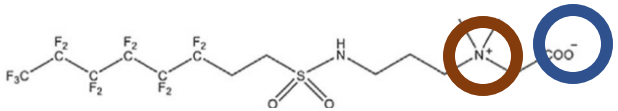
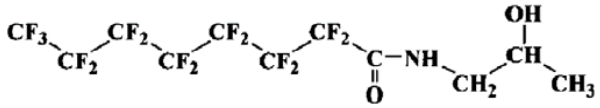


Zwitterionic

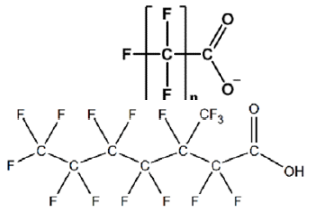


Neutral



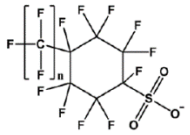
Physical

Straight-chained perfluoroalkyls

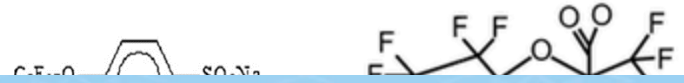


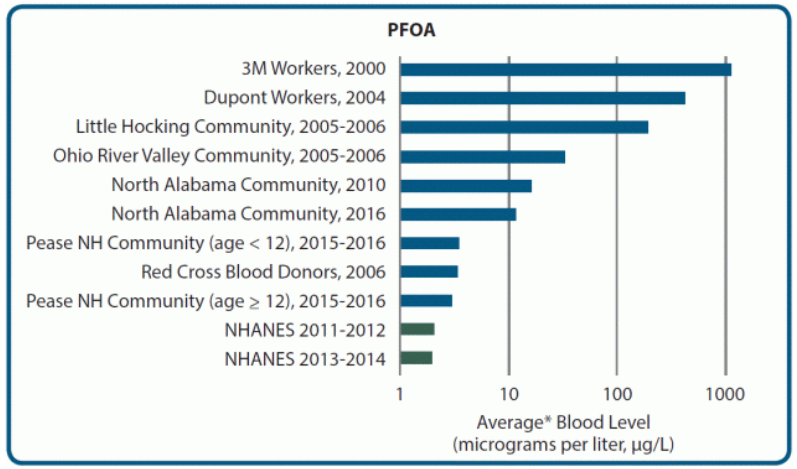
Branched perfluoroalkyls

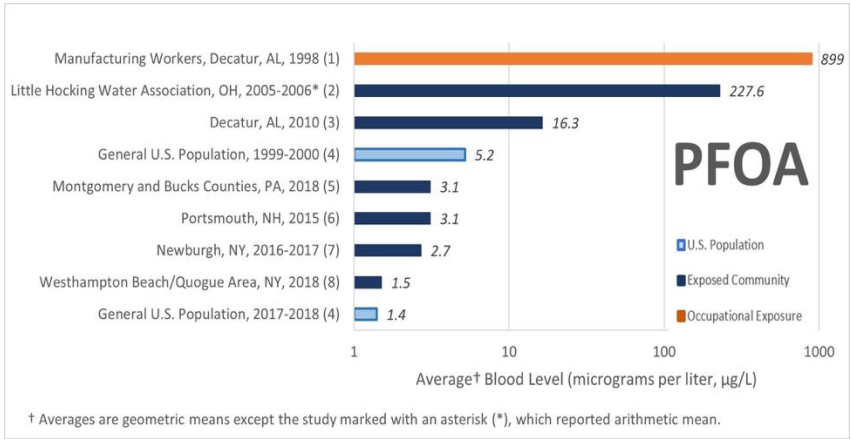
Oxygen-bridge bonds



Cyclic

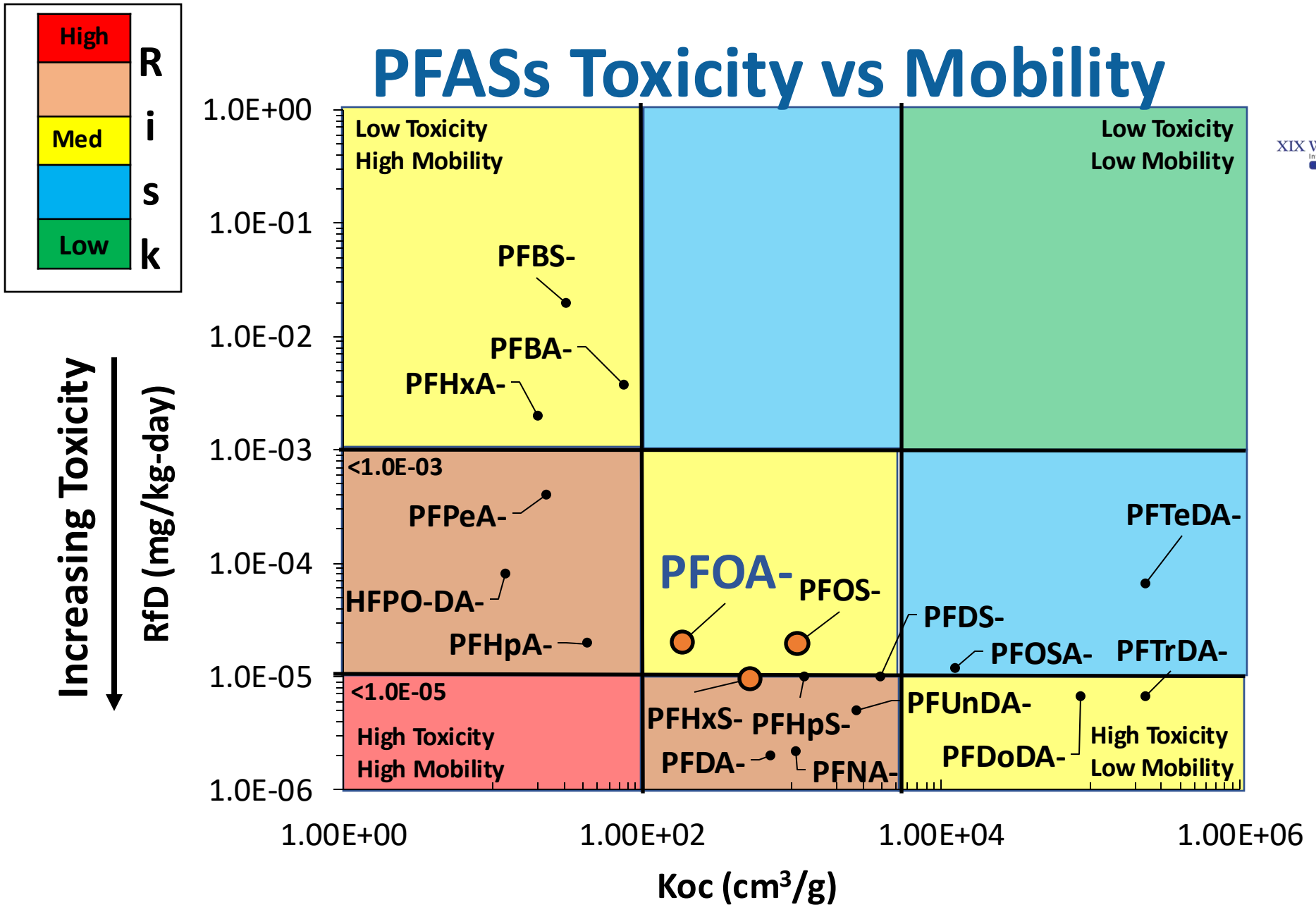






Since 2002, production and use of PFOS and PFOA in the U.S. have declined.

PFASs Toxicity vs Mobility



Developing Health and Environmental Concerns in U.S. states

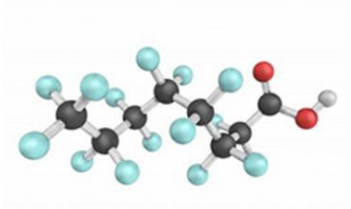
- **Initial Health Advisory Levels (2016):**

PFOA + PFOS (combined or individual): 70 ppt (70 ng/L)

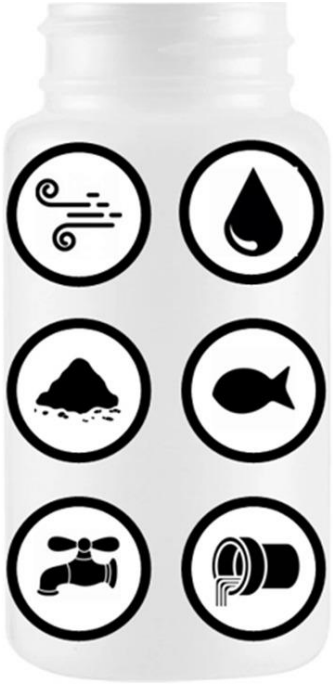
- **Revised Health Advisory Limits (2024):**

