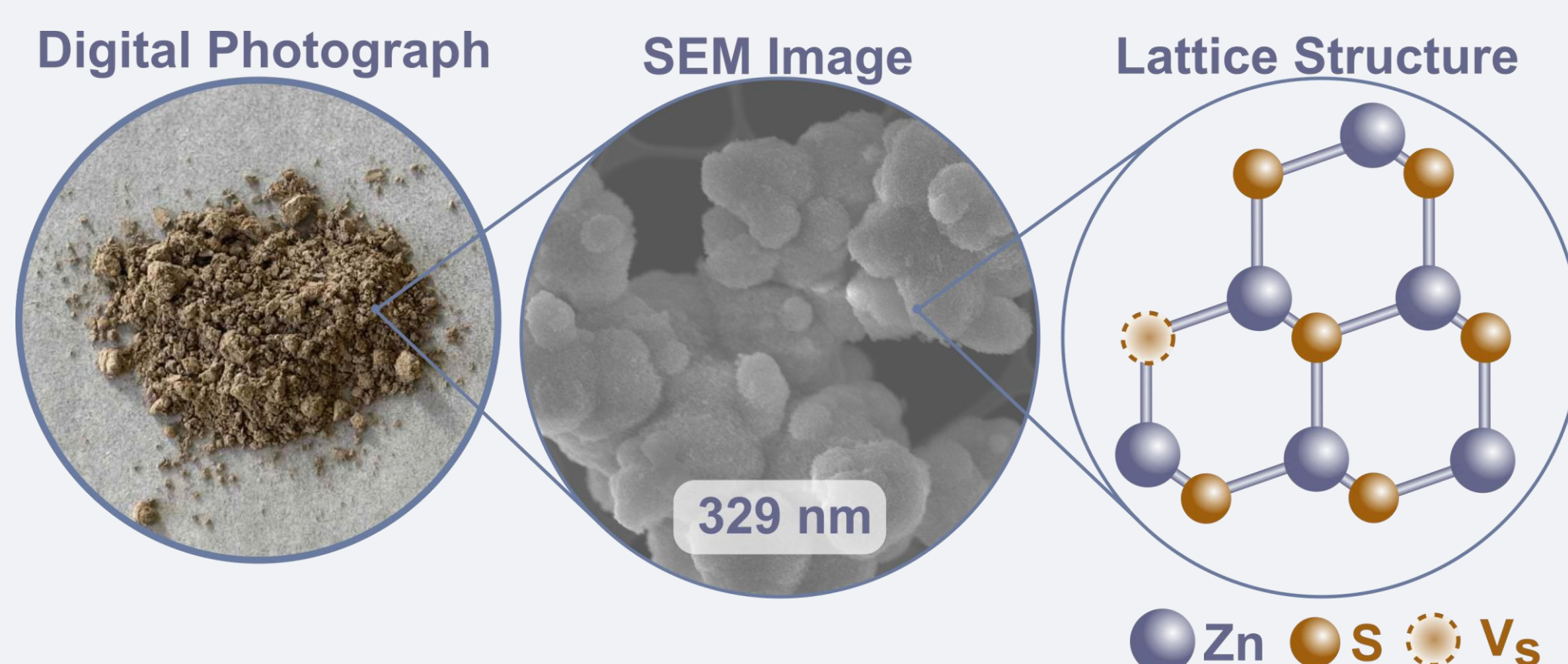


Taking the “forever” out of forever chemicals using zinc sulfide

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2. How are we going to break them down?



