ABSTRACT: Research conducted at the University of Southern California, Montana State University, and now at Rensselaer Polytechnic Institute in Troy, New York, embraces controlled cultivation approaches for controlling and optimizing the production and activity of extracellular conductive protein filaments called ‘bacterial nanowires’ by diverse groups of microorganisms. The objective of our collaborative project is to evaluate the contribution of conductive bacterial nanowires on the fate and transport of uranium and chromium in contaminated subsurface systems.

During the past 2 years, we have developed and applied controlled-cultivation techniques for optimizing the production of conductive bacterial nanowires by 2 organisms isolated from contaminated sediments within the DOE National Lab complex. *Geobacter daltonii* FRC32 is an iron(III) and uranium(VI)-reducing bacterium isolated from uranium-contaminated subsurface sediments at the DOE ORFRC. *Desulfovibrio vulgaris* RCH-1 is a sulfate-reducing bacterium that was isolated from chromium-contaminated groundwater at the 100H Hanford Site. Both organisms produced branched extracellular appendages in response to electron acceptor limited conditions, with ferric nitrilotriacetic acid (Fe(III)-NTA) provided as electron acceptor for *G. daltonii* FRC32 and sulfate provided for *D. vulgaris* RCH-1 in chemostat and biofilm reactors, respectively. Amending the medium with amino acids to support the production of protein increased the production of extracellular filaments under electron acceptor limitation. Branched appendages from *G. daltonii* FRC32 were confirmed to be electrically conductive nanowires using conductive atomic force microscopy. Attempts to evaluate the conductive properties of *D. vulgaris* RCH-1 are ongoing.

The influence of *G. daltonii* FRC32 and *D. vulgaris* RCH-1 on fate and transport of uranium and chromium will be evaluated using 2D-flow columns designed and manufactured at RPI. Conditions within these flow columns will be manipulated to control the production of bacterial nanowires and other components of the extracellular polymeric matrix. Information gained from this research will be used to better understand the biogeochemical processes that influence contaminant transport at Hanford and the Oak Ridge Integrated Field Research Center. Understanding the components and mechanisms of charge transfer to extracellular electron acceptors by this and other environmentally-relevant organisms is an important step in realizing their full potential as tools for remediation of contaminated subsurface systems.