Curriculum Vitae

James A. Behan is an Irish-born researcher currently working with the Centre National de la Recherche Scientifique (CNRS) at the Institut des Sciences Chimiques de Rennes. He completed his PhD in electrochemistry at Trinity College Dublin in 2019 followed by a post-doc in bio-nanoscience at University College Dublin in 2020-2022 and a Marie Skłodowska-Curie fellowship in Rennes (2022-2023) which focused on interactions of electroactive bacteria with nanomaterials. His current research focuses on diverse applications of electroactive biofilms for energy and environmental applications.

Webinar Abstract: *Environmental and depollution applications of electroactive bacteria: from denitrification to iron bioremediation*

Electroactive bacteria are known for their capacity to donate or accept electrons from solid electron acceptors and donors. This unique metabolism is perhaps best-known in microbial fuel cell systems where bacteria such as those of the *Geobacter* genus transfer electrons derived from the oxidation of organic matter to bioanodes for electricity production and wastewater depollution. Electroactive bacteria developed this capacity in anaerobic environments such as soils and sediments rich in metal oxides of iron which served as extracellular solid electron acceptors, giving these bacteria an important role in the Fe cycle. The role of electroactive bacteria in cathodic processes including the bioelectrochemical reduction of nitrate are also of research interest due to the environmental impact of nitrate pollution from intensive agriculture.

In this webinar we discuss the results of recent and ongoing investigations of electroactive bacteria focused on environmental and depollution applications. We present a fundamental assessment of the role of Fe(III) oxides in modulating the charge transfer properties of organic matter-oxidising bioanodes developed using mixed communities of electroactive bacteria, including a previously unknown electroactive species of *Pelobacter* identified via 16S rRNA sequencing. Using a variety of field-sampled paleomarine sediments as the inoculum we also demonstrate the development of natural communities of exo-electrogens from iron-rich minerals, correlating bioanode catalytic performance and iron sediment transformation to the biofilm composition.

In a separate study we investigated the development of nitrate-reducing biocathodes using artificial wetland inoculum under negative polarisation. We developed oxygen-reducing biofilms rich in *Pseudomonas* which were capable of rapid nitrate reduction under polarisation, despite the absence of any direct electrocatalytic nitrate reduction in voltammetry studies. This result leads to a possible syntrophic, 'electro-assisted' mechanism whereby O_2 reduction by electroactive bacteria leads to local anoxia in the biofilm, promoting denitrification by non-electricigens in the mixed community.

Our results have implications for practical biofuel cell development, iron cycling and denitrification in natural environments.

References

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