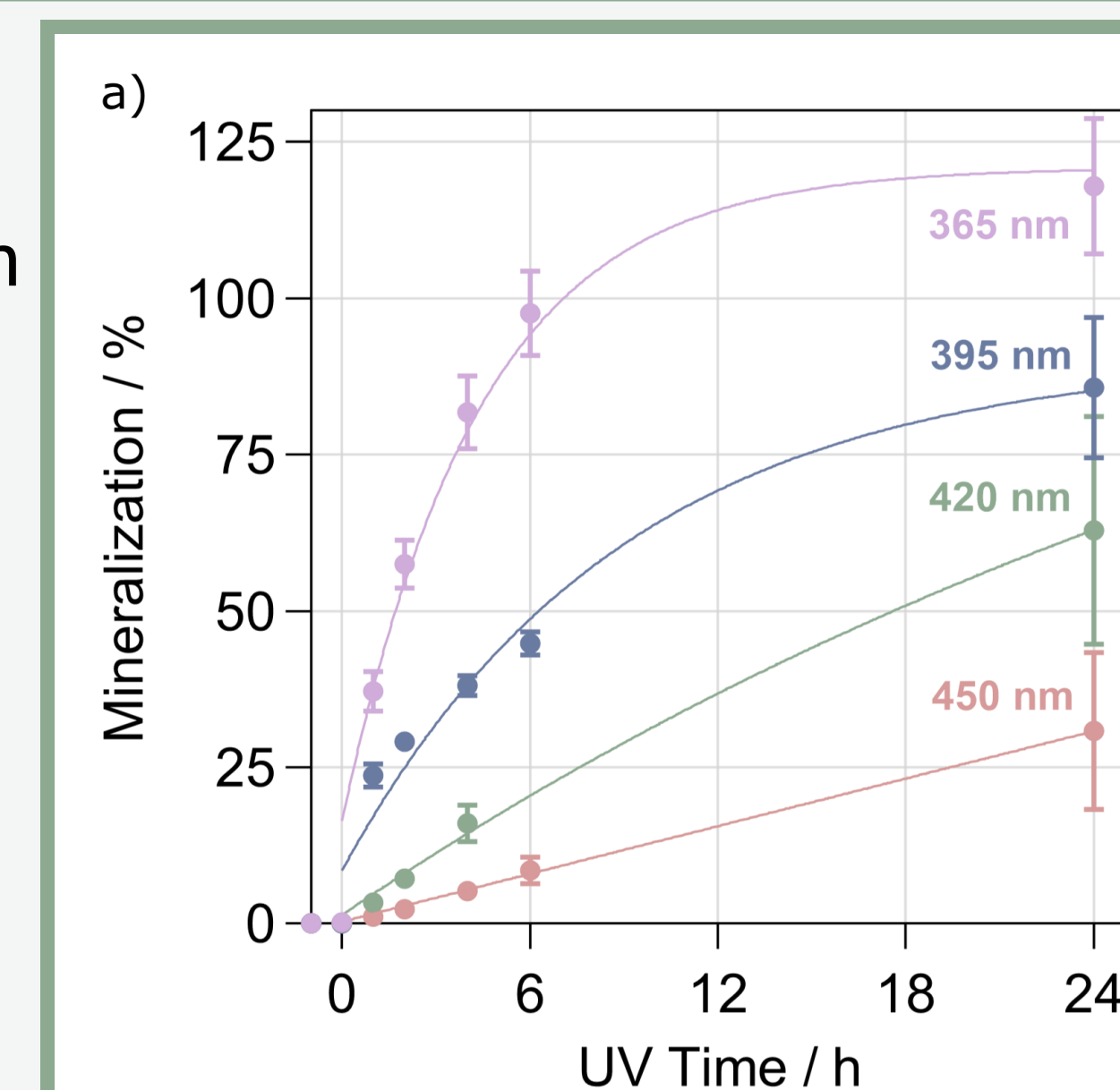
Sulfur vacancies in ZnS improve activity!

- There are currently no approved methods for PFAS destruction in Australia.
- Photocatalysis** is a light-driven process whereby the energy from light can drive chemical reactions- in this case, breaking C-F bonds in PFAS.
- My research utilises **zinc sulfide (ZnS)**, which is made from Earth-abundant, non-toxic, and cheap materials.

3. Can we use visible-light?

- Photocatalysis is generally limited to deep UV LEDs, which can be dangerous and energy intensive.
- The sulfur vacancies present in ZnS improve its **visible-light activity**.
- PFAS is mineralized using 365, 395, 420, and 450 nm. This is a promising step toward utilizing sunlight for photocatalysis!

