Microbial electro-photosynthesis (MEPS) - a platform to deliver electrons for biosynthesis to photosynthetic microorganisms

Christine Lewis[†‡], Omar Khdour[†], Wim Vermaas, Petra Fromme[†‡], **César Torres[‡Δ]**

School of Molecular Sciences[†], Biodesign Institute[‡], School of Life Sciences[Φ], School for Engineering of Matter, Transport and Energy[Δ], Arizona State University, Tempe Arizona 85287, USA.

The cascading reactions within photosynthetic electron transport chains (PETCs) are responsible for charging cells for autotrophic life. In our work with microbial electro photosynthesis (MEPS), we develop a biosynthesis platform in which photosynthetic organisms accept electrons from a cathode for growth and organic synthesis. To achieve this, a □*psbB Synechocystis* PCC6803 cells had PSII genetically removed. Our novel photosynthetic reactor system drives electron flow without PSII downregulation. Our preliminary data shows that MEPS can generate light-dependent current which increases with light intensity up to 2050 μmol photons m^{-2} s^{-1}, delivering 113 μmol electrons h^{-1} mg-chl^{-1}, and an average current density of 150 A m^{-2} s^{-1} mg^{-chl-1}. In our current work, we look more closely at our MEPS system and characterize the use of different analogues of redox mediators (beyond our duroquinone control) that can (1) interrogate the chain more efficiently or in different areas of the electron transport chain, (2) be less toxic and/or highly soluble in photosynthetic medium, and (3) be electrochemically active. We also look also look at how to model redox mediator's journey to and from the cathode to cell in both dark and light reactor systems to provide more specific transport rates of the mediator to the cyanobacteria as well as the overall rate determining steps.