



Capture and concentrate PFAS with recyclable magnetic nanoparticles

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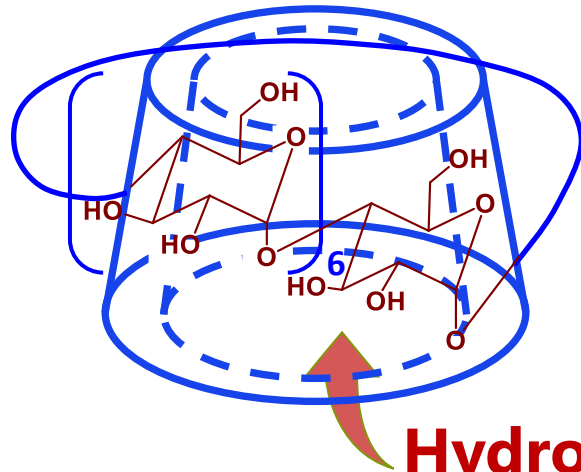
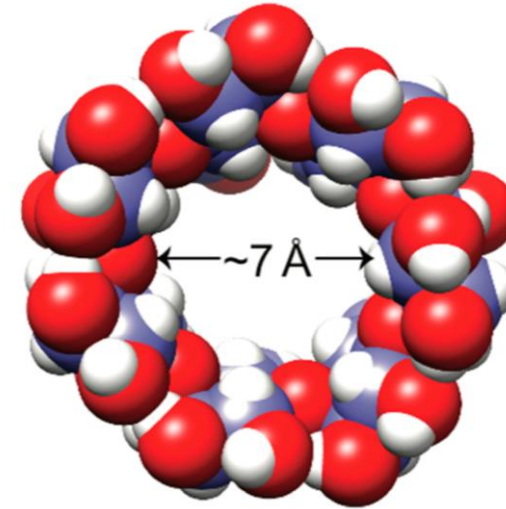
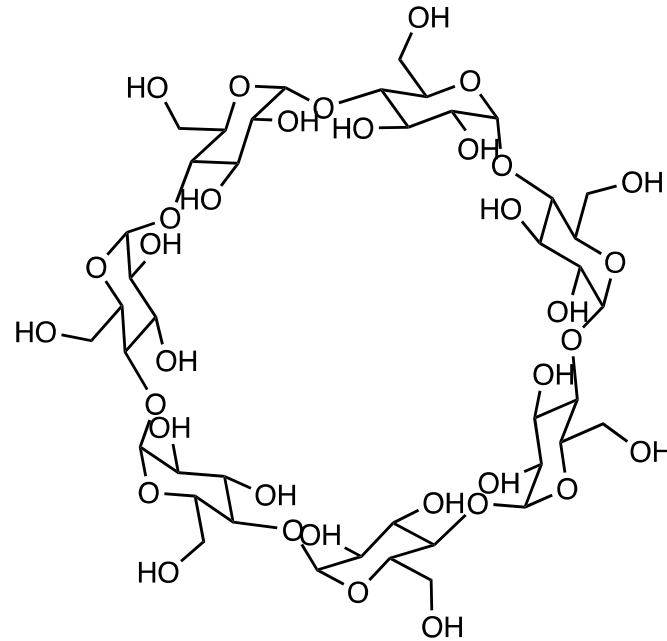
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IMMM
Institut des Molécules
et Matériaux du Mans
Le Mans Université
CNRS - UMR 6283

β -Cyclodextrins

Biobased
Commercial
Cheap



**Hydrophobic
Cavity**



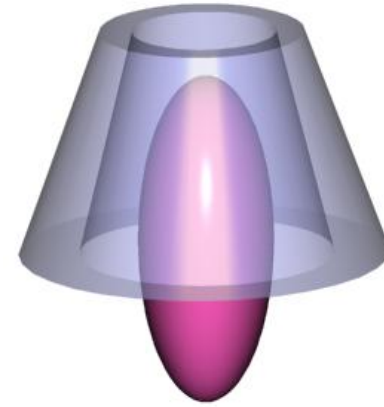
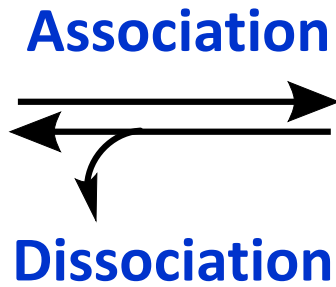
Host

Non-toxic
Water soluble
Conical shape

Capture and release of PFAS



+

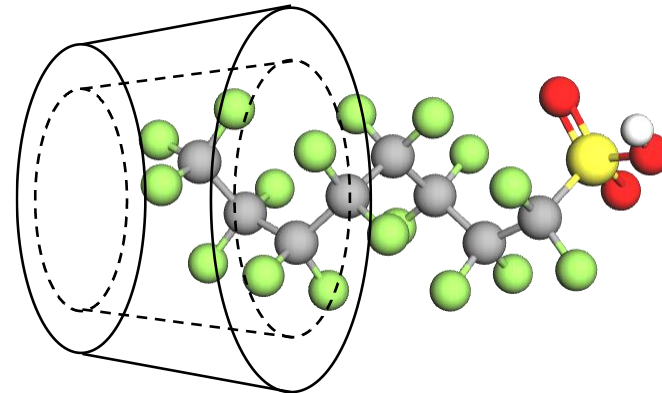
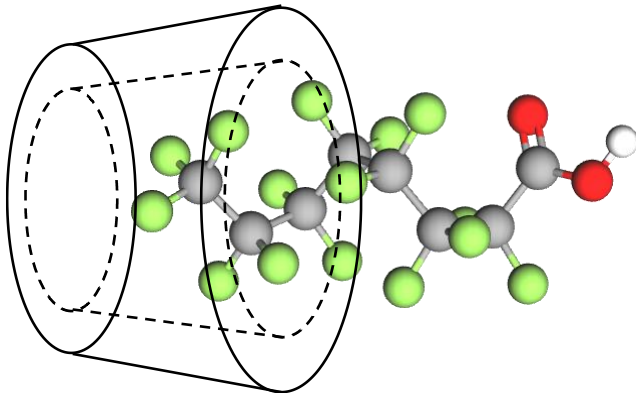