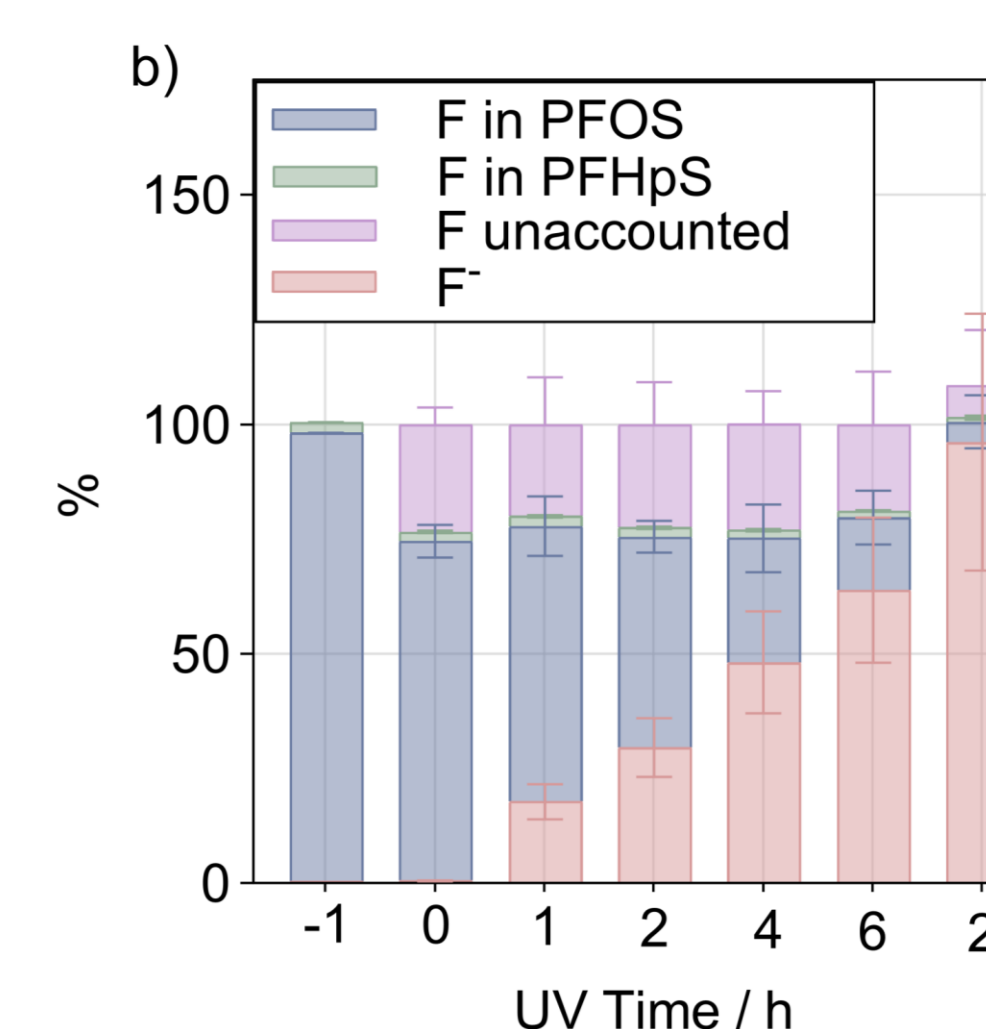
ZnS can degrade PFAS under visible-light!



4. How are the PFAS degrading?

- A fluorine mass balance allows us to monitor if we are generating toxic byproducts or breaking C-F bonds.