PFOA: 0.004 ppt

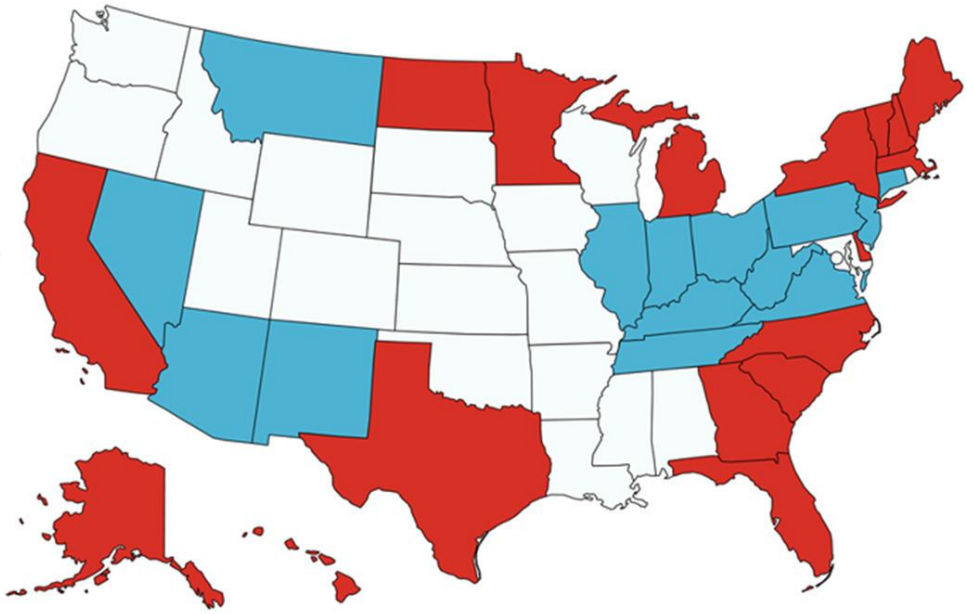
PFOS: 0.02 ppt



Per- and Polyfluoroalkyl Substances (PFAS)



PFAS Sampling in Different Environmental Matrices



- Not actively sampling for PFAS
- Uses only EPA guidelines for PFAS Sampling
- Uses EPA and State guidelines for PFAS Sampling

Detection of PFAS Using FT-ICR MS

Environmental Science & Technology
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Article

PFAS Analysis with Ultrahigh Resolution 21T FT-ICR MS: Suspect and Nontargeted Screening with Unrivaled Mass Resolving Power and Accuracy

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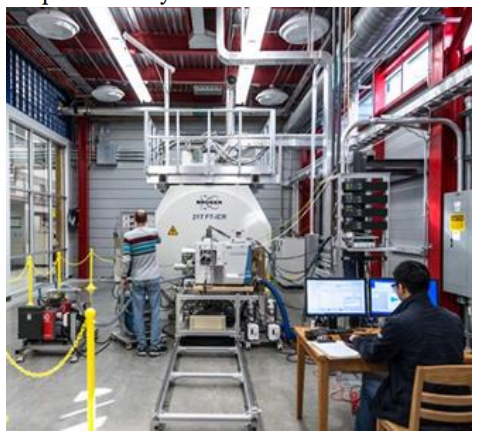
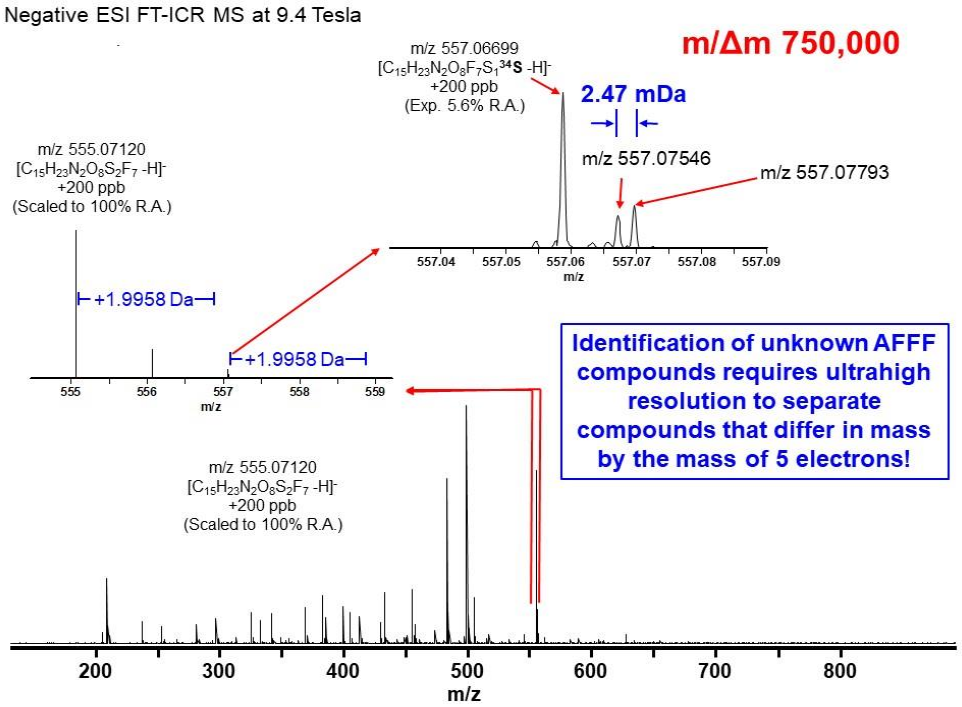
journal homepage: www.elsevier.com/locate/watres

Exploring the fluorinome of PFAS-impacted groundwater using 21 tesla FT-ICR mass spectrometry



The world's largest mass spectrometer (21 T)



Only FT-ICR MS can resolve and identify these PFAS in complex aqueous film-forming foam (AFFF).

Site sampling & sample processing

Our Team sampling AFFF-impacted groundwater at a U.S. DoD site.

GW samples (3 U.S. DoD sites)

WWTP samples

AFFF sample(s)

blanks, blanks, blanks

liquid-liquid extraction*

↓

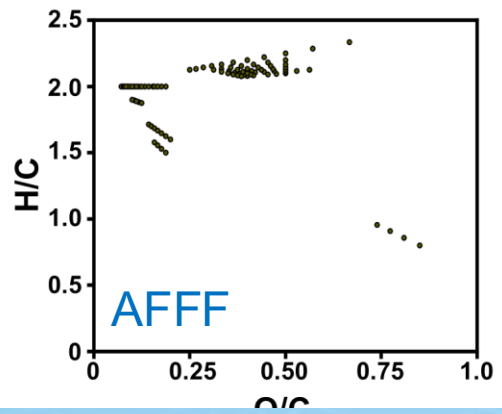
evaporate

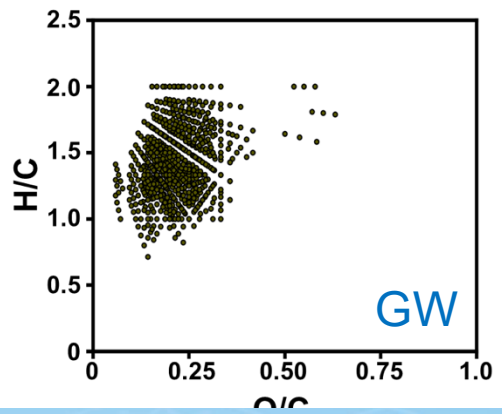
↓

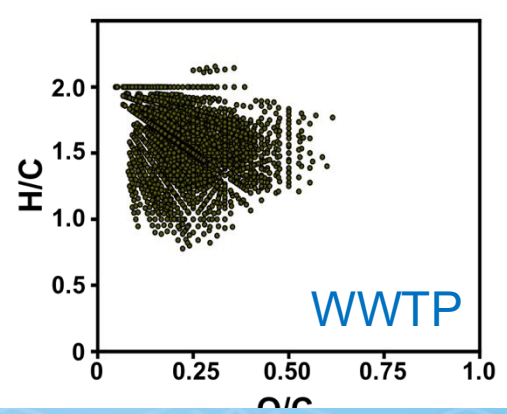
ultrahigh-purity methanol

Identification of natural organic matter

Location	Sample ID	Total Peaks	DOM Peaks
N/A	AFFF	9,247	114
Site A	ONBASE 1	14,990	3,364
	ONBASE 2	20,719	5,625
	OFFBASE 1	14,011	1,753
	OFFBASE 2	19,020	5,993
	OFFBASE 3	18,938	5,650
	OFFBASE 4	18,145	5,686
SITE B	SITE B 1	15,625	1,083
	WWTP	19,242	7,757
SITE C	SITE C 1	15,362	1,807
	SITE C 2	12,748	3,856





