

Studying exoelectrogen biofilm formation, structure and composition: An integrated approach

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Exoelectrogens are bacteria capable of reducing insoluble electron acceptors. The biofilms they build at insoluble metal oxides and electrodes are important for biogeochemical cycles and for microbial electrochemical technologies. While our understanding of extracellular electron transfer in the biofilm has improved, much remains to be elucidated, such as: biofilm formation, structure and composition, as well as metabolic cascades in the biofilm. To answer some of these questions, we have created a trans-disciplinary collaboration, employing methods from electrochemistry, microbiology, and theoretical physics.

Confocal Raman Microscopy, a non-destructive method, allows 3D imaging of chemical composition and redox states in electroactive biofilms connected to electrochemical circuitry. SEM-EDX, Helium Ion Microscopy, FISH-CARD and Stable Isotope Mass Spectrometry provide structural imaging, elemental analysis, species identification and isotopic analysis. Physical models serve to qualitatively and quantitatively explain and predict observations made at various stages of bacterial aggregation and biofilm formation. This combination of *in-vivo*, *in-situ* and *in-silico* methods will result in a new integrated approach for electroactive biofilm research, yielding unprecedented insight into these little-understood systems, whose role in nutrient cycling in nature and in microbial electrotechnologies is only beginning to unveil.