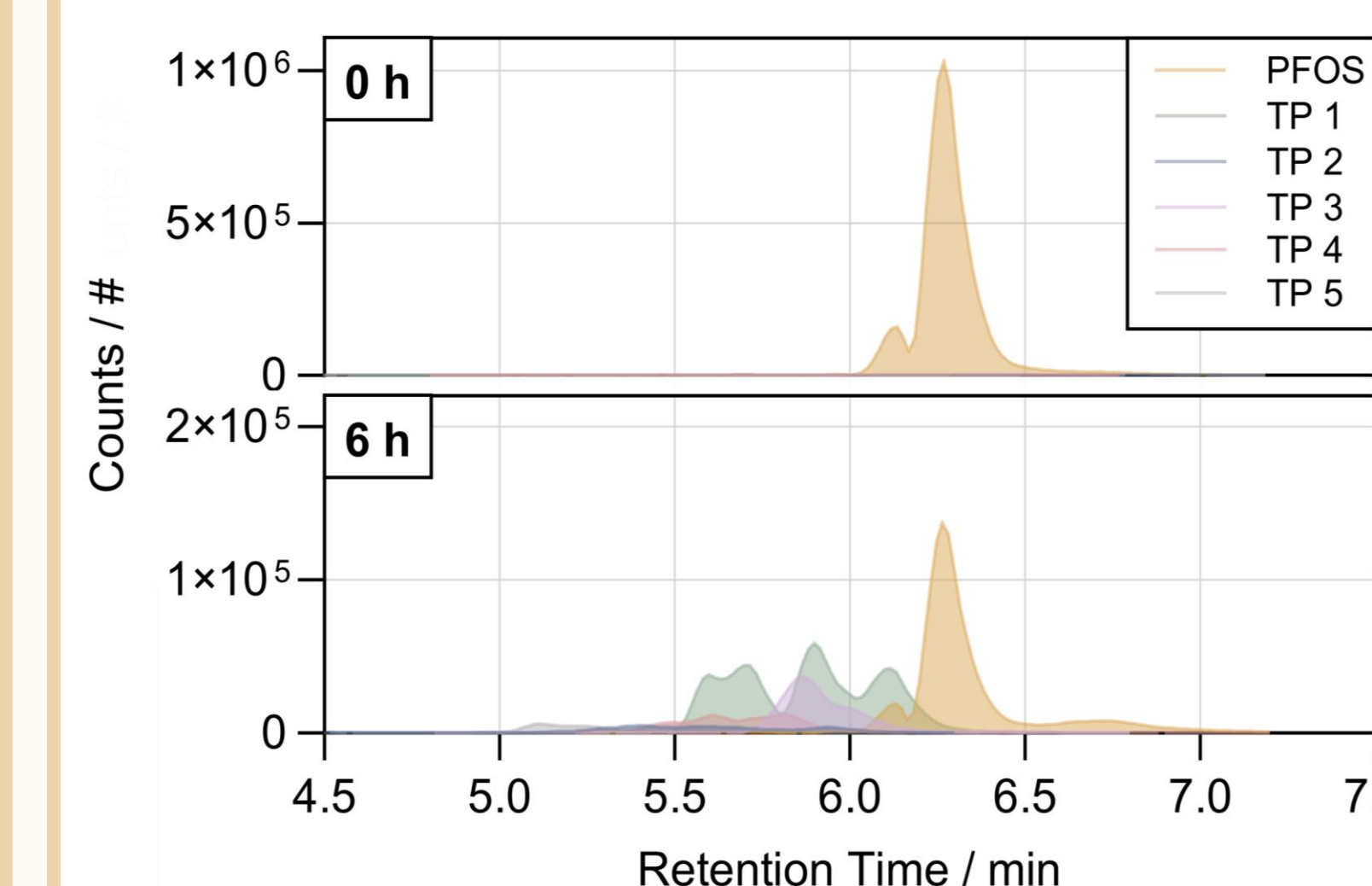
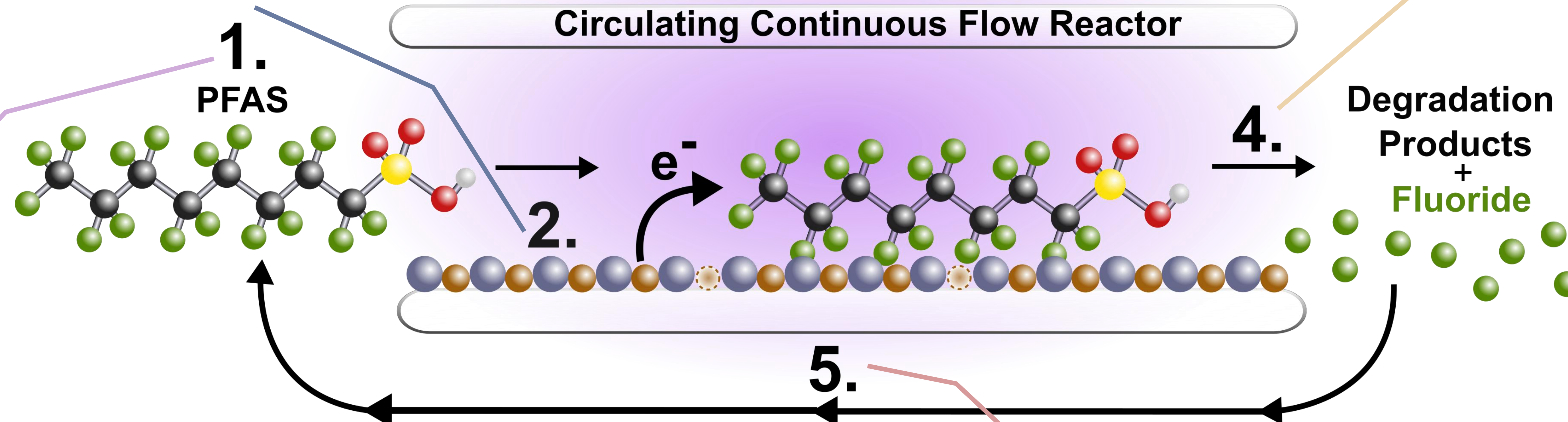
No shorter-chain PFAS produced!