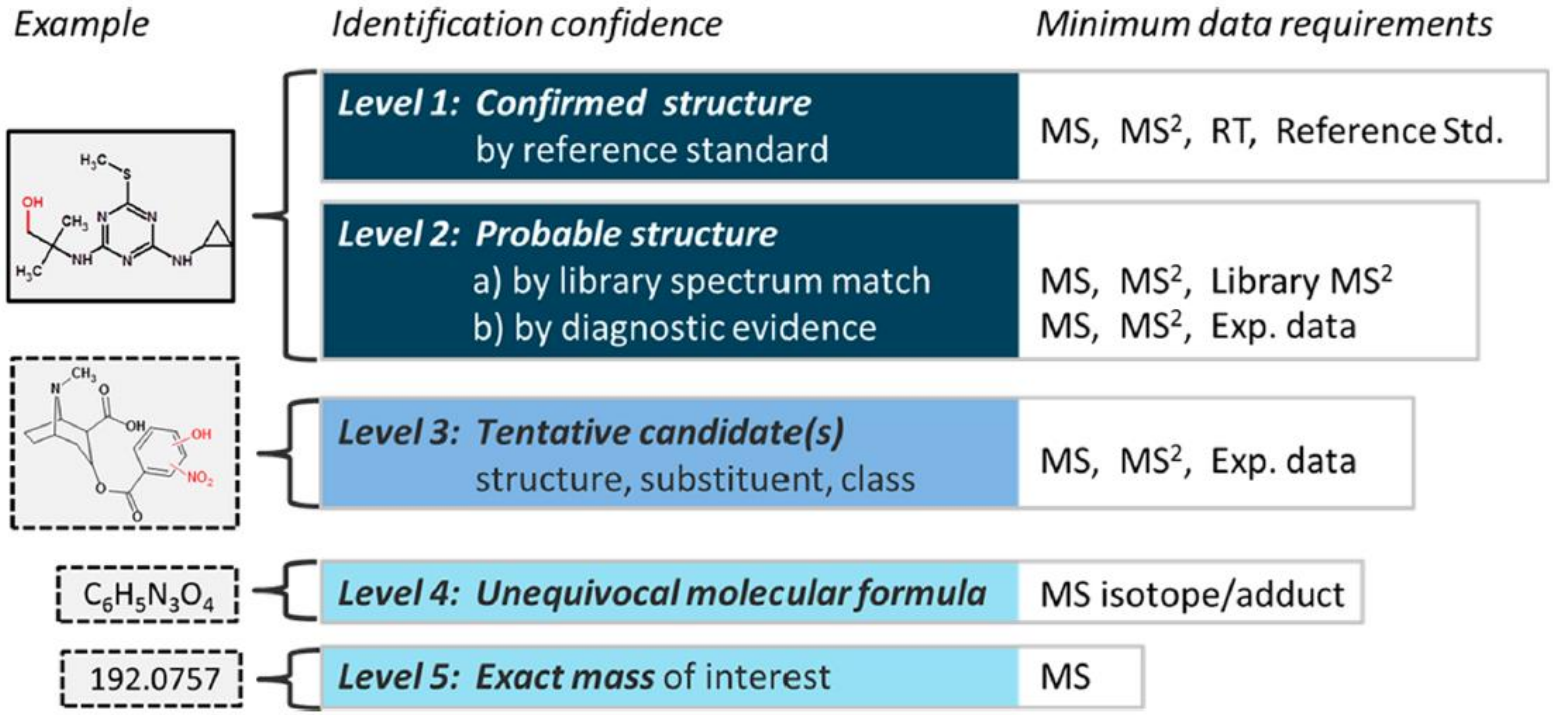


How confident are we in our HRMS identification?

Environmental Science & Technology
Viewpoint
pubs.acs.org/est

Identifying Small Molecules via High Resolution Mass Spectrometry: Communicating Confidence

Emma L. Schymanski,*[†] Junho Jeon,[†] Rebekka Gulde,[†,‡] Kathrin Fenner,[†,‡] Matthias Ruff,[†] Heinz P. Singer,[†] and Juliane Hollender*[†,‡]



MS1 operates at scan mode while MS2 selects the product ion of a particular

Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR MS)

Our Team sampling AFFF-impacted groundwater at a U.S. DoD site.

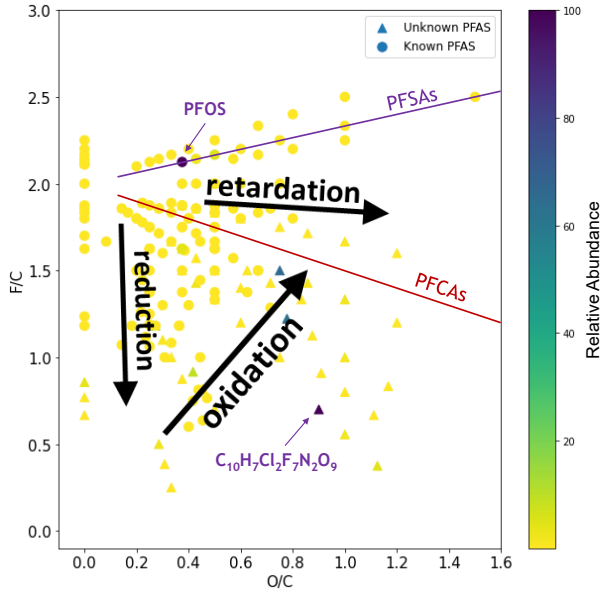
Summary of detected PFAS in 11 samples:

- Previously reported PFASs: 403
- **Novel PFAS** (highest confidence)**:** **300**
- **Novel PFAS classes:** **75**
- Novel PFAS (CF_2 series): 1739
- Other novel potential PFAS: 6312

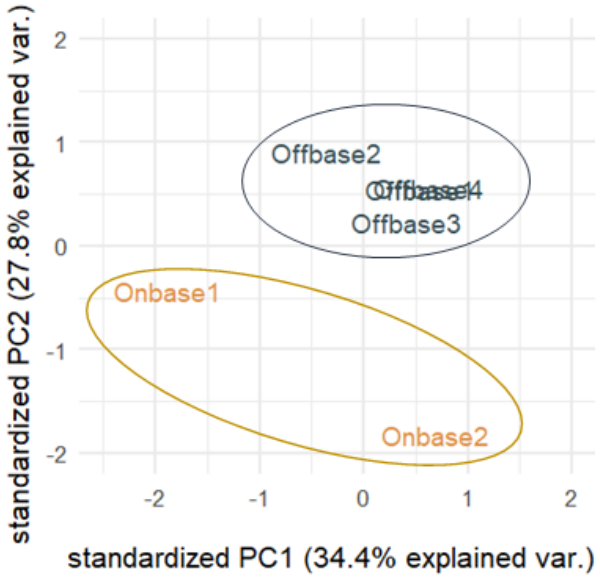
Extended Mass Spectral PFAS Library

Blotevogel, J.* et al. (2021): SERDP ER20-1265 Final Report. *https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Risk-Assessment/ER20-1265*

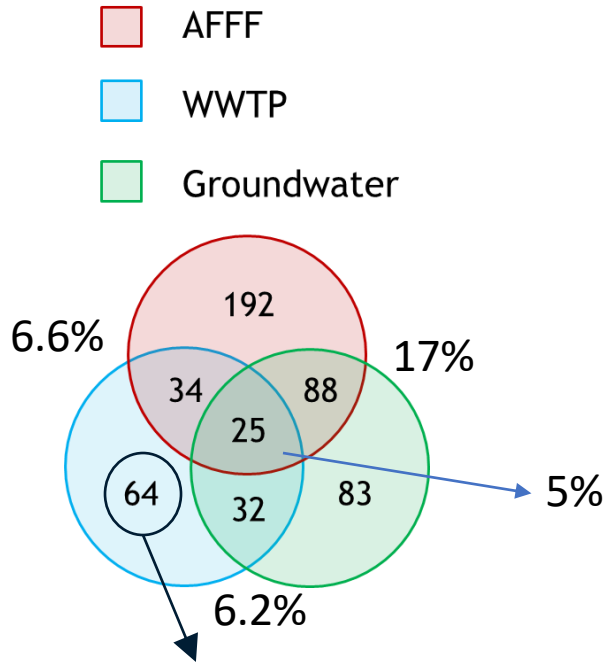
Forensic data reduction approaches can be used for compositional profiling and source allocation.



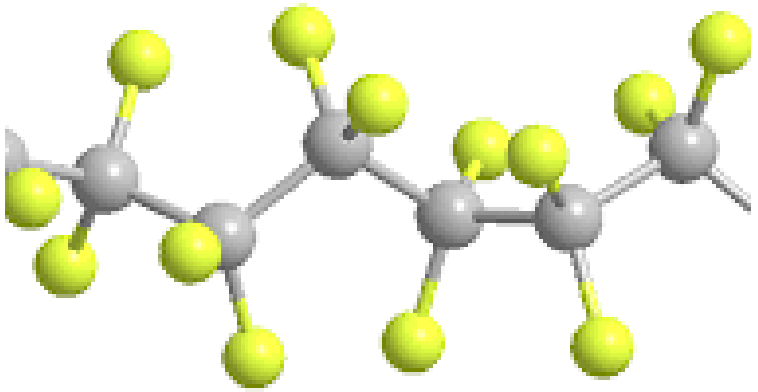
(Modified) van Krevelen diagram: "fingerprinting" and determination of fate & transport processes



Principal component analysis: distinguishing sources of PFAS contamination



Venn diagram: Identification of potential source-specific markers



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Marrakech, Morocco | 1-5 December 2025

analytical chemistry

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Developing a Novel Sensor for ...

Article

Fluorescent Sodium Alginate Hydrogel–Carbon Dots Sensor for Detecting Perfluorooctanoic Acid in Potable Water

Somayeh Mohammadi, Christian Sandoval-Pauker, Zayra N. Dorado, Thomas P. Senftle, Robert Pankow, and Hamidreza Sharifan*

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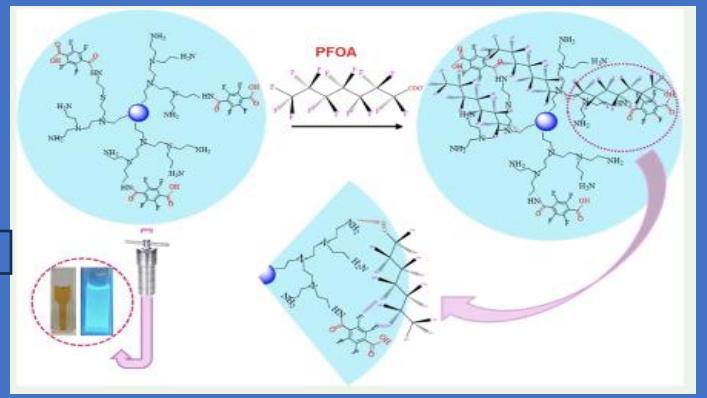
Article

