196b Engineering Geobacter Metabolism for Enhanced Electricity Generation

Radhakrishnan Mahadevan, Anthony Burgard, Christophe H. Schilling, Derek R. Lovley, and Mounir Izallalen

The *Geobacter* species are known for their dissimilatory metal reduction properties and consequently are known to have several applications in bioremediation and energy production. This group of bacteria can couple the complete oxidation of organic compounds to the reduction of Fe and some highly toxic metals. Moreover, they have also shown the capacity to generate energy by using graphite electrode as terminal electron acceptor. The work presented here is an ongoing project aiming at increasing the range of reduced substrate that can be oxidized by *Geobacter*. We used a genome scale metabolic model of *G. sulfurreducens* to elaborate strategies to increase the flux through the electron transport chain. Among several candidate substrates with a relatively high electron per mole ratio, the model based prediction proposed that glycerol can be used as an electron donor if a transporter was present. The prediction was tested by cloning the glycerol uptake and processing operon from another d-proteobacterium *Desulfovibrio vulgaris* . The engineered *Geobacter* gained, as predicted, the capacity to grow on glycerol as an electron donor and completely reduced the terminal electron acceptor tested. In addition, we have used a hierarchical optimization strategy to identify specific in silico gene deletions that could enhance the rate of electron transport for growth on glycerol, and acetate and have constructed Geobacter strains that respire at higher rates indicating the potential for increased electricity generation. In summary, an integrated computational and experimental strategy for engineering *G. sulfurreducens* metabolism for enhanced electricity generation will be presented.