High fluoride output!

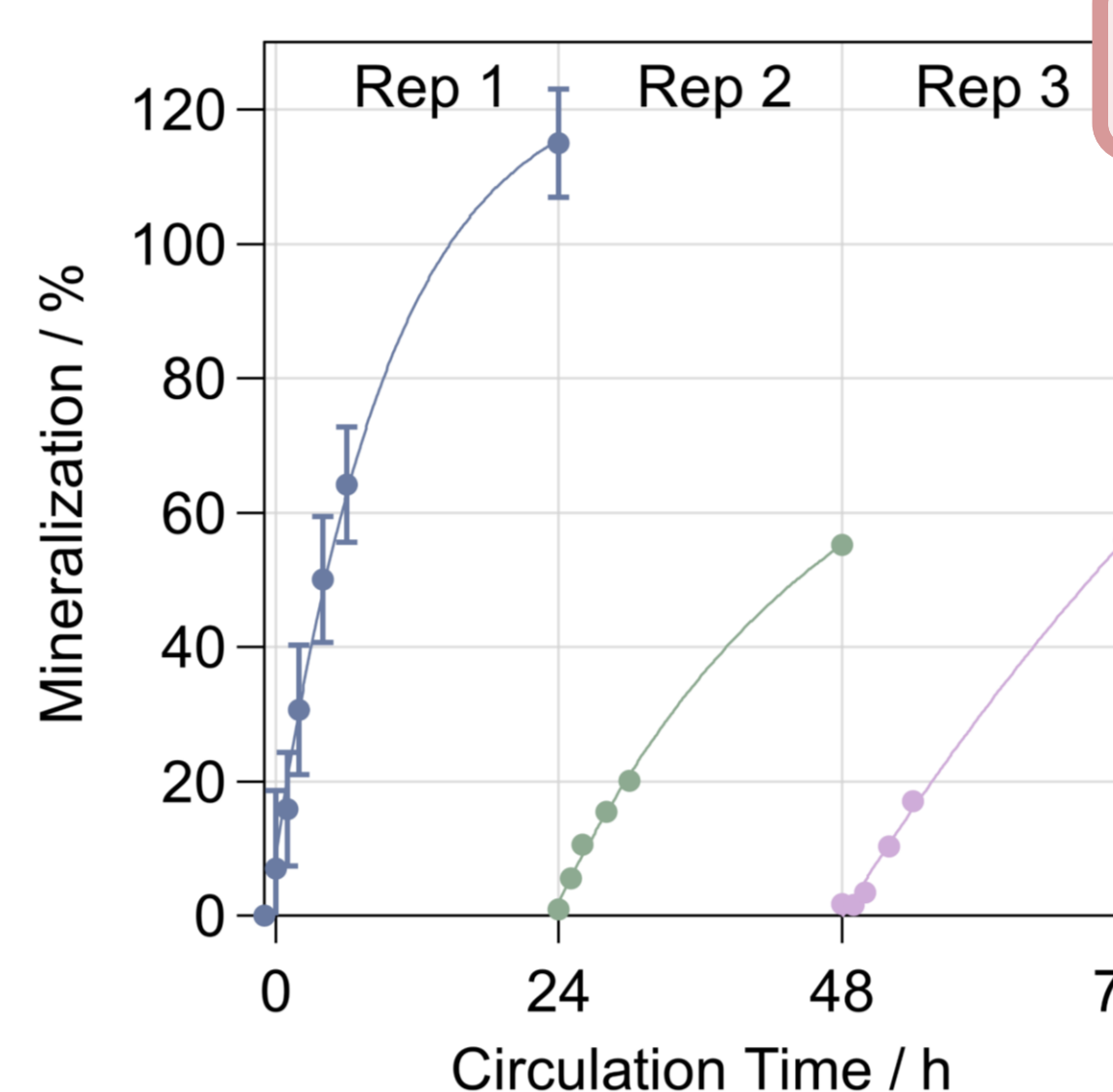
1. What are PFAS?

- Perfluoroalkyl substances (PFAS) are a group of synthetic chemicals
- They are present in everyday items and firefighting foams.
- PFAS are often called “**Forever Chemicals**” due to their environmental persistence, arising from the strength of the carbon-fluorine (C-F) bonds.
- PFAS have been linked to increased risk of cancer, diabetes, mutations, and lowered immune response.



