Department of Molecular and Cellular Biology

Graduate Seminar MCB*6500

Friday, February 3, 2023 @12:00 p.m.

presented by:

Sean Lee

(Co-Advisors: Dr. Cezar Khursigara and Kamelia Atefi-Monfared)

" Engineering of *Escherichia coli* for optimization of microbiologically induced calcium carbonate precipitation for bio-cementation applications "

Microbiologically induced calcium carbonate precipitation (MICP), also referred to as bio-cementation, is an environmentally sustainable alternative to conventional cementation process. MICP is a biomineralization process induced by ureolytic bacteria that results in the precipitation of calcium carbonate that functions as a binding agent similar to cement. *Sporosarcina pasteurii*, is a model organism selected for MICP applications due to the high enzymatic activity of urease, resulting in rapid calcium carbonate precipitation. MICP production is heavily influenced by environment conditions and thus environmental applications outside the metabolic threshold of *S. pasteurii* severely limits the applicative potential of MICP. Current alternatives to optimize the MICP process include mutagenesis and development of recombinant bacteria capable of MICP through synthetic biology. The goal of this thesis project is to recombineer the urease operon of *S. pasteurii* into *Escherichia coli* which will result in a bacterium capable of MICP under lower temperature conditions. The objectives of this project will include the development of urease containing recombinant *E. coli*, comparative enzyme kinetics analysis of the recombinant *E. coli* and *S. pasteurii*, and determination of ureolytic activity and calcium carbonate precipitation. Lastly, MICP will be optimized under lower temperature conditions by investigating factors influencing the precipitation of calcium carbonate upon induction. This project aims to overcome the temperature limitations of MICP and demonstrate proof of concept that synthetic biology can be utilized to improve MICP production.