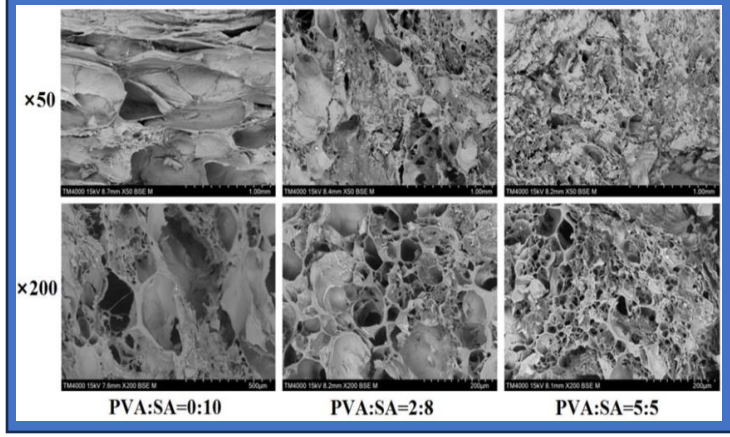
Nanoscale Fluorinated Carbon Dots for the Detection of Perfluorooctanoic Acid in Aqueous Systems: A Fluorescence Assay Enhanced by Fluorophilic Interactions

USDA

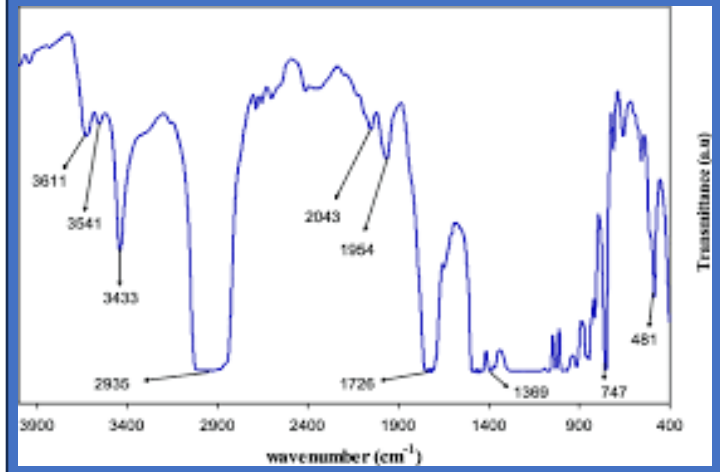
1 Carbon dots



2 SA Hydrogel



3 Ferrimagnetic Polymer



Developing a Novel Sensor for Detection of PFOA in Water Systems

Somayeh Mohammadi
Ph.D. Student, Chemistry and Biochemistry

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Nanoscale Fluorinated Carbon Dots for the Detection of Perfluorooctanoic Acid in Aqueous Systems: A Fluorescence Assay

Systematic Approach in PFAS Detection Sensors

1- Synthesis

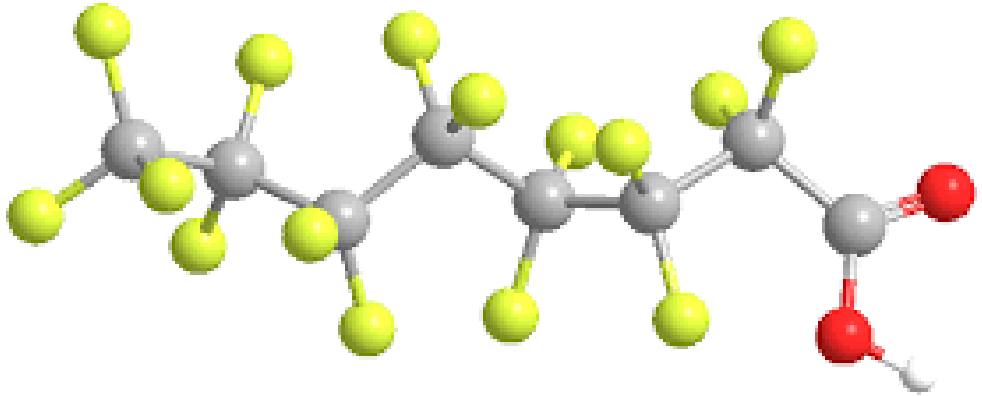
2-Characterization

3-Optimization

4- Testing against other PFAS species

5-Testing in the presence of interfering water compounds

6-Field Application for groundwater and tap water



Why Carbon Dots?

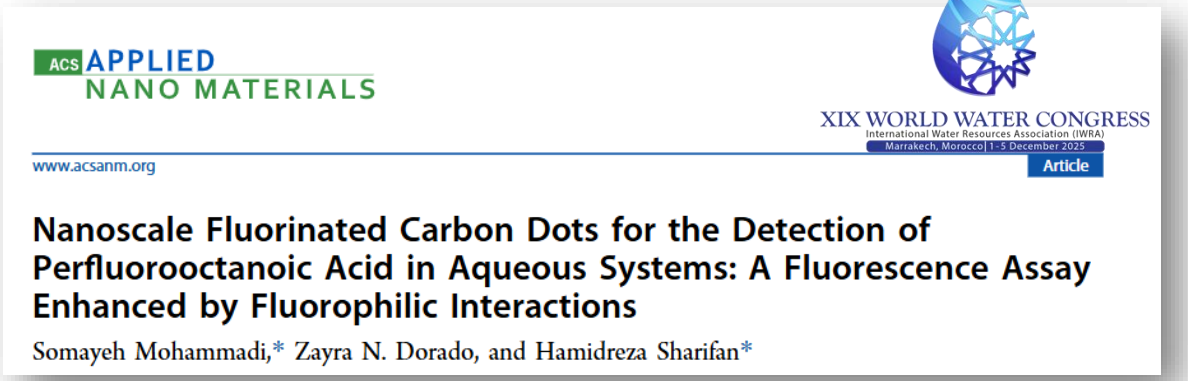
Excellent Fluorescence Properties:
- Exhibit strong & Stable fluorescence
- High yield

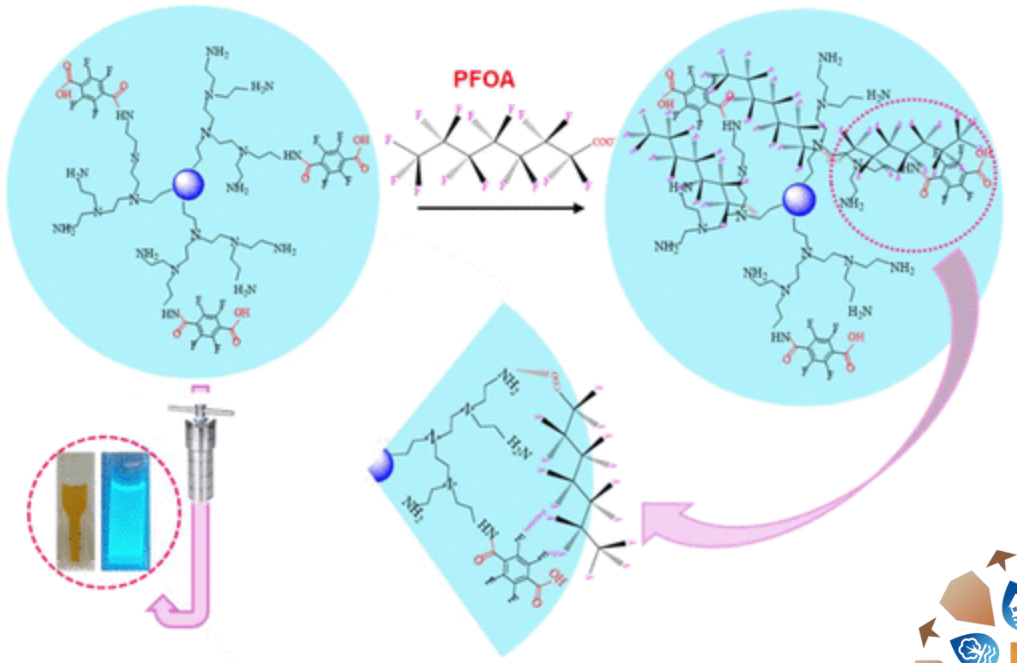
Eco-Friendliness and Biocompatibility:
- Derived from non-toxic
- Sustainable materials

Surface Functionalization:
- Easily functionalized with various groups

High Stability:
- Photostable and chemically stable

Cost-Effectiveness and Scalability





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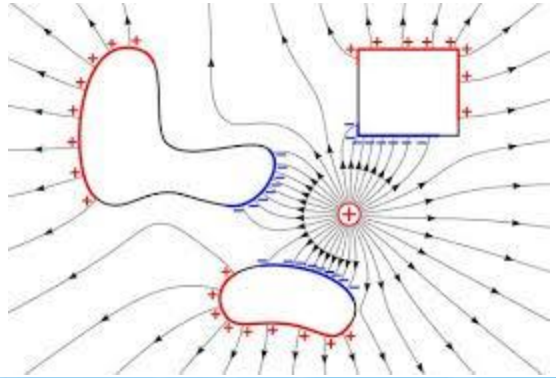
Somayeh Mohammadi,* Zayra N. Dorado, and Hamidreza Sharifan*

