SUMMER RESEARCH 2024/25
PROJECT ABSTRACT

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

PROJECT # 35

SUPERVISOR/S: Dr Peter Kovalsky

PROJECT TITLE: Investigation of Microfluidic Electrolyser Architectures for Hydrogen Production

FIELD: Engineering

DIVISION/SCHOOL: HECS - Te Kura Mata Ao School of Engineering

PROJECT LOCATION: Hamilton

PROJECT ABSTRACT:

The production of hydrogen by splitting of water, commonly referred to as an electrolyser, involves a reaction occurring within an electrochemical cell. Many electrolyser variations exist. This project focuses on novel microfluidic designs to assist with creating the ideal conditions for the Faradic reactions to occur. These designs involve variation of the size and structure of flow channels involved with the multiple phases involved with the reaction. Evaluation of cell performance will be performed by way of analysis of the evolution of hydrogen and current density produced by the design. This will also form part of the scope of the project

STUDENT SKILLS:

- Chemistry, especially a desire to want to learn more (not necessarily difficult, but based around Faradaic reactions)
- Maker mindset (3D printing, fabrication)
- Computational modelling, examples include COMSOL, ASPEN, MATLAB, SIMULINK

PROJECT TASKS:

1. The first task is to undertake a rapid induction training exercise to bring up to speed with the principles of electrochemical design with focus on certain designs produced by the research group over the last 5-10 years. This aids with developing the core skills both in terms of calculations and having a conceptual framework of how electrochemical cells work.
2. Lab safety induction to operate electrochemical cells that produce hydrogen. This will also involve spending a week supervised by our graduate students on the sensors instrumentation available to help characterize hydrogen experiments. This includes operation of a gas chromatograph.
3. Training on use of microfluidic fabrication techniques using the Roland SRM20, gasket design using the Siser Juliet , resin 3D printer, laser cutter and standard 3D printer to produce a new microfluidic cell design
4. To produce new electrolyser cell designs that are optimised around the new catalyst layers formed by other graduate students in the lab. Such designs involve novel methods of carbon activation and homoginisation to produce the various layers of the electrolyser. Such new designs can include changes to shape, structure, inclusion of novel microfluidic features. You are encouraged to use all the tools and techniques learned in Task 3.

EXPECTED OUTCOMES:

- Student's Research Poster (as per clause 6 of the Scholarship regulations)
- To create a microfluidic hydrogen electrolyser design that is optimised around our catalyst preparation method and is characterised in terms of cell integrity by way of destructive testing.
- An evaluation of how robust the fabrication technique is and how repeatable the performance is in terms of gas evolution and cell efficiency.