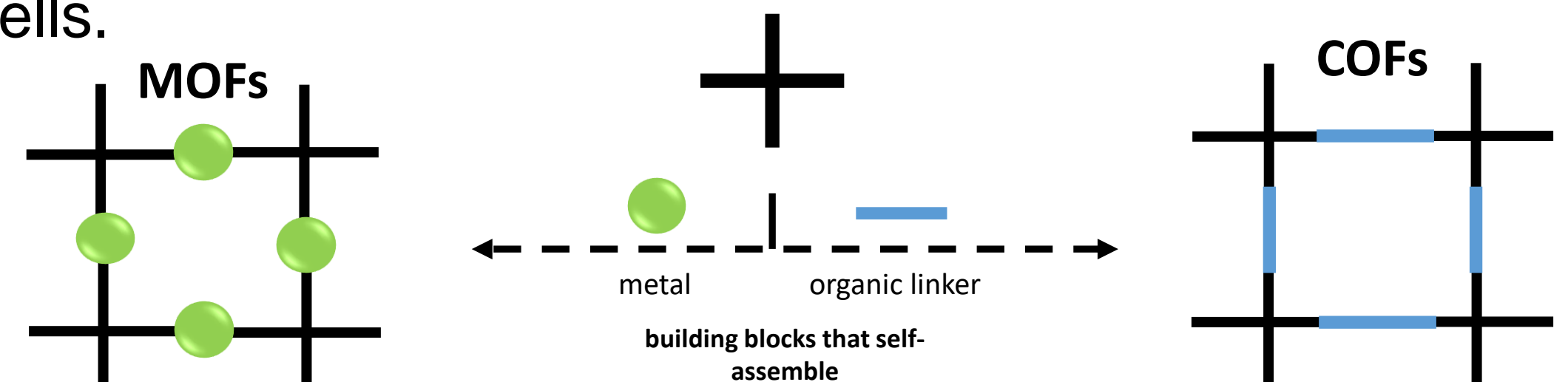
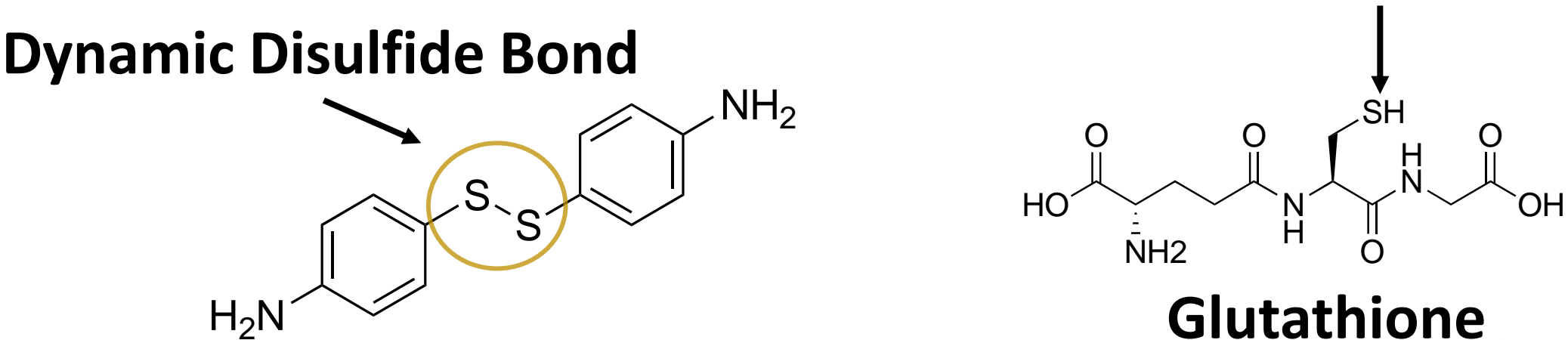


Frameworks For Drug Delivery

Cancer remains one of the leading causes of death worldwide, with an estimated 2 million new cases expected in the United States this year alone. Cancer involves the unchecked and rapid process of mitosis and cell division, which can lead to the formation of a tumor. Treatment options for cancer include chemotherapy, radiation, hormonal therapy, and surgery. While these treatments can be effective, they each come with limitations, such as their cost, their invasiveness, and their poor selectivity for tumor cells.