Host
Water soluble

Guest
Insoluble

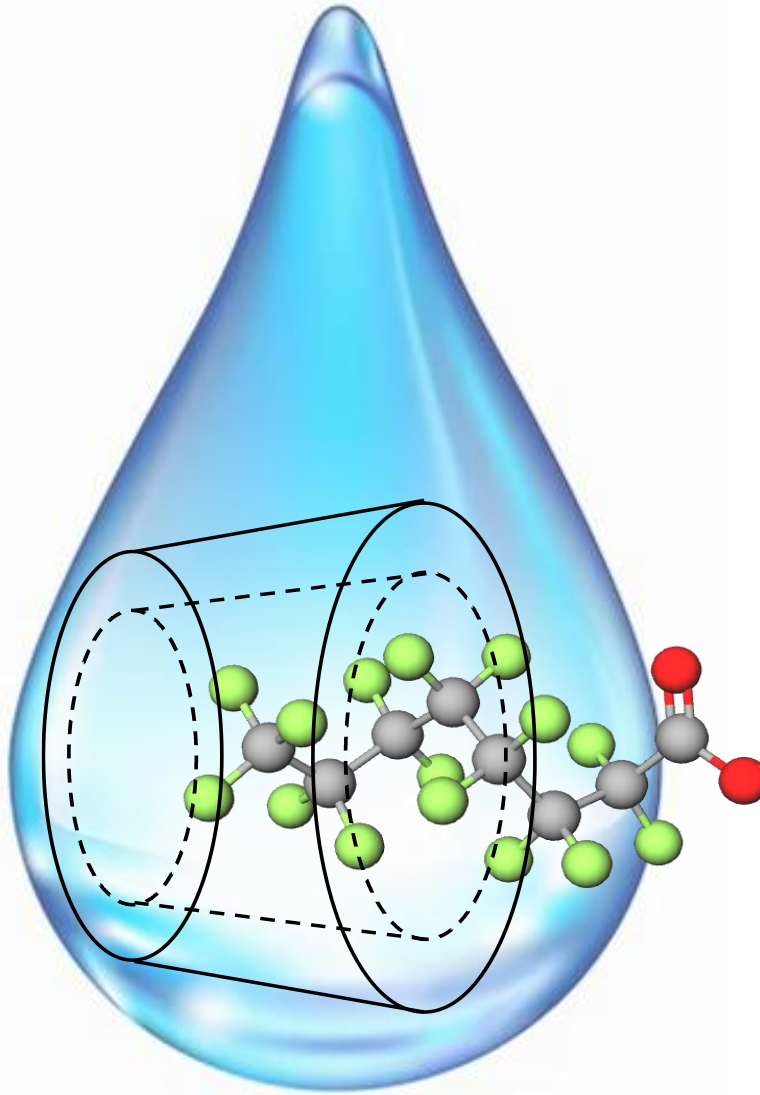
Host-Guest 1:1 Complex
Water Soluble
Stability constant K

CD:PFOA
 $K = 5 \times 10^5 \text{ M}^{-1}$



CD:PFOS
 $K = 7 \times 10^5 \text{ M}^{-1}$

Remediation Strategy



Water soluble!