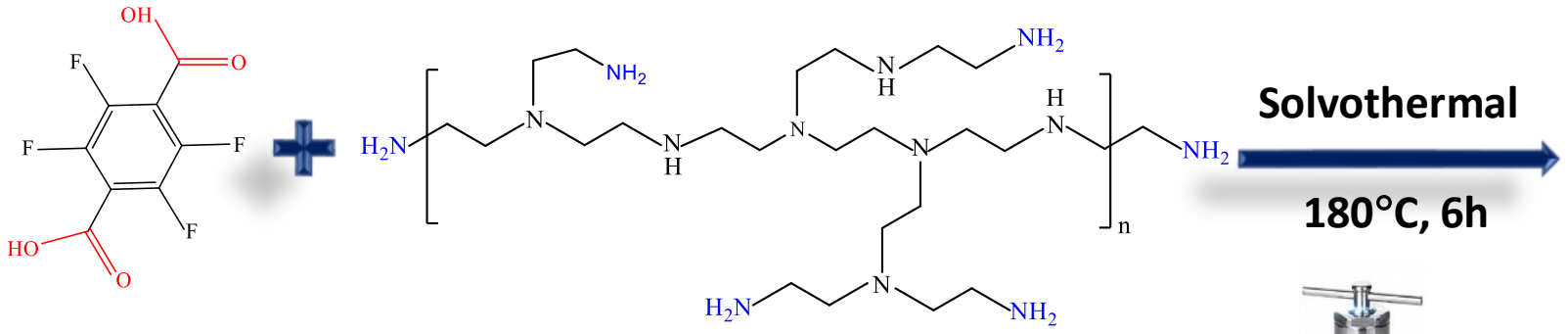
Optimizing the potential for:

Electrostatic
Hydrophobic

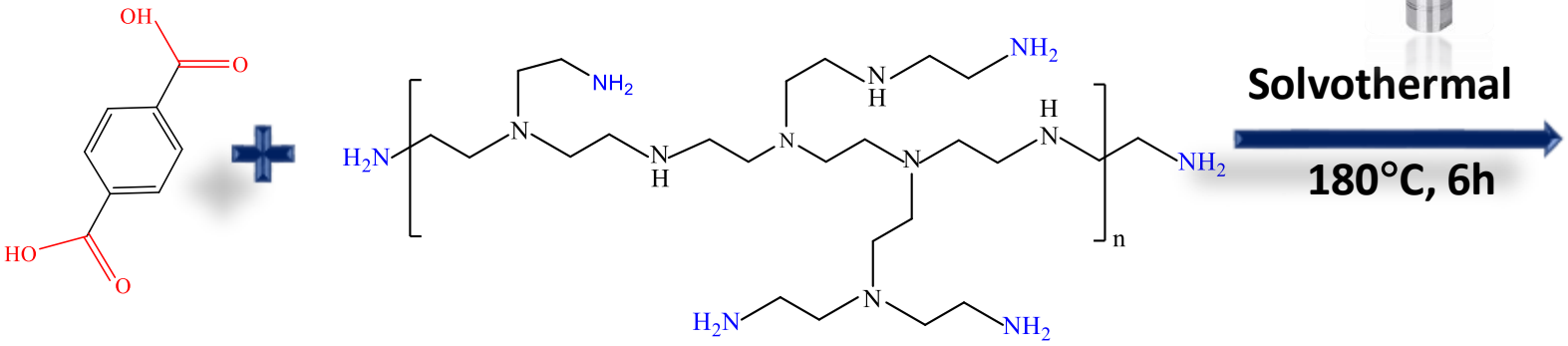


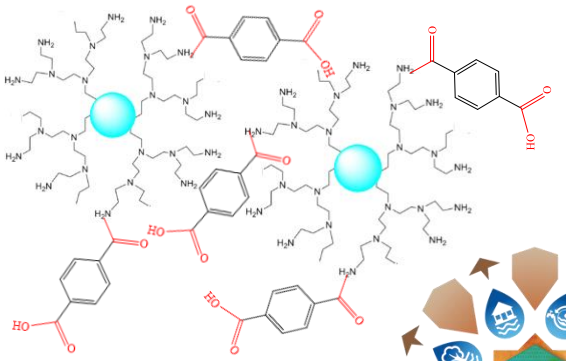
Synthesis Optimization

Synthesizing fluorinated carbon dots (FCDs)



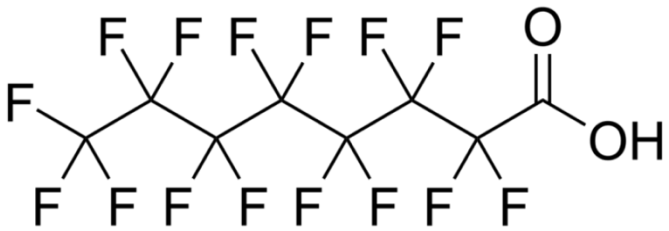
Synthesizing non-fluorinated carbon dots (NFCDs)

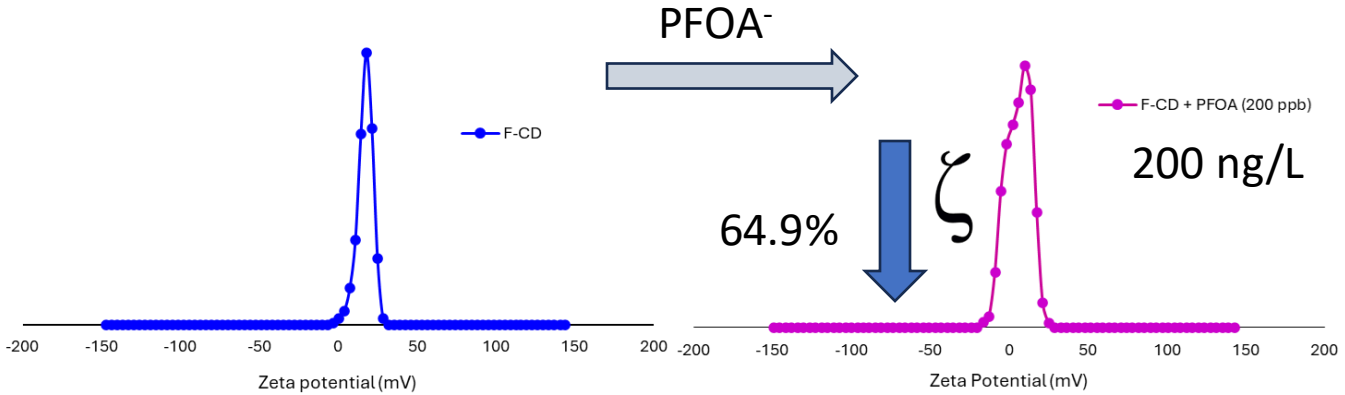


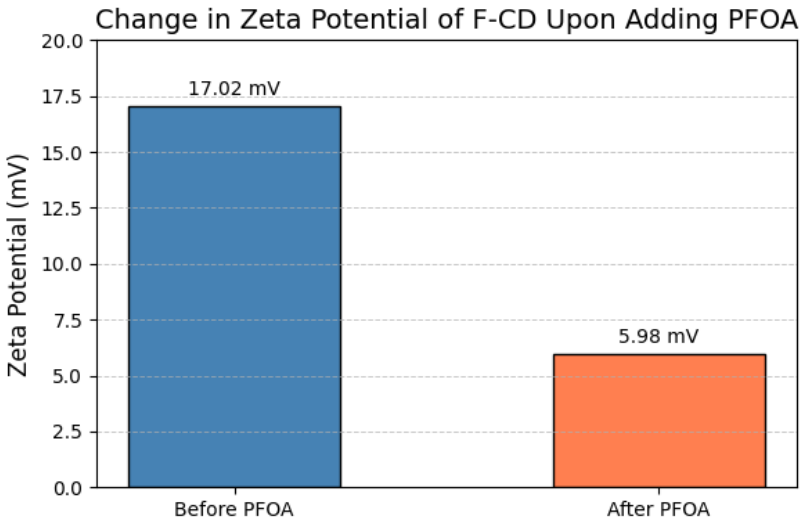


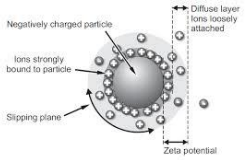
tetra[fluoroter](#)ephthalic acid (TFTA) + polyethylenimine (PEI)