Metal and Covalent-Organic Frameworks (MOFs/COFs) both show promising potential for drug delivery applications. Along with their ability to self assemble, these complex crystalline nanocarriers made up of organic building blocks can be highly functionalized to respond to stimuli. This high tunability factor can be utilized for design of a drug delivery system with a selectivity for proteins found in cancer cells.



Our objective is to deliver chemotherapeutics with disulfide linked Covalent-Organic Frameworks to induce apoptosis in cancer cells.

Motivation and Rationale

The investigation of redox-responsive disulfide bonds as drug delivery systems has gained traction due to tumor-specific physiological triggers. Under oxidative conditions, these bonds can be broken by cellular free thiols such as glutathione (GSH), which is 100 to 1000 times more concentrated in cancer cells. The COF should degrade in these conditions without harming any healthy cells.

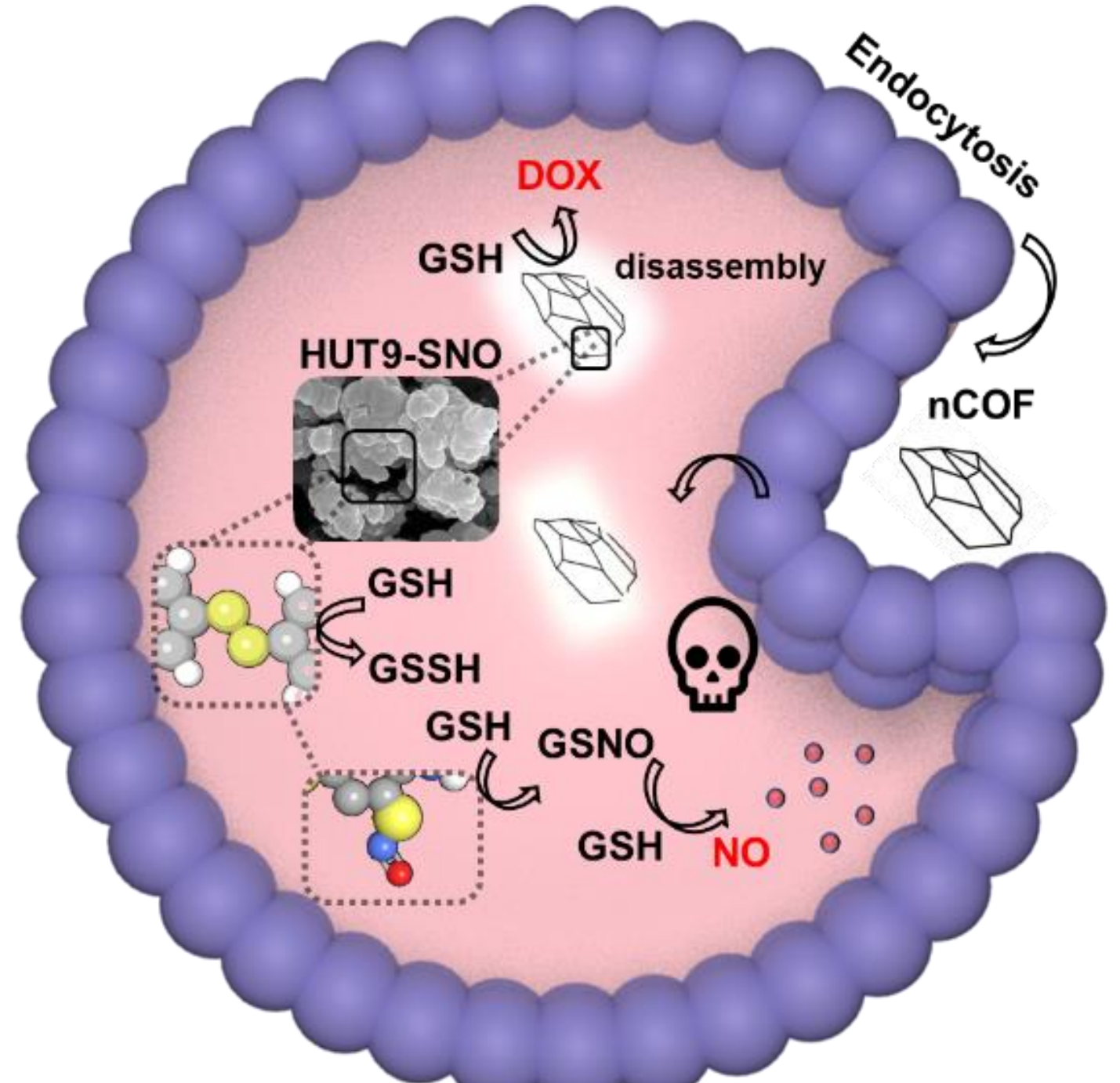


Figure 1. Endocytosis of nCOF to facilitate the release of chemotherapeutics doxorubicin (DOX) and reactive oxygen species (ROS)

Molecular Design

Glutathione-Sensitive Nanocarrier Covalent Organic Frameworks for the Synergistic Release of Chemotherapeutics

