Toward High Resolution Chemical Imaging to Characterize Microbial Biofilms: Integration of Synchrotron IR Imaging

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The objective of this research is to apply state-of-the-science synchrotron-based infrared (IR) imaging at the InfraRed ENvironmental Imaging (IRENI) beamline in combination with select electron microscopy capabilities and synchrotron-based X-ray analysis for the enhanced visualization, compositional analysis, and functional characterization of microbial biofilms as they influence biogeochemical processes. We intend to use synchrotron IR imaging to rapidly detect changes within biofilm composition with biologically-relevant spatial resolution and to deliver morphological and chemical information from microbial biofilms without the need for stains or labels. The nondestructive nature of synchrotron IR analysis will facilitate direct comparative analysis, such as, high-resolution EM imaging or X-ray microscopy to produce element-specific chemical distributions. This proposed research will investigate the fundamental question of extracellular electron transfer (ET) in biofilms of dissimilatory metal-reducing bacteria. This research will lead to a better mechanistic understanding of how biofilms catalyze geochemical reactions (*e.g.*, redox, complexation) that significantly influence microscale chemical speciation and mineral formation/dissolution, and thus influence biogeochemical processes central to the Department of Energy's (DOE) science missions. The correlated use of these capabilities will provide detailed, high-resolution visualizations and compositional data of biofilms as they influence local biogeochemical reactions in their environment.