Zeta Potential Studies

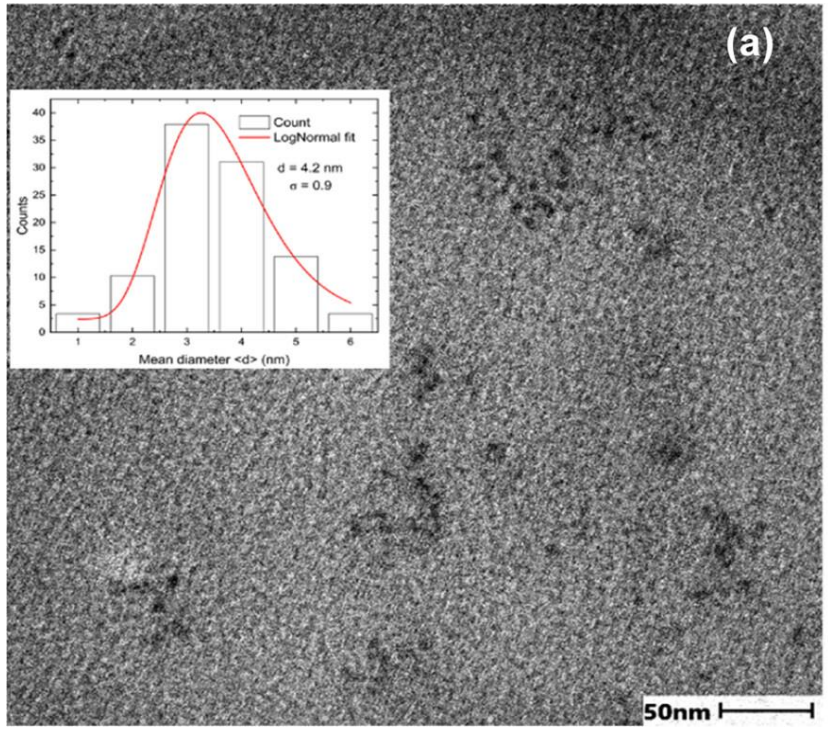


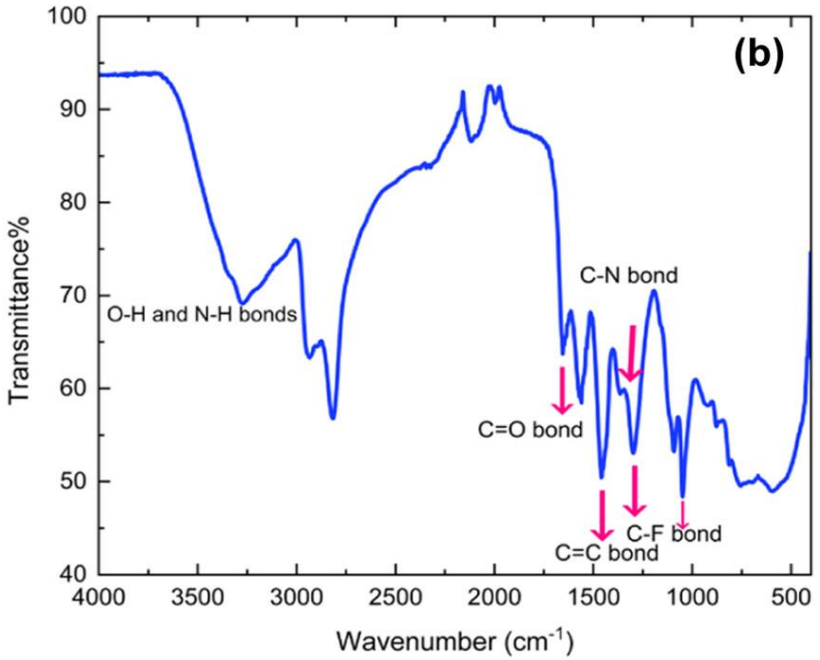






Characterization of Physiochemical Properties





TEM image of the F-CDs at 50 nm scale, the inset represents the size distribution of F-CD (a). FT-IR spectrum of F-CD (b).

Characterization of Physiochemical Properties

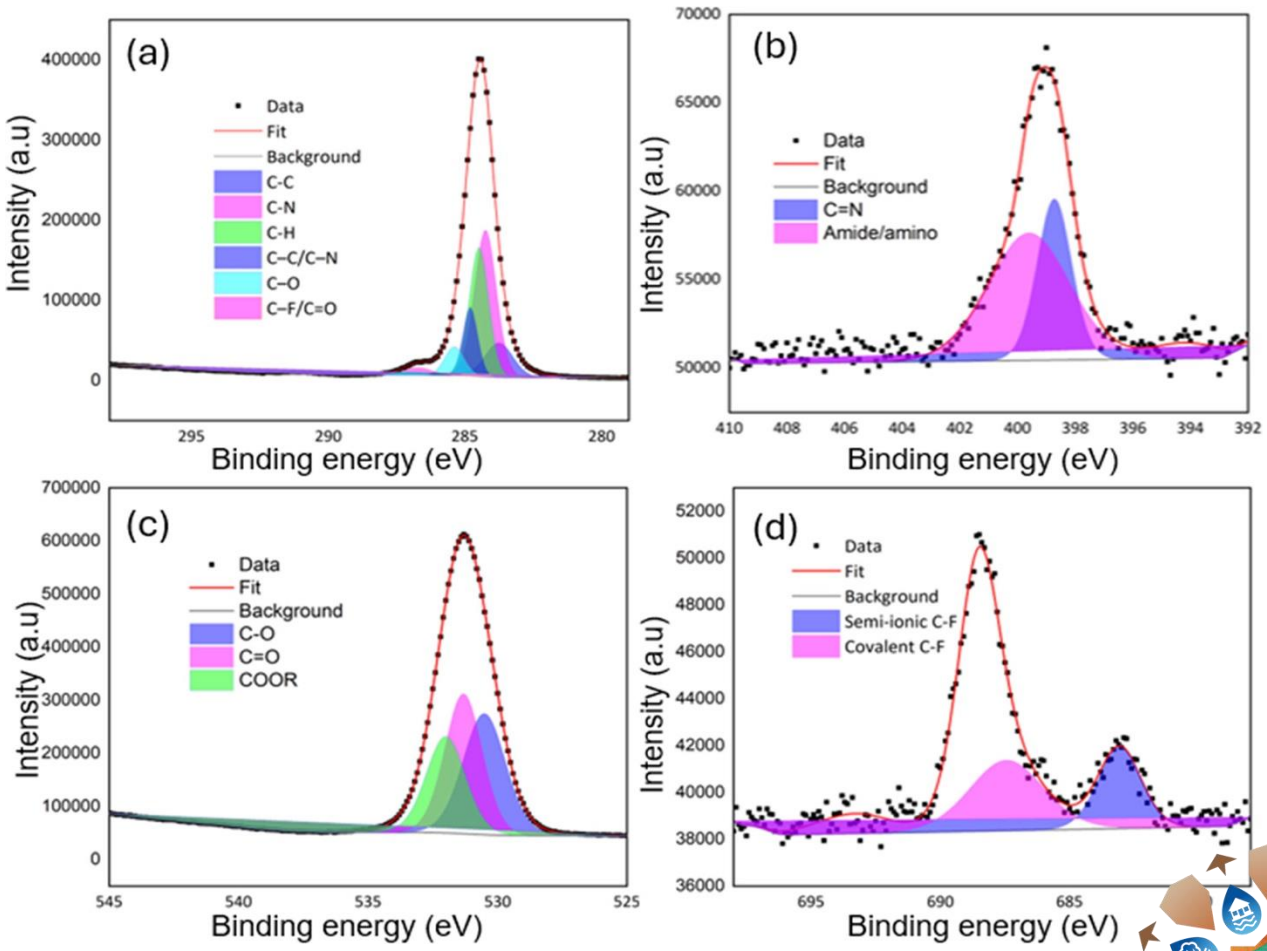
The elemental scans of the FCD flow as C 1s (a), N 1s (b), O 1s (c), and F 1s (d).