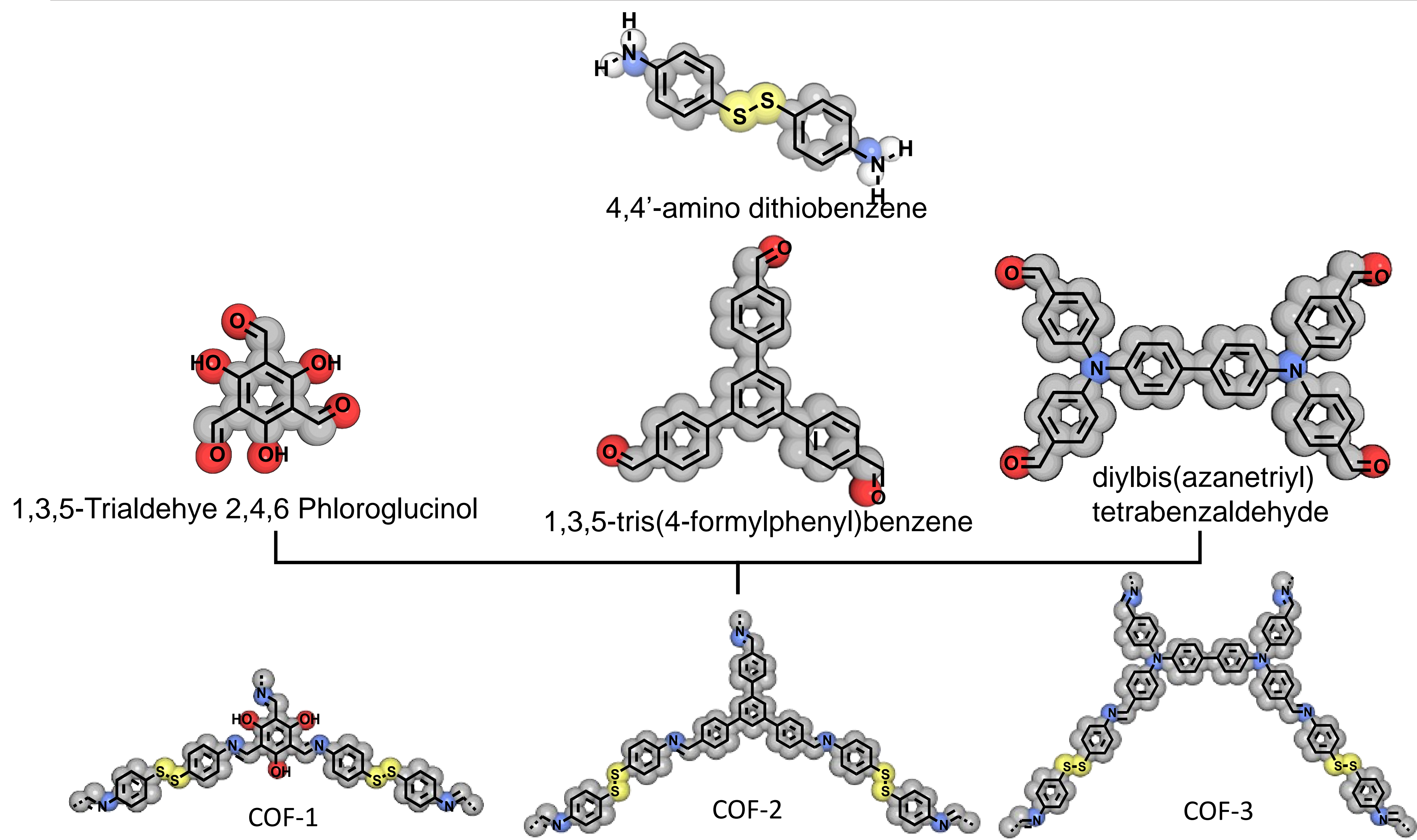
