J.T. Beatty/University of British Columbia -- mSSB Project -- 2019

My research centres on microbes that capture solar light and convert its energy to electrical current, using special proteins and pigments combined in a biological photosystem or photosynthetic reaction centre (RC).

The application of biological photosystems to photovoltaics has become feasible as a result of: gene engineering methods; the solution of the 3-D structures of photosystem membrane protein complexes; and the quantitative understanding of the primary electron transfer processes of photosynthesis. The reaction centre (RC) of the bacterium Rhodobacter sphaeroides is the simplest and perhaps the most easily-studied photosynthetic complex, with a ~200-fold longer recombination time of separated charges than in silicon-based devices. We have made major advances in the study of the R. sphaeroides and related RCs, but such RCs are not able to withstand high temperatures that might be encountered in solar energy applications, such as on a rooftop. However, the bacterium Chloroflexus aurantiacus grows at temperatures of 65-70º C. Thermophiles such as C. aurantiacus lack genetic malleability and are difficult to cultivate, and so we will use synthetic biology to circumvent these obstacles. The protein-encoding genes from C. aurantiacus will be expressed in an R. sphaeroides strain that lacks its own RC genes, while providing chlorophylls and other cofactors. In preliminary experiments we created synthetic versions of the C. aurantiacus RC genes and found that an RC-like complex was assembled in vivo, which could be purified for in vitro applications. We wish to move onward from this promising result to improve the stability and yield of this RC.

This position is a balance of essential lab maintenance tasks, and direct participation in a research project. Preparation of growth media, stock solutions of molecular biology reagents, and cleaning glassware are essential duties of this position. The student must also have experience in cultivation of microbes (aseptic technique, streaking agar plates, etc.) as well as some hands-on experience in DNA and/or protein manipulation. For example: plasmid purification, agarose gel electrophoresis of DNA samples, PCR, gene cloning; and/or SDSPAGE, protein purification, column chromatography, assays of enzyme activity.

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