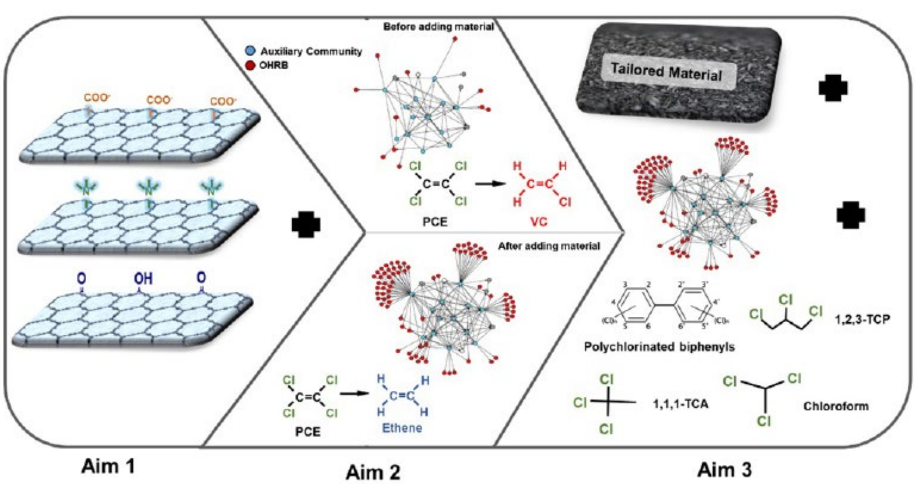
THE UNIVERSITY OF IOWA

Grant Information: Institution, Principal Investigator(s), Contact Information, Grant Number	**University of Iowa** **Project:** Elucidating Mechanisms for Enhanced Anaerobic Bioremediation in the Presence of Carbonaceous Materials Using an Integrated Material Science and Molecular Microbial Ecology Approach **Grant Number:** R01ES032671 **Project Leader:** Timothy E. Mattes **Email:** tim-mattes@uiowa.edu **Co-Investigator:** Wenqing Xu (Villanova University) **Funding Period:** 2021-2025
Technology	An emerging remediation strategy involving amendment of pyrogenic carbonaceous matter (PCM), such as activated carbon, to the subsurface could promote synergistic interactions among OHRB and the auxiliary microbial community and subsequently improve OHRB-driven bioremediation efficacy. Elucidating positive impacts between PCM and OHRB will allow for the development of tailored PCM that offers a potential solution to problems with organohalide respiring bacteria (OHRB)-driven bioremediation.
Innovation	**Materials: What novel materials are you developing?** We aim to develop tailored pyrogenic carbonaceous matter (PCM) with the aid of a tunable PCM-like polymer synthesis platform where material properties can be varied individually. **Biological: What is the biological component?** Organohalide-respiring bacteria (OHRB) and the supporting anaerobic microbial community. **Why is this technology/approach different than what is already in the market?** Colloidal activated carbon (CAC) is already available for injection into contaminated groundwater. However, the purpose of CAC is to sorb organic pollutants, such as chlorinated ethenes. The purpose of tailored PCM will be to promote/enhance bioremediation while providing the potential to sorb organic pollutants that inhibit OHRB.
Contaminant and Media	**Contaminants: What contaminant(s) does your project target?** Chlorinated ethenes **Media:** ***(e.g., groundwater, drinking water, soil, sediment)*** Contaminated groundwater, soil, and sediment

Continued

Expansion Potential	**Looking Forward: What other contaminants/media would work for your technology?** Our potential technology could be useful for bioremediation of other organic pollutants in groundwater and sediments, such as chlorinated ethanes and PCBs, and possibly emerging contaminants, such as chlorinated propanes. **Combined Remedy: Would this technology work well with other treatment approaches?** We expect that a tailored PCM amendment strategy would be compatible with other groundwater treatment approaches such as in-situ bioremediation.
Sites/Samples	We are not yet working on any sites or using real-world samples. We expect to begin working with environmental samples in the last year or two of this project.
Technology Readiness Level	TRL 2 — Technology concept formulated
Update of Progress	Tetrachloroethene (PCE), a halogenated pollutant commonly found at Superfund sites, can be detoxified (i.e., converted to ethene) by stimulating or adding specialized anaerobic dechlorinating microorganisms to contaminated groundwater. However, anaerobic dechlorinators sometimes have problems fully converting PCE to ethene, accumulating the lesser chlorinated products cis-dichloroethene (cDCE) and vinyl chloride. Pyrogenic carbonaceous materials (PCM) have promising applications in pollution remediation, including enhanced chlorinated ethene bioremediation processes at contaminated sites. Experiments were performed with a commercially available PCE-dechlorinating consortium experiencing "cDCE-stall" (i.e., converted PCE to cDCE and stopped). However, adding PCM (granular poplar biochar) to the stalled consortium stimulated complete dechlorination of PCE to ethene. Microbial community analyses showed that methane-producing and cDCE-dechlorinating microbes colonized the biochar surface. These findings are significant because a PCM amendment strategy during bioremediation could enhance important microbial interactions that ultimately improve bioremediation outcomes for chlorinated pollutants commonly found at Superfund sites.



Technology development begins with a tunable platform for synthesizing PCM-like polymers where PCM surface properties can be varied individually (Aim 1). The effects of PCM surface properties on microbial interaction networks and subsequent performance of an organohalide-respiring mixed culture will be quantified (Aim 2). Tailored PCM for enhanced anaerobic bioremediation and contaminant mixture retention will be developed and its performance validated in microcosms (Aim 3).