C–F/C=O
C–C/C=C
C–N
→ Surface Polarity →
- Electrostatic
- Hydrophobic

C–N
amide/amino
→
- Electronic balance
- Surface reactivity

C=O
C–O
COOR
→
- Hydrophilicity
- Hydrogen bonding

C–F → Selectivity



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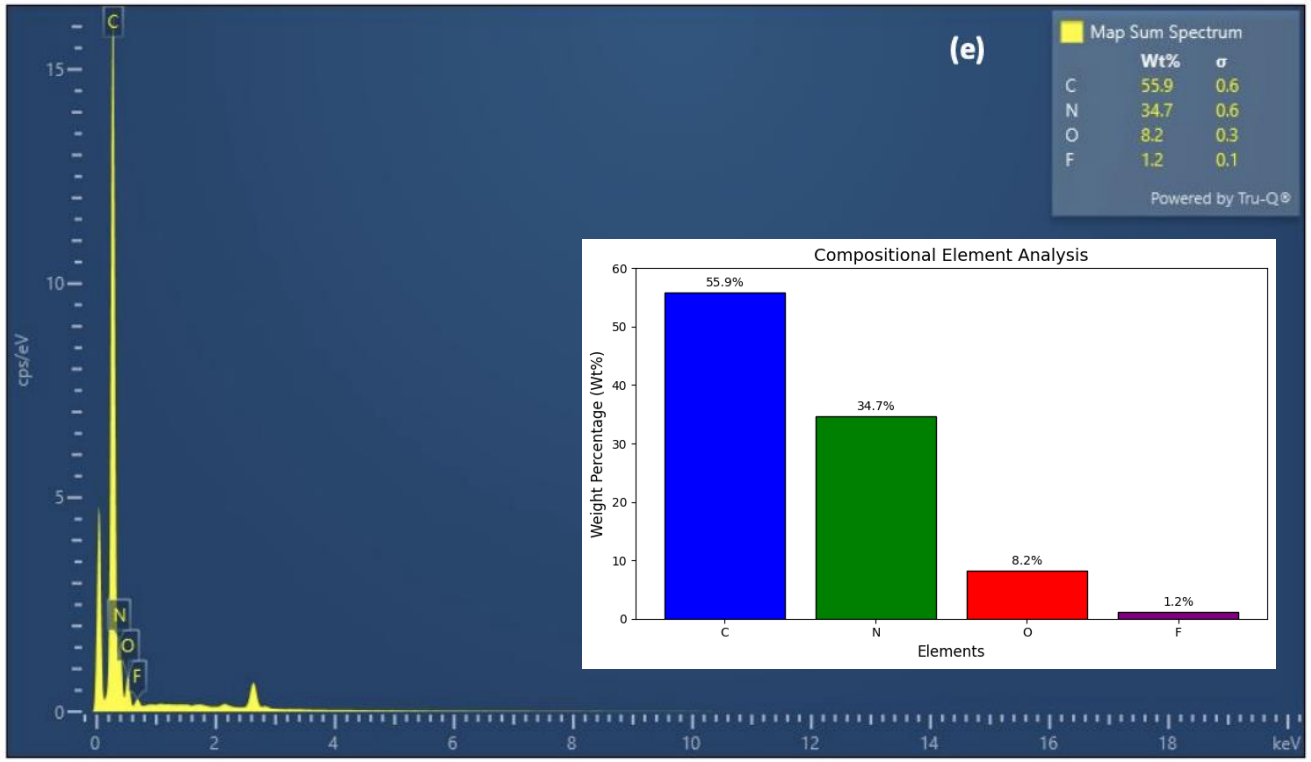
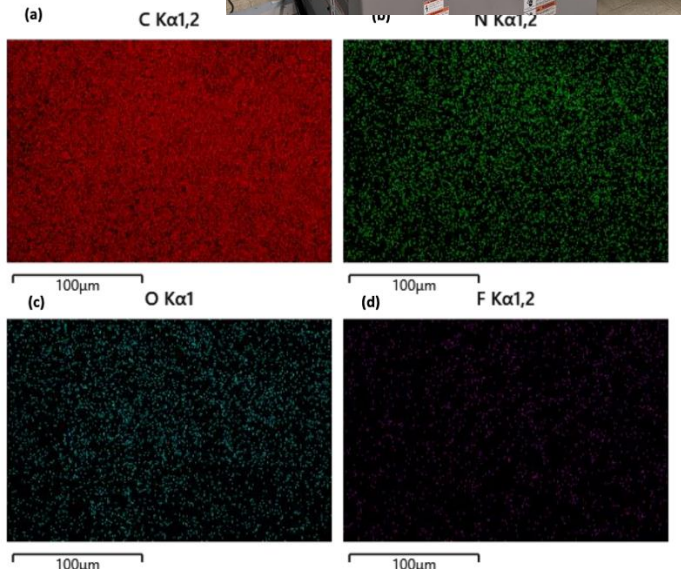
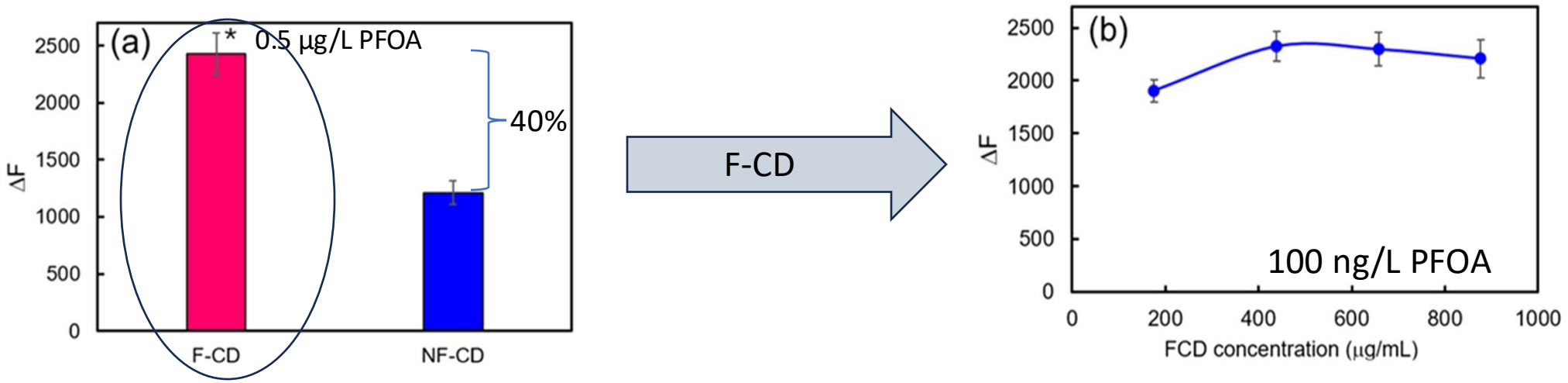




Elemental Analysis by EDX

PFOA Sensing Performance

- The ΔF increases as the FCD concentration rises, **suggesting that FL is positively correlated with FCD concentration within 400–600 µg/mL.**
- After 600 µg/mL, the intensity plateaus, indicating saturation or reduced sensitivity at higher concentrations.



Minimum ΔF: ~1500 at 200 µg/mL.
Maximum ΔF: ~2500 between 400 and 600 µg/m

PFOA Sensing Performance

Reaction Time

A:

Significant ΔF rise in the initial 40 minutes.

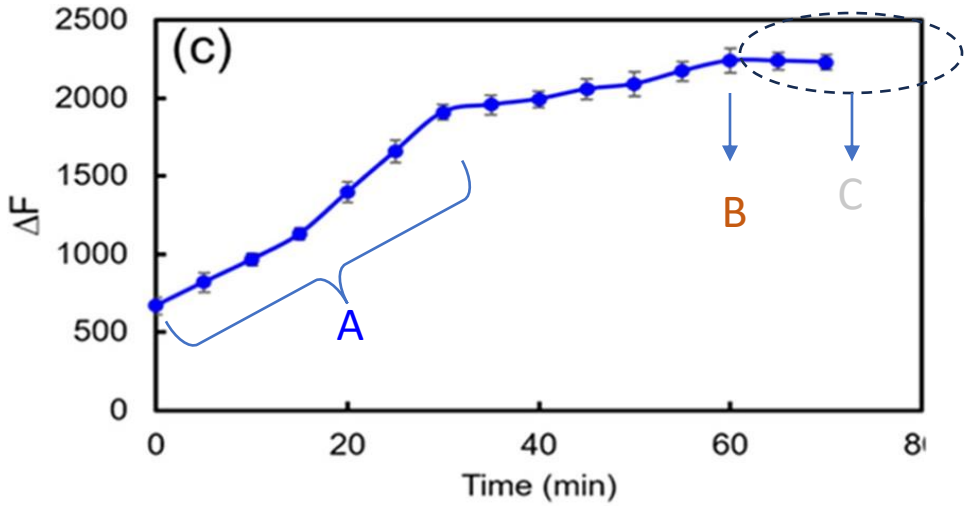
Rapid increase in ΔF within the first 20–40

B:

Intensity reaches a plateau around 60 minutes

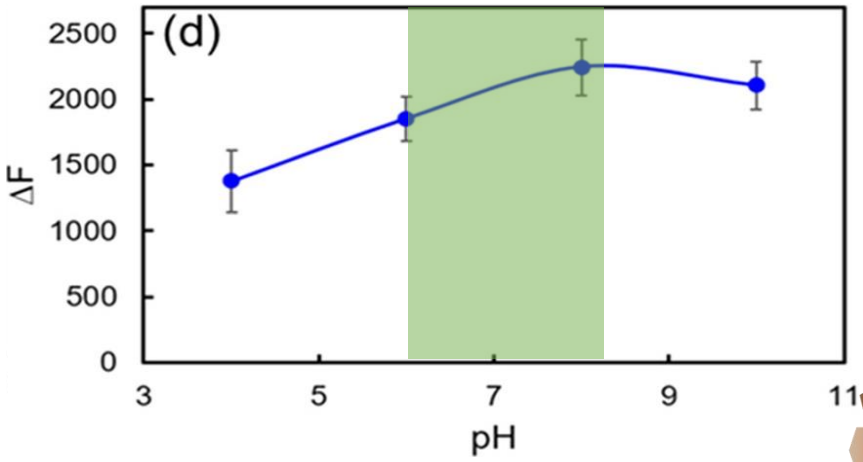
C:

The system achieves equilibrium at this point.

