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ELECTRICITY GENERATION BY *Geobacter sulfurreducens* USING MICROBIAL FUEL CELLS

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Geobacter, Bio-electricity and bacterial nanowires

The greatest technological challenge for human society today is the replacement of fossil fuels with energy sources that are renewable and carbon neutral. Microorganisms can produce renewable energy without damaging the environment or disrupting food supply. *Geobacteraceae* offer the possibility of efficiently converting organic compounds into electricity in microbial fuel cells.

Geobacteraceae is the predominant group of bacteria in subsurface environments, where dissimilatory metal reduction is an important process (Holmes et al., 2004; Lovley et al., 2004). In addition to its importance in global carbon, nutrient, and metal cycles, *Geobacter* species are able to couple the oxidation of waste organic matter to carbon dioxide, with direct electron transfer to electrodes, generating electricity (Bond and Lovley, 2003; Lovley, 2006).

Although significant progress has been made in understanding the mechanism of electron transfer to Fe(III) in *G. sulfurreducens*, little is known about the regulatory cues involved in controlling gene expression of the participants in the complex process of transferring electrons released from the central metabolism to the outside cell environment. Understanding regulation of gene expression of δ–proteobacteria, *Geobacteraceae* is critical for our ability to gain insight into cellular processes that allow these bacteria to participate in environmental bioremediation and energy production. The main goal for this investigation is to determine how electrons are transferred to the electron acceptors and electrodes, the factors controlling the rate and extent of this process. With this information in hand, it may be possible to optimize practical applications and better model natural processes and construct mutants in relevant genes in order to get more energy.

It has recently been determined that the pili of *G. sulfurreducens* function as nanowires that are required for electron transfer to Fe(III) oxides and electrodes (Reguera et al., 2005). Genome-scale studies of the regulation of pilin formation suggested that expression of *pilA*, the gene for the structural pilin protein, is