Easy regeneration

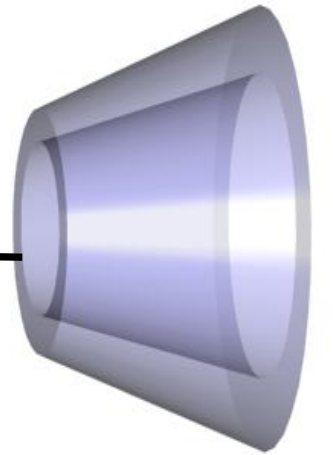
Low energy

Stable support

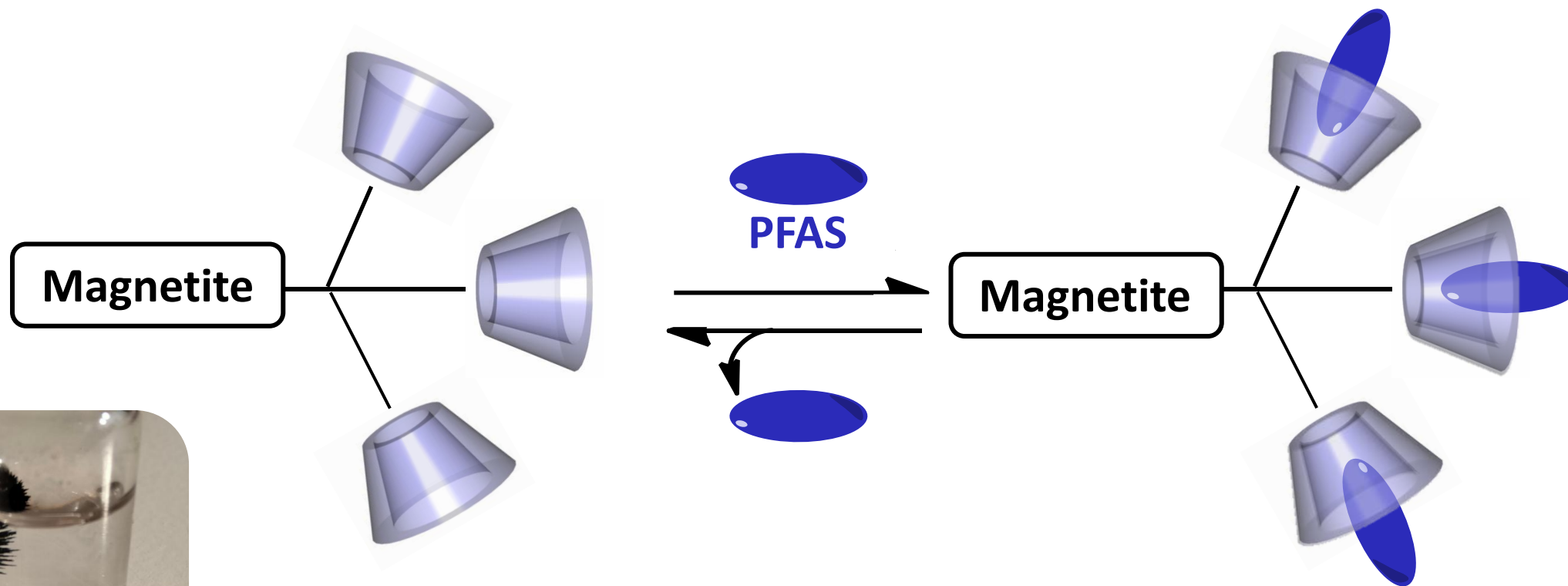
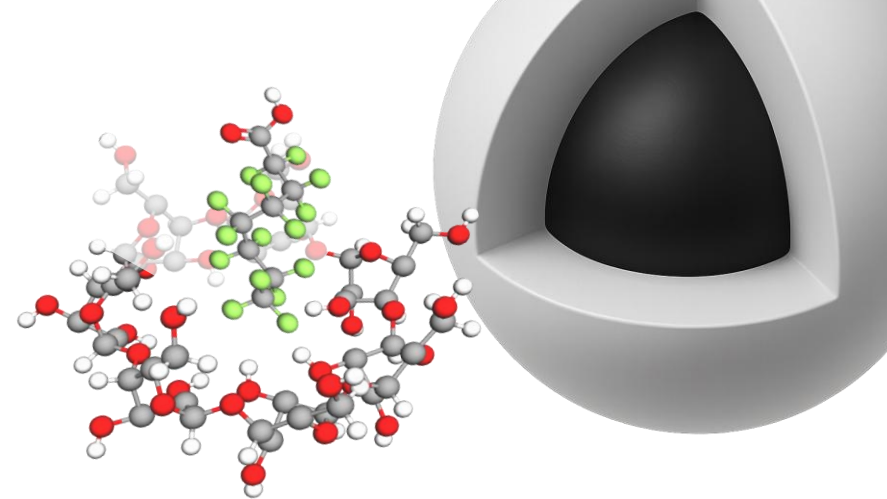
Easy recovery

