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PHOTOCLEAN- Functionalized porous organic cages for adsorption and photodegradation of per- and polyfluoroalkyl substances (PFAS)

Increasing energy consumption, depletion of natural resources, and environmental pollution are nowadays among the biggest economic and social challenges. Per- and polyfluoroalkyl substances (PFAS), also known as forever chemicals, are persistent emerging pollutants not naturally degraded in the environment. PFAS are anthropogenic compounds with harmful health effects, inert and resistant to heat, and nowadays found in water, air, and soil, thus posing a heavy impact on our environment. Adsorption on activated carbon, ion-exchange resins, cyclodextrins, and nanofiltration are the methods currently used or under study for PFAS removal from water. However, critical gaps, such as the adsorbent regeneration, affinity, production of secondary waste, analytical method limitations, and efficient PFAS degradation pathways are major challenges. PhotoClean aims to synthesize novel palladium functionalized, solvent-responsive nanocage adsorbents able to remove PFAS from water. The nanocages will promote rapid PFAS photodegradation, being excited by visible-light to a photoexcited state able to interact with PFAS through a single electron transfer. Depending on the energy of the photoexcited state, PFAS decomposition is expected to be initiated either through oxidative or reductive events and be sustained by the formation of radicals. The new approach proposed by PhotoClean is based on the development of reusable adsorbent cages and the exploitation of visible-light as the energy source to activate PFAS decomposition; it thus constitutes an environmentally sustainable strategy for PFAS removal and degradation. The project will contribute to understand fundamental structure-property relationships of PFAS adsorption on nanoporous organic cages and integrate photodegradation of PFAS with catalytic activity. The action has the potential to revolutionize methods for PFAS removal from water and tackles a variety of scientific and societal challenges of environmental importance.

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