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The omnipresence of per- and polyfluoroalkyl substances (PFAS) in natural and engineered environments has led to today's overwhelming environmental and public health crisis. Although PFAS are not the first class of synthetic organic contaminants, we know little about their environmental fate and transport, and they have unique characteristics that make them much more complicated than ordinary pollutants.[1] First, PFAS are persistent enough to endure typical natural attenuation pathways such as UV oxidation, hydrolysis, or biodegradation.[2,3] Second, the compounds are found at low levels (i.e., ng/L or ng/kg) where engineered mitigation options such as remediation or treatment become costly and tedious. Third, the compounds are detected as mixtures where a certain chemical character may not necessarily be exploited for mitigation. In other words, efficient thermal or chemical degradation of perfluoroalkyl carboxylic acids may not necessarily degrade perfluoroalkyl sulfonic acids. Last, the environmental policy and toxicity aspects of the chemical class are still underway with progressive vigor.[4] As a consequence, studying various aspects of the PFAS crisis is timely and imperative. Analytical detection via mass spectrometry, implications of interfacial interactions sensing in complex matrices, treatment and remediation, monitoring, designing healthier industrial ecosystems, pollution prevention, identifying chemical alternatives, conducting epidemiological studies, training workforce, accomplishing public communication, preventing social injustice for PFAS exposure, and performing policy studies are only a short list of areas that require immediate attention. Therefore, this special collection addresses timely and critical topics that require further attention from the scientific community.

The special collection contains five articles in the areas of (i) PFAS-laden wastewater sludge management, (ii) PFAS-free fibers as chemical alternatives, (iii) PFAS plant uptake as a driver for decision-making for agricultural land management, (iv) PFAS self-assembly on surfaces for industrial applications, and (v) PFAS contamination of compost by "compostable plasticware." The wider array of topics cover aspects of PFAS from cradle to grave where the compound class is evaluated from production to final disposal. The polycrystalline gold surface coating with PFAS and the changes in molecular structure and chemistry are analytically evaluated for various chain lengths of perfluorinated molecules. The orientation of PFAS was dependent on the chain length where the longest molecule tested produced a well-ordered self-assembled monolayer.[5] These efforts complement the understanding of molecular attachment stability of widely applied PFAS on surfaces for industrial applications as well as commercial uses. This understanding is crucial due to the potential for PFAS-laden materials to leach from surfaces over their lifetime, leading to contamination of the surrounding environment. One such example is the release of PFAS from food serviceware labeled as "compostable" during composting.[6] The article highlights the detection of 12–13 different PFAS at higher levels (i.e., 20–45 times) than only food waste composted with grass clippings or manure. This example of PFAS release from one product and contaminating the compost tells a similar tale of cascading catastrophic results as the spread of PFAS-laden biosolids and contaminating the agricultural sites in rural Maine. Although sludge spreading is now banned in Maine, the historical application of PFAS-laden biosolids (i.e., excess wastewater treatment sludge) led to an increase in background levels of PFAS in soil, groundwater, crops, animals, dairy products, and even farmers' blood.[7] The article discusses the long-term consequences of PFAS-laden biosolid spreading onto farmland and explains advantages and drawbacks of possible alternatives that are currently viable (such as landfilling and incineration of waste) as well as the future alternatives for immobilization, destruction, or encapsulation of PFAS-laden waste. Once spread onto farmland,

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the native or planted crops will cause the entrance of PFAS into the food chain and increase the damage caused to human health. However, there is no blanket conclusion that can be drawn for PFAS uptake by plants.[8] The PFAS mobility in soil, their bioavailability, and retention in different parts of the plants (e.g., roots, leaves, or fruits) depend on PFAS chain length, functional groups, and their intermolecular interactions between plant tissues/soil particles and PFAS molecules. This complex model has been previously studied to conclude that leaves and roots may retain more PFAS based on a limited number of species tested. A rigorous and systematic evaluation is needed to make conclusive statements, but the information gathered for PFAS uptake by plants can help make decisions regarding agricultural land management. Considering the complex lifecycle of PFAS and its cascading implications, it is evident that mitigation and management are at the forefront, but it is also of utmost importance to eliminate or minimize its use altogether. For this, the efforts for replacing PFAS-laden food packaging with equivalent or better performing, PFAS-free, water and oil-repelling molded-fibers present an excellent opportunity.[9] The convenience and longevity of PFAS-coated packaging is undeniable but accomplishing the same performance without the penalty of PFAS pollution is an idealistic goal. This practice also paves the way for discovering other chemical alternatives such as PFAS-free foams and several other commercial and industrial materials.

The holistic approach for sustainable PFAS mitigation starts from its synthesis and captures its sustainable applications and proper ultimate disposal. This special issue covers many of these important and timely topics. We hope you enjoy the article collection and get inspiration for other needed research efforts relevant to this contemporary environmental crisis.

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