**INSOLUBLE
SUPPORT**

Green chemistry

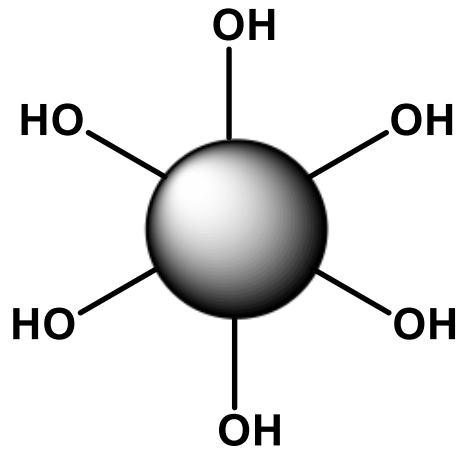


Problem of recyclability and energetic destruction



Capture et desorption of PFAS by magnetism

Recycled Magnetic Nanoparticles MNPs




HYMAG'IN

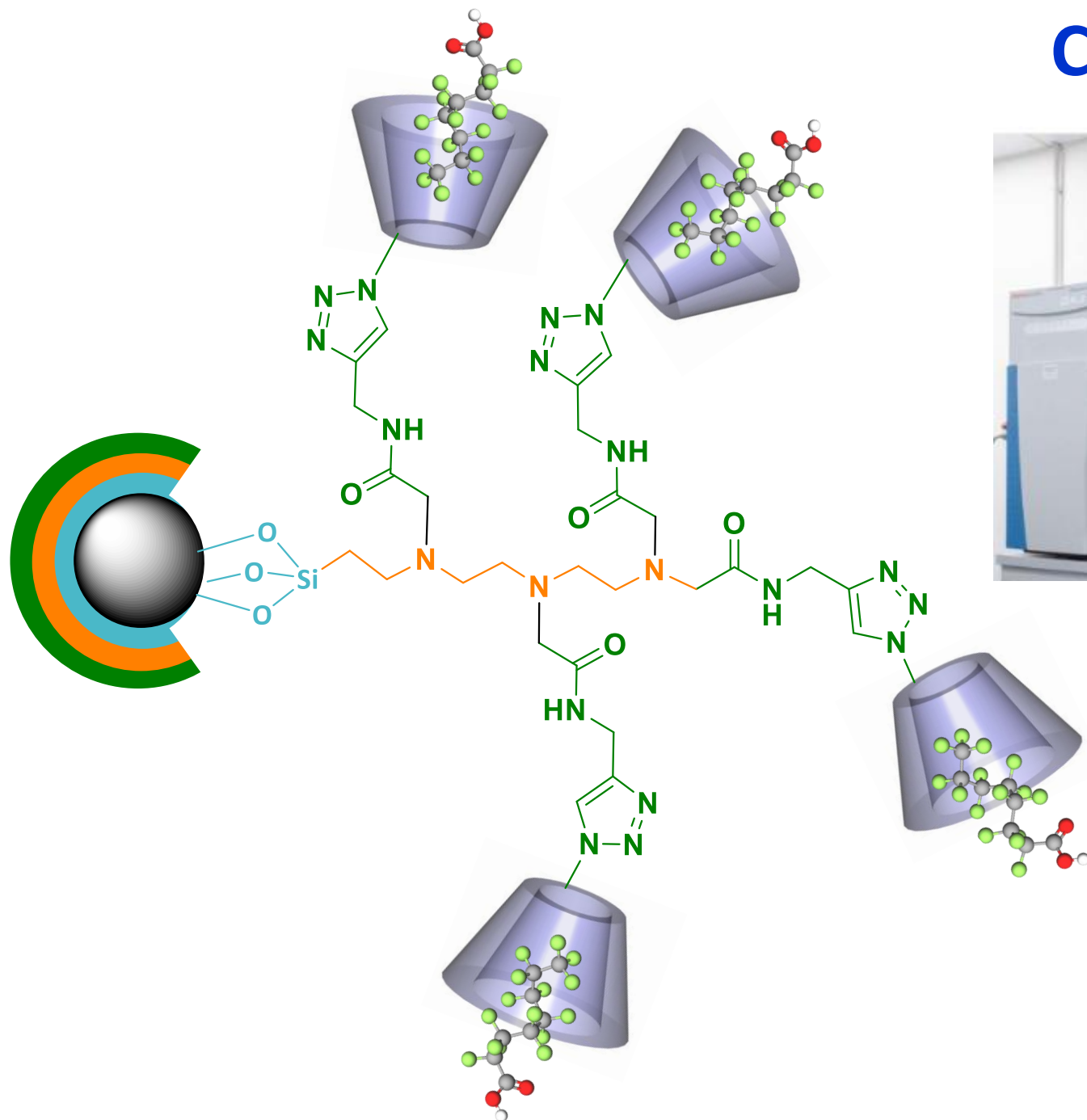
Magnetite
 Fe_3O_4
150-200 nm



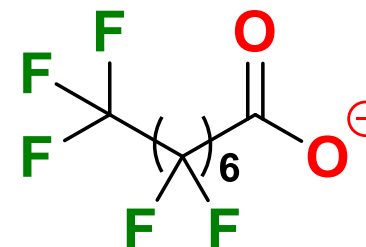