- Direct e⁻ transfer from ZnS to the PFAS is responsible for C-F bond cleavage.
- LC-MS analysis identified degradation products (H/F substitution)

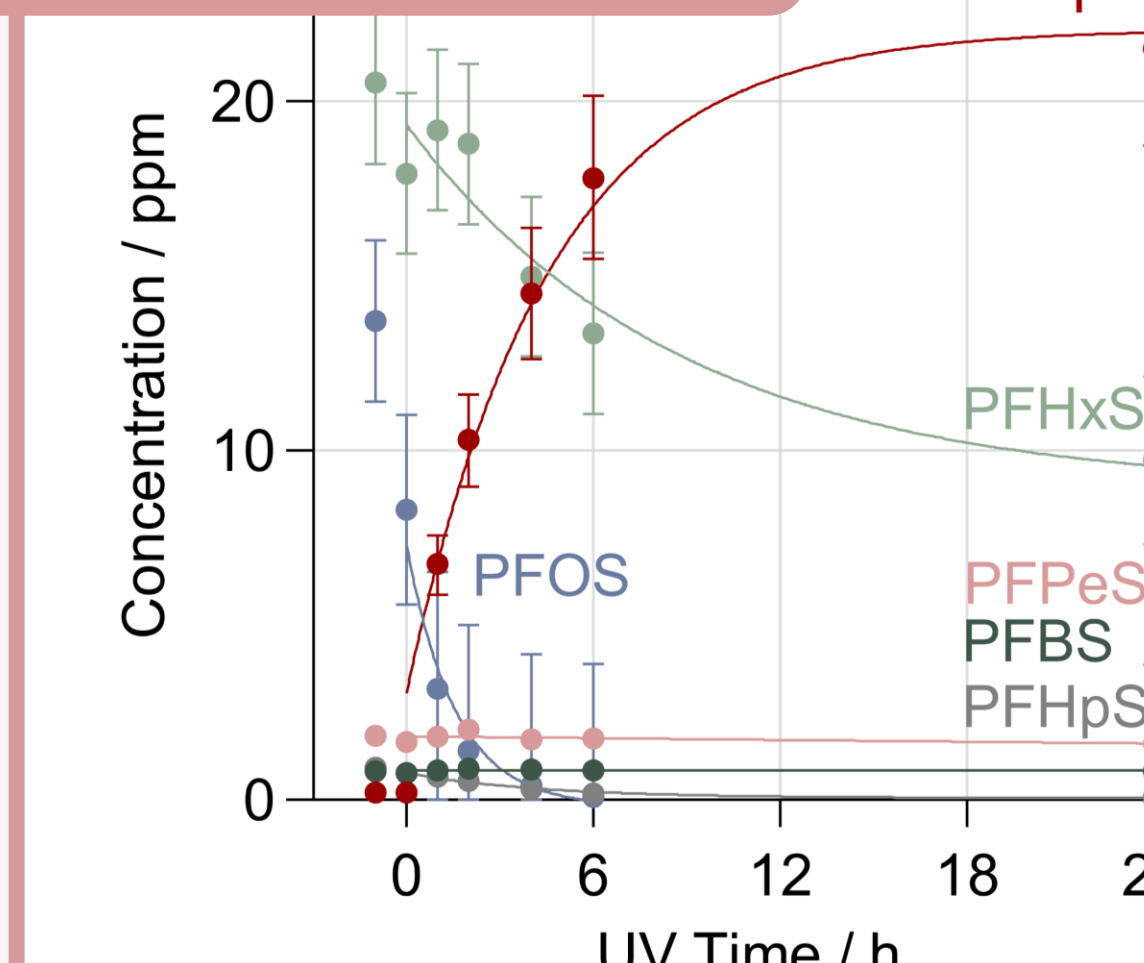
5. Is upscaling possible?



Activity in flow after 72 h!

- A circulating continuous flow reactor using ZnS films can treat larger volumes of PFAS-contaminated water.
- Within 24 h of continuous circulating flow, PFOS (50 ppm, 12mL) was completely mineralized into fluoride (ideal reaction outcome).
- Despite an initial decrease in performance after 24 h, activity was retained between 24 and 72 h of continuous flow.

66% mineralization of AFFF field sample!



- Aqueous film forming foams (AFFF) is a type of PFAS-containing firefighting foam.
- This AFFF-contaminated field sample was sourced from a contaminated water treatment plant in South Australia and subsequently isolated and concentrated.
- With increasing UV illumination time, we can see fluoride evolving and PFAS in the AFFF degrading.