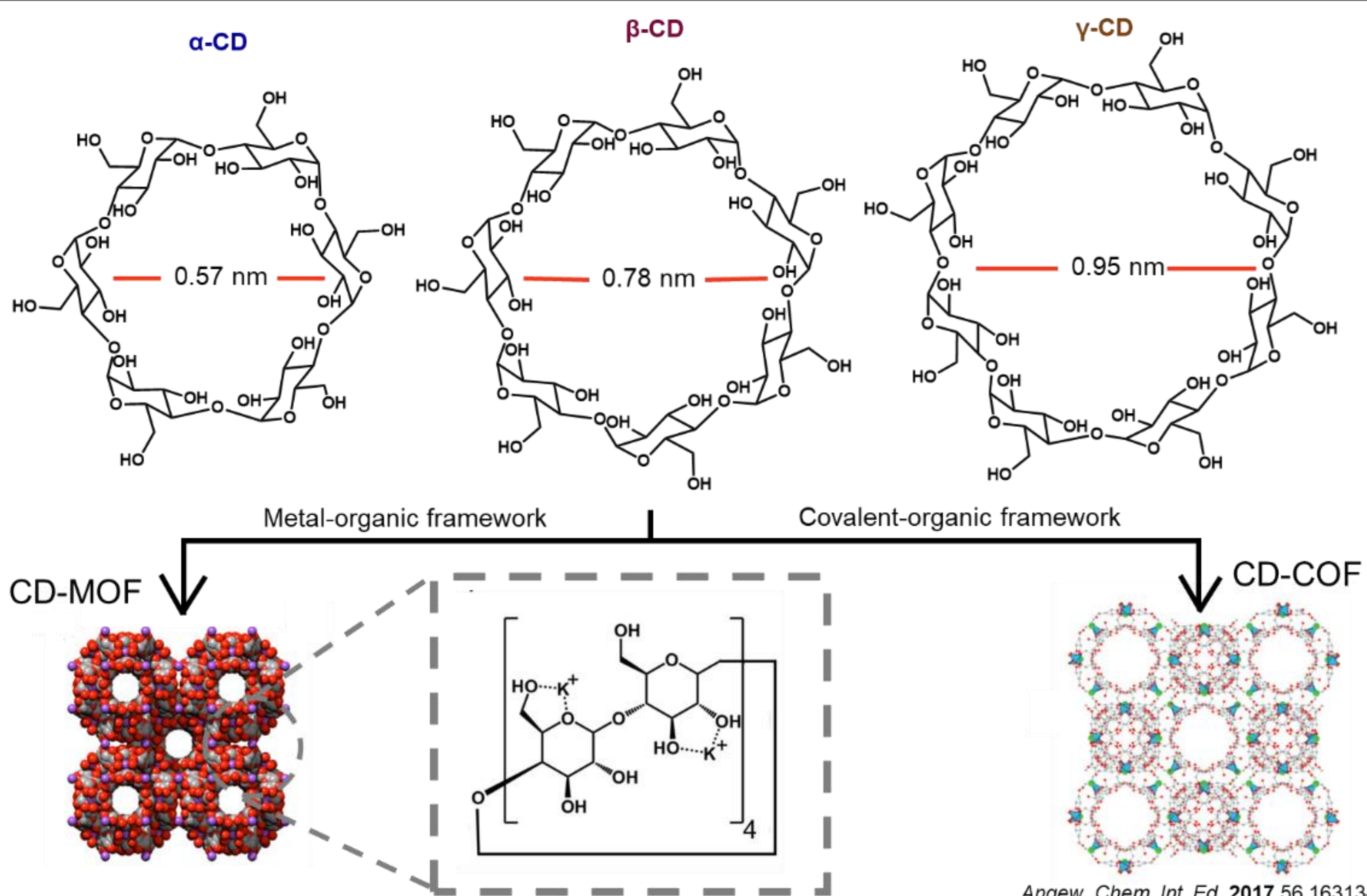