**Dust
of Steel Industries**

**Wastes &
By-products
600 Mt/an**

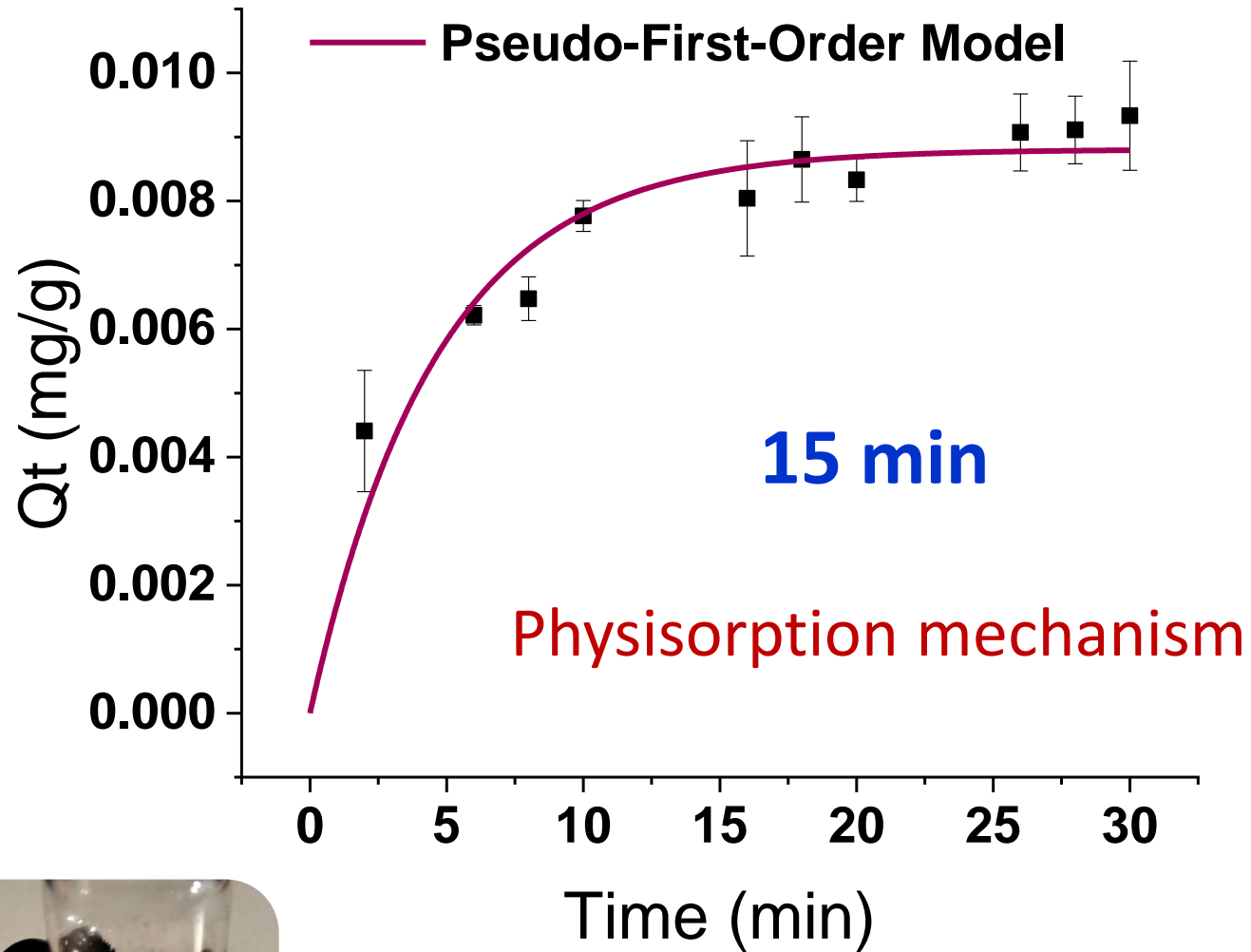
Capture & Desorption



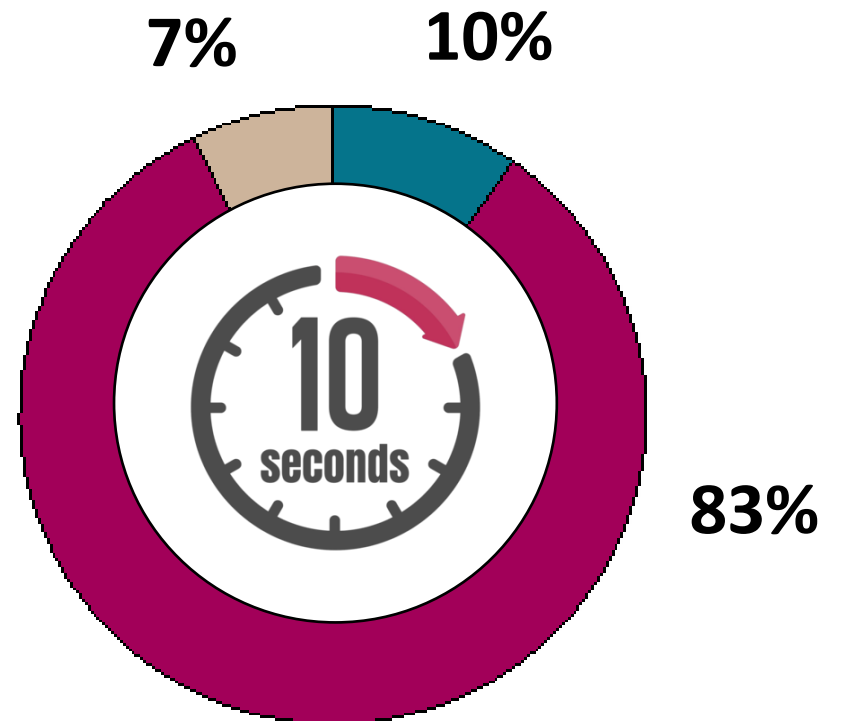
PFOA, as model, in excess



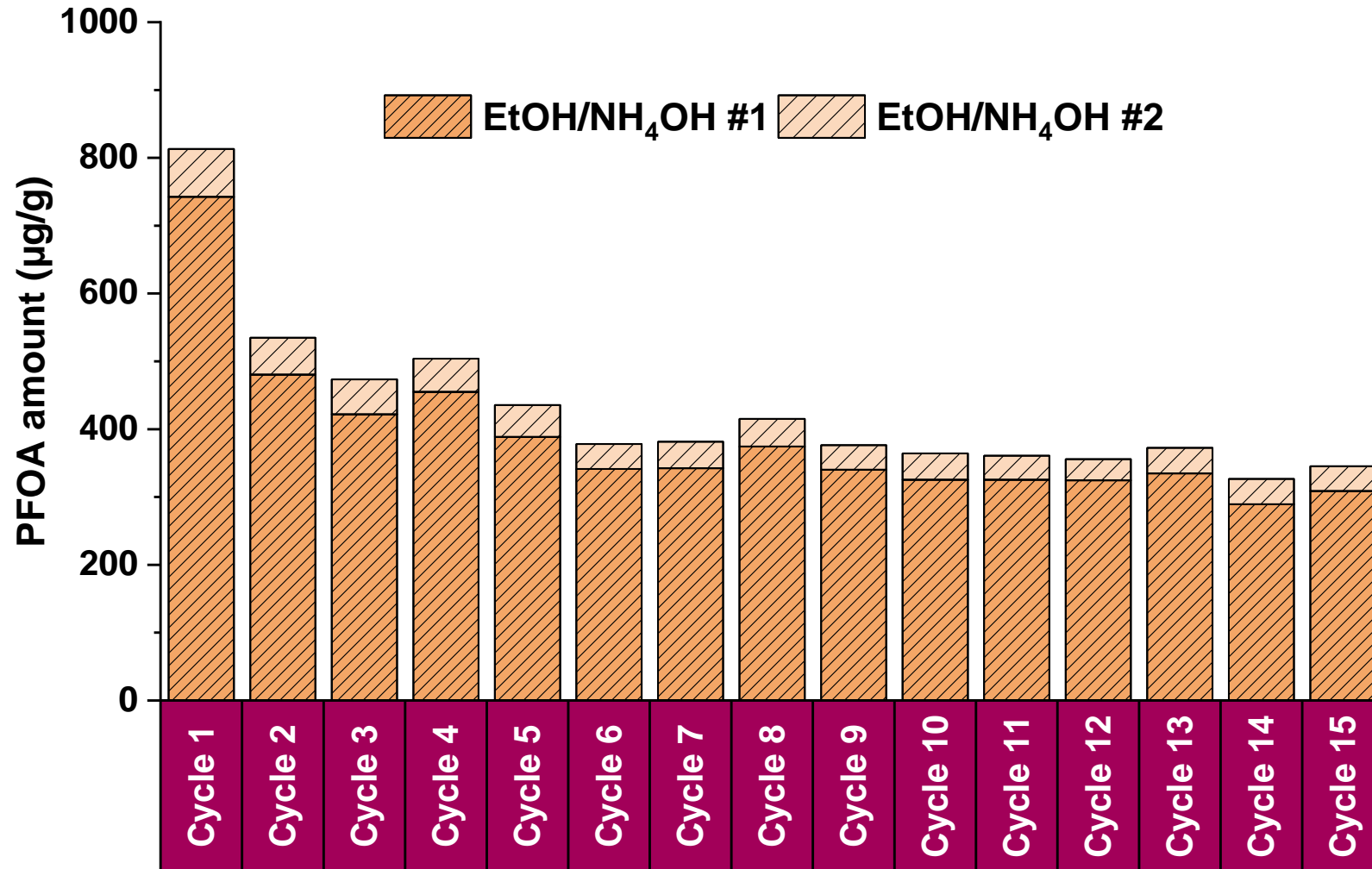
Capture & Desorption of PFOA



- Excess of PFOA
- Washing 1
- Washing 2



