The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

PROJECT TITLE	**INVESTIGATING THE CAPACITY FOR EXTRACELLULAR ELECTRON TRANSFER IN PSYCHROPHILIC MICROORGANISMS ISOLATED FROM ANTARCTICA**
PROJECT CODE	**UQIDAR 00173**
PROJECT DESCRIPTION	Electrochemically-active microorganisms are capable of exchanging electrons with solid conductive surfaces, such as metal oxides in nature and electrodes in the laboratory. This phenomenon, termed extracellular electron transfer, results in microbially-derived electricity in the form of an extracellular current. Such microorganisms are the foundation of electromicrobiology; an interdisciplinary field at the nexus of microbiology, electrochemistry, materials science and engineering. Electrochemically-active microorganisms have been found in diverse regions (1) and are considered to have functionalities not yet completely understood (2). Nonetheless, the diversity and metabolic limits of such microorganisms is not fully elucidated, as work has primarily focused on mesophilic inocula such as waste water, with comparatively few studies exploring extreme natural environments (3). In this study, sediment samples from Marian Cove, Cardozo Cove and Coppermine island, Antarctica will be subjected to electrochemical enrichment in order to select for psychrophiles that are capable of extracellular electron transfer. Due to the unique selective pressure offered by low temperature, it is possible that alternative mechanisms of extracellular electron transfer have evolved compared with those found in mesophiles. Consequently, novel isolates will be recovered and grown in pure culture in order to investigate their electroactivity using techniques including voltammetry, chronoamperometry and electrochemical impedance spectroscopy. These electroanalytical methods will be complemented by molecular biology techniques to identifying the genetic basis for electroactive behavior in low temperature. The findings will increase fundamental understanding of extracellular electron transfer and have the potential to identify strains useful in bioelectrochemical systems, particularly for use in powering remote sensors in cold climates. 1. Koch, C., & Harnisch, F. (2016) ChemElectroChem, 3(9), 1282-1295. 2. Doyle, L. E., & Marsili, E. (2018) Bioresource Technology, 258, 354-364. 3. Doyle, L. E., & Marsili, E. (2015) Bioresource Technology, 195, 273-282.
PROJECT OUTCOMES	• Isolation of novel psychrophilic microorganisms and characterisation of their electroactivity: • 1 x review article focusing on unexplored environments that may harbor electrochemically-active bacteria. • 1-2 experimental articles on enrichment/isolation. • 1x conference presentation by student.
ADVISORY TEAM	**Professor Gordon Southam** http://researchers.uq.edu.au/researcher/2716 g.southam@uq.edu.au School of Earth and Environmental Sciences The University of Queensland **Assistant Professor Lucinda Doyle** http://beb.iitd.ac.in/lucinda.html lucinda@iitd.ac.in Department of Biochemical Engineering and Biotechnology Indian Institute of Technology Delhi

TYPE OF STUDENT	Applications are open to i/a students who meet eligibility criteria. note: i-students must have own scholarship to apply (CSIR, UCG-NET, etc)
DISCIPLINE BACKGROUND OF STUDENT	Ideally, this project requires students with a background in microbiology, biotechnology, chemistry
IDEAL CANDIDATE	Essential capabilities: • Fundamental understanding of basic microbiology and basic chemistry Desirable capabilities: • Background in electrochemistry and molecular biology Expected qualifications (courses, degrees, etc): • Bachelors or Masters degree in relevant field
APPLICATION PROCESS	Apply online by the due date: https://www.uqidar.org/students/how-to-apply/