Figure 2. Synthetic scheme of disulfide-linked covalent organic frameworks using 4,4'-aminodithiobenzene and three aldehyde-based linkers.

Cyclodextrin-frameworks for PFAS Removal

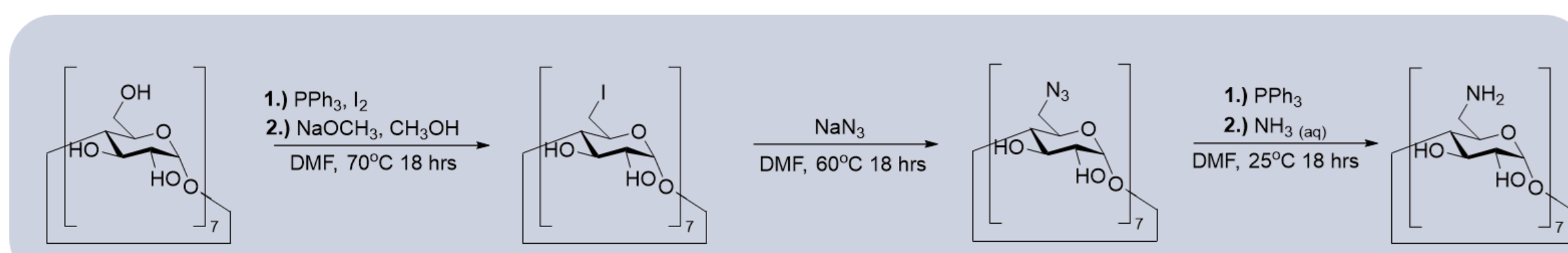


Acc. Chem. Res. 2021, 54, 6, 1440-1453

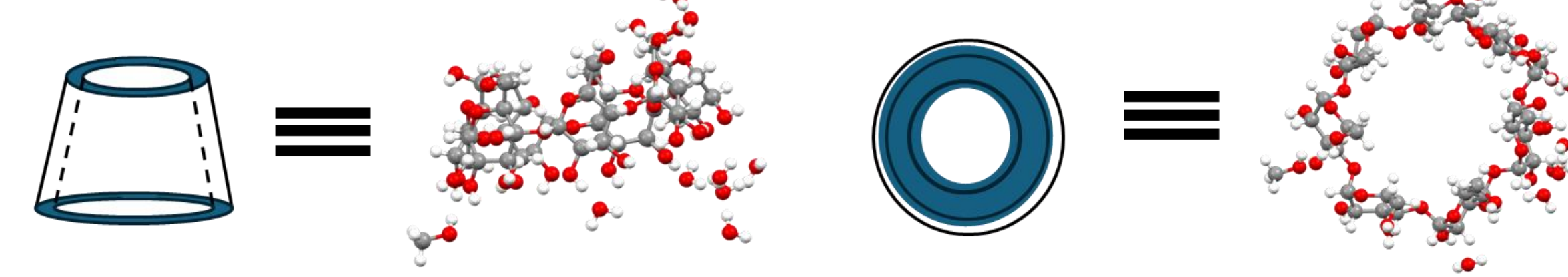
Angew. Chem. Int. Ed. 2017, 56, 16313-16317

Frameworks For Pollution Remediation

Polyfluoroalkyl substances (PFASs) are a class of organic compounds comprised of C-F bonds, and a hydrophilic head group. While used in many manufacturing processes, these compounds have been shown to pollute our water supply. Due to the strength of the C-F bond, filtration is the best form of remediation.



We hypothesize that the arrangement of functionalized cyclodextrins (CD's) into highly ordered frameworks will allow us to leverage the host-guest chemistry of CD, and more efficiently absorb PFASs from water.



*Crystal structure obtained from single crystal x-ray diffraction (SCXRD) performed at Brown
 Figure 3. CDs are macrocyclic sugar molecules composed of glucose monomers. Each macrocycle exhibits a hydrophilic exterior that circumscribes a hydrophobic void.

Motivation and Rationale

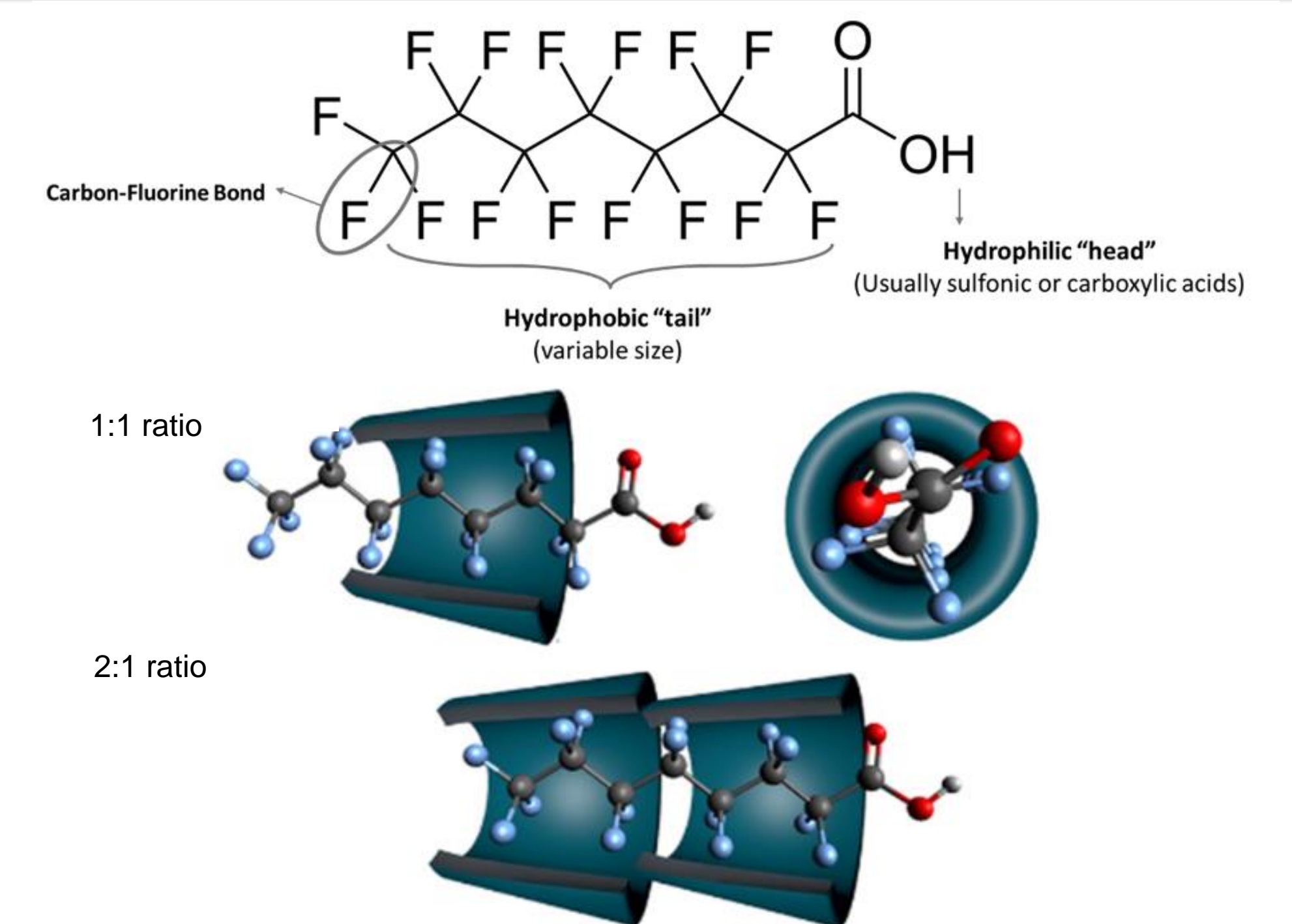