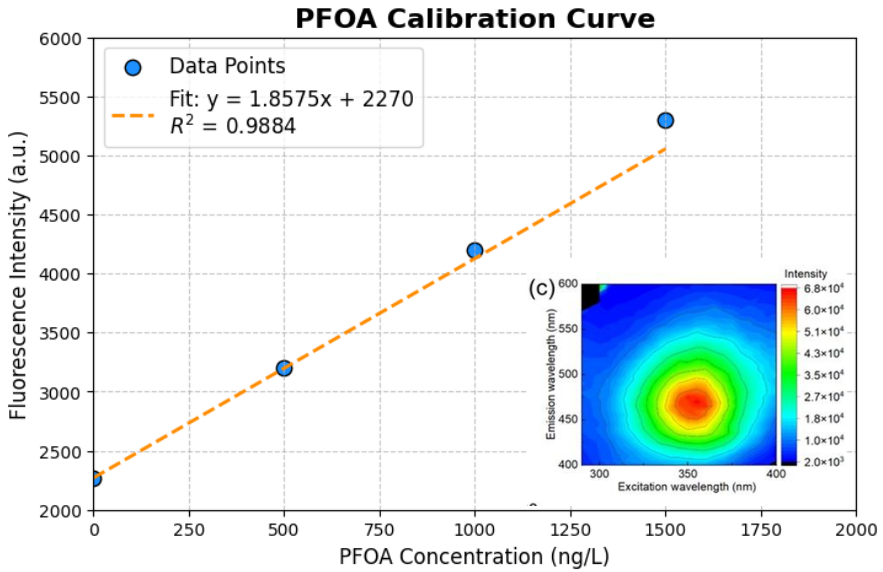


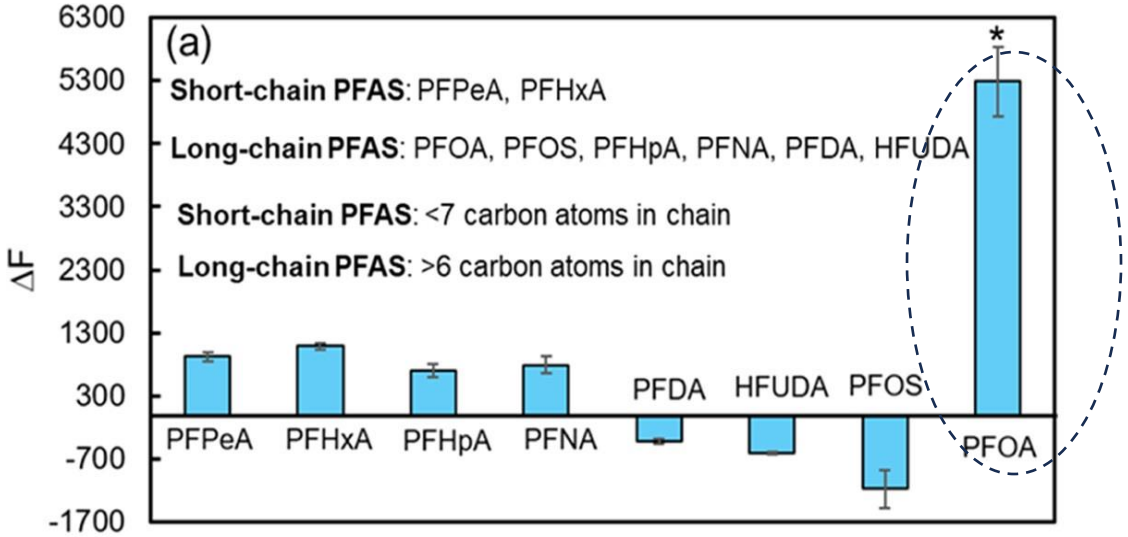
pH

- The optimal ΔF is at **neutral to slightly alkaline (pH 7–9)**.
- Lower ΔF at acidic (pH 3) and strongly alkaline (pH 11) suggests reduced stability or interaction efficiency
- At acidic, protonation of functional groups on F-CDs or PFOA may reduce binding efficiency, leading to lower fluorescence.

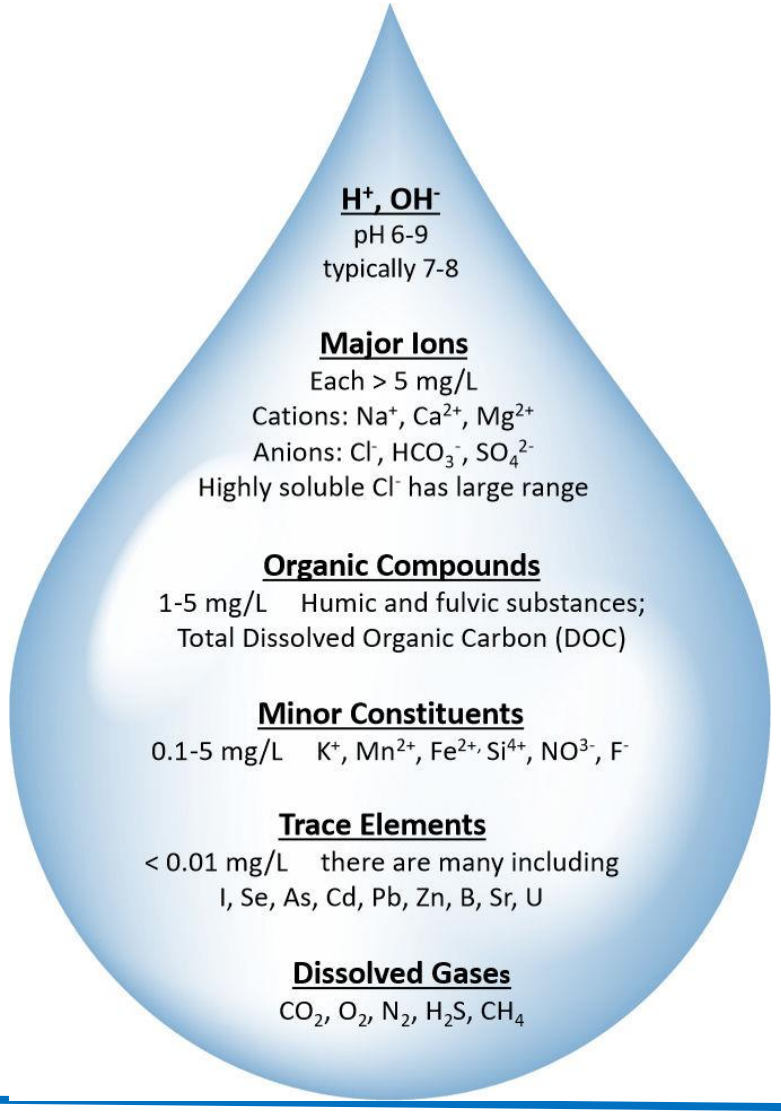


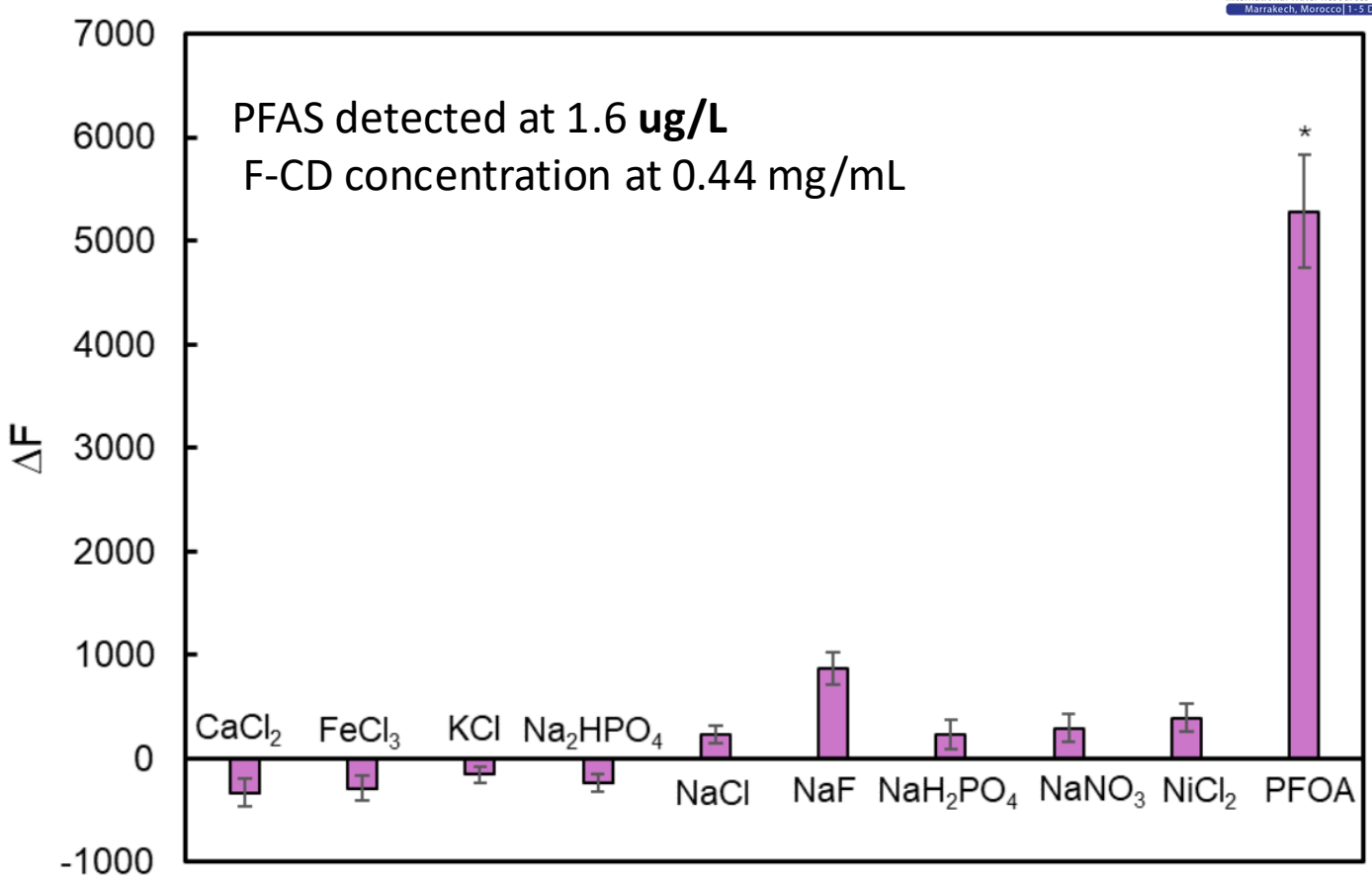
Sensitivity and Selectivity in PFOA Sensing





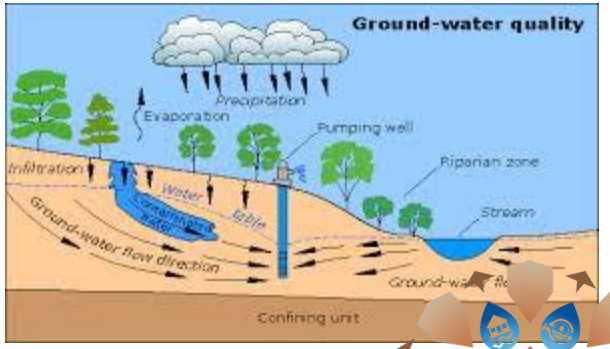
Investigating the Interfering Water Compounds





Measuring PFOA in El Paso Ground Water Samples

Samples	Found (ppt)	Spiked (ppt)	Detected (ppt)	Recovery%
Groundwater	0.0	10.0	10.1±0.4	101±4.4
		60.0	58.6±3.6	97.8±6.0
		160.0	154.2±2.9	96.4±1.8
Tap Water	0.0	10.0	10.3±0.3	102.6±2.6
		60.0	60.3±0.4	100.5±0.6
		160.0	160.5±5.7	100.3±3.6



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Thank you!

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