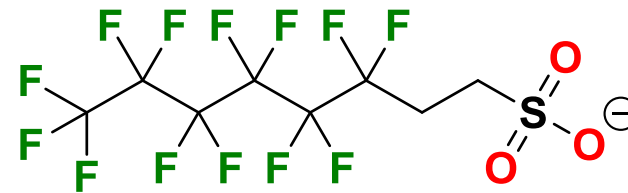
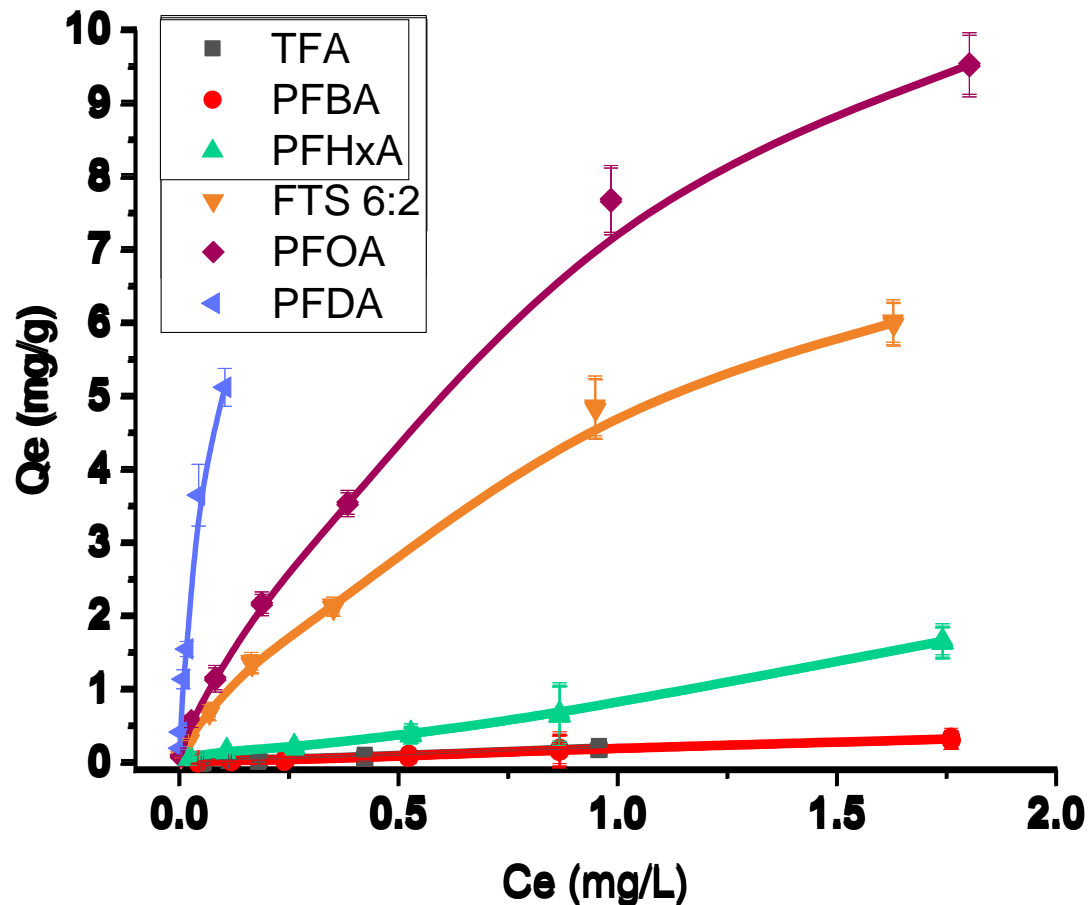
Desorption Cycles of PFOA



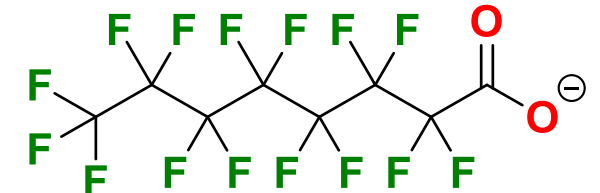
Magnetization

Competitive Adsorption

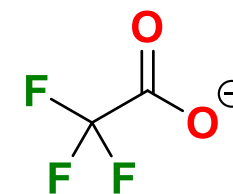
PFAS	TFA	PFBA	PFHxA	FTS 6:2	PFOA	PFDA
q_{\max} (mg/g)	/	/	0.25 ± 0.01	10 ± 1	16 ± 1	8.2 ± 0.8