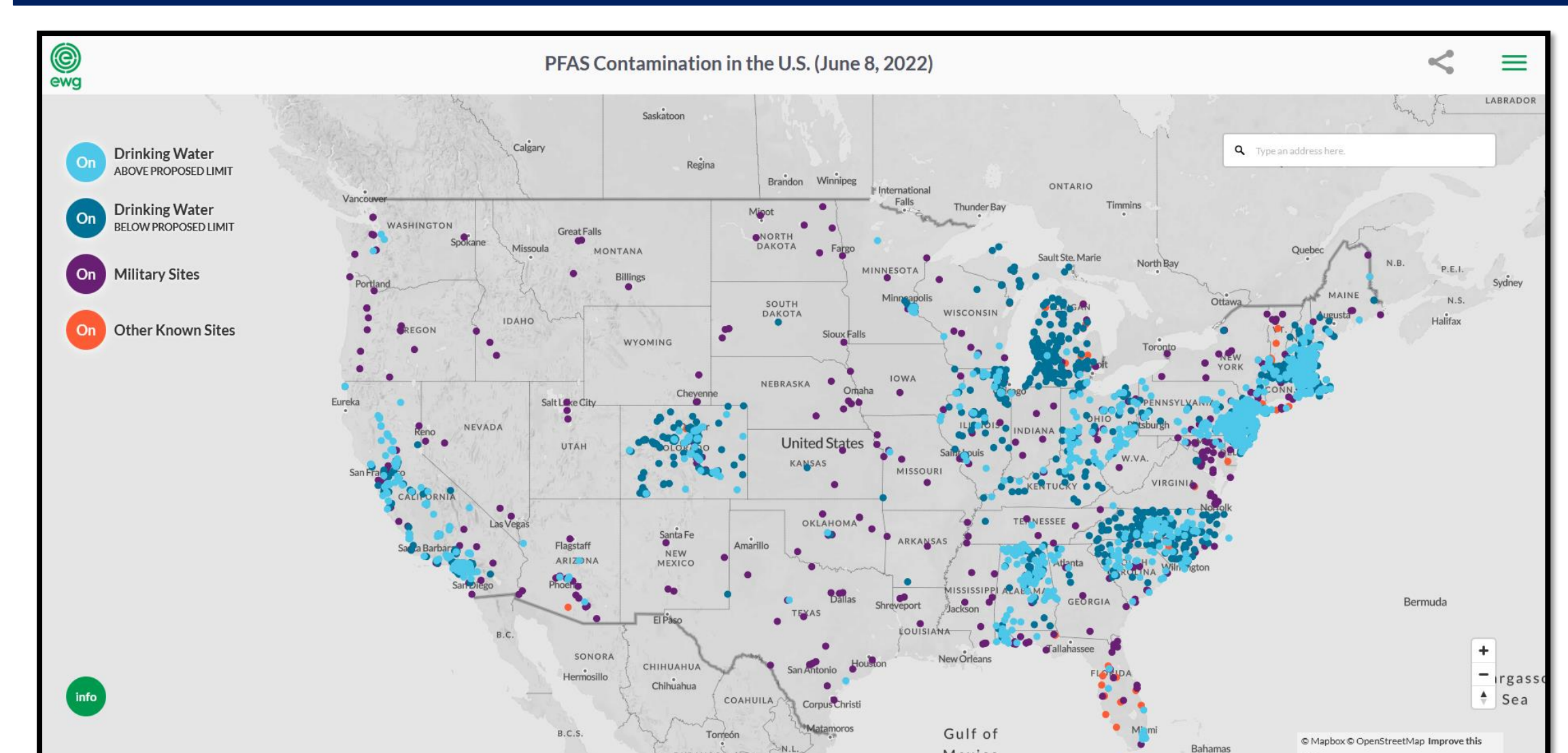


Figure 4. Each macrocycle exhibits a hydrophilic exterior that circumscribes a hydrophobic void. This unique structure-property enables the formation of effective host-guest complexes with PFAS.

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