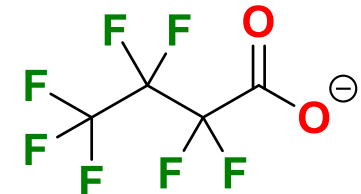
FTS 6:2



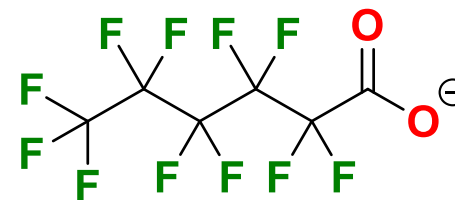
PFOA



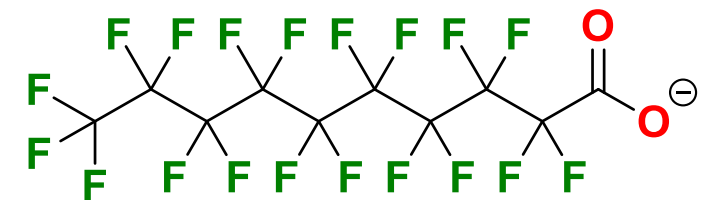
TFA



PFBA

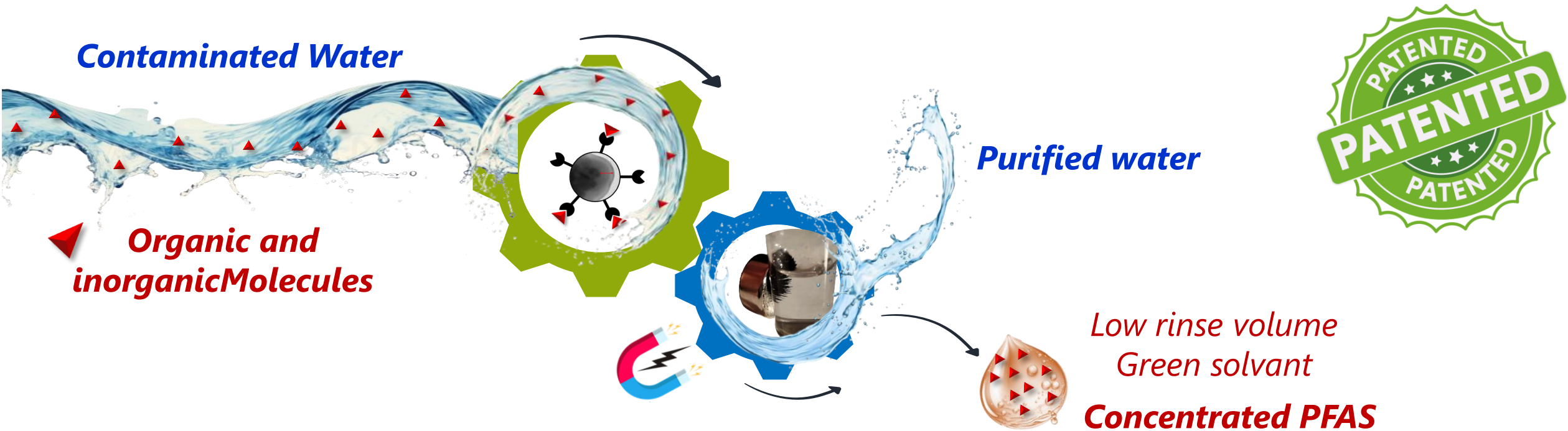


PFHxA



PFDA

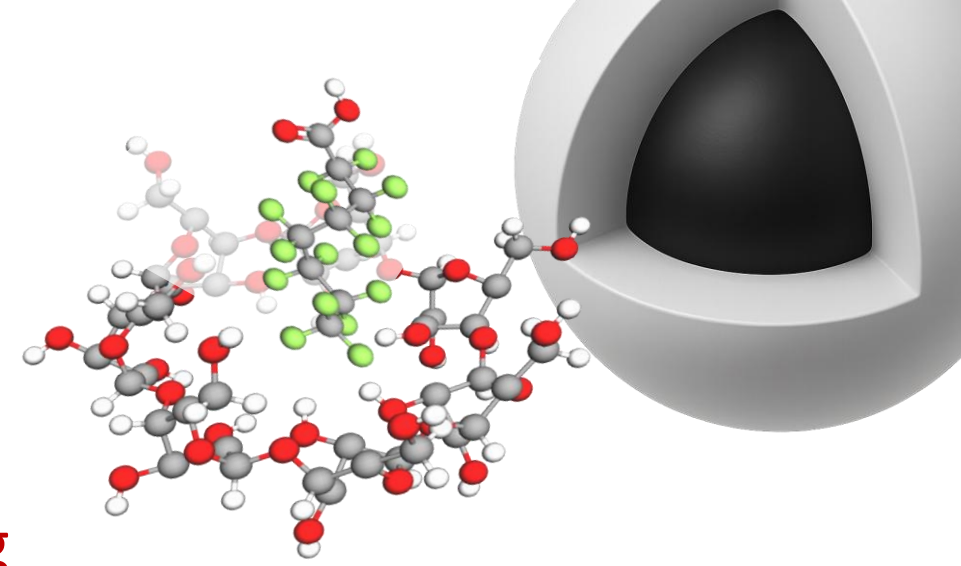
PFAS capture and concentration by magnetism



- ✓ Magnetite from steel industrial waste
- ✓ Rapid capture/desorption process (15mn/10s/30s)
- ✓ Separation by simple magnetism/low-energy process
- ✓ Reuse of the magnetic support in continuous cycle

Works in progress

- Optimization and scaling-up
- Improvement of the capture rate and recycling
- New strategy for short-chain PFAS
- Tests on real matrices
- Testing of other organic and inorganic pollutants
- Collaboration for the degradation of PFAS
- Tests on volatile PFAS



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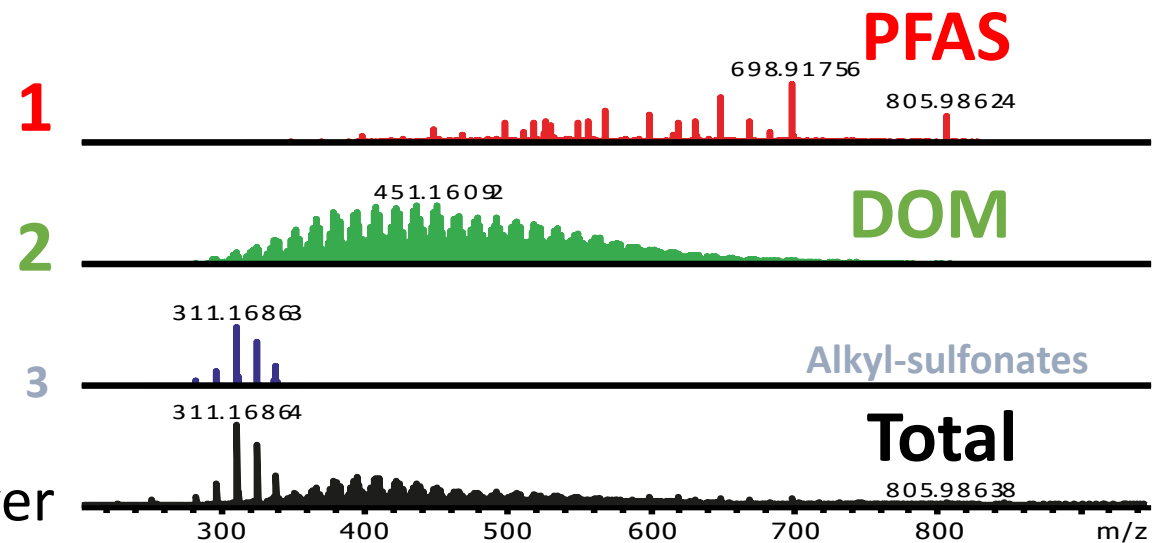
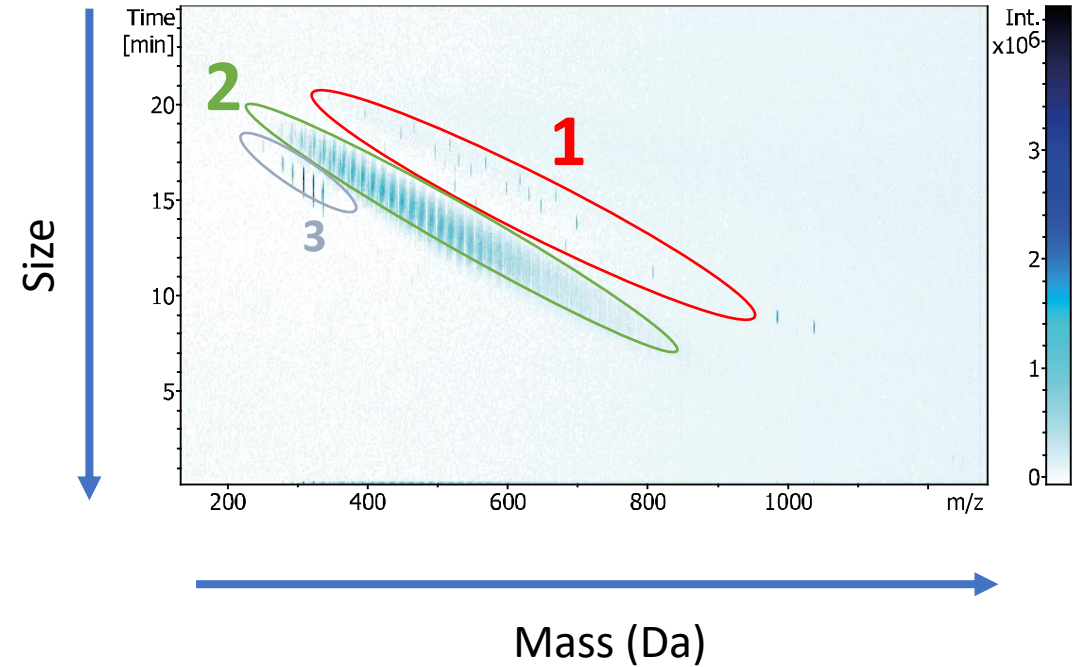


FTICR 18 T

**Targeted and no-targeted PFAS
on very complex mixtures**

Looking for industrial partners
for further studies

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Water river



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Brandan MAURICE
Anthony ROUSSEAU***



***Dr. Nicolas COUVRAT
Prof. Yohann CARTIGNY***



Prof. Jean JURASEK



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Dr. Lisa ROUVIERE
Léa MAURICE-PEROUMAL
Dr. Cécile BARBOT
Laetitia BAILLY
Emilie PETIT
Dr. Mélanie MIGNOT
Christine DEVOUGE-BOYER
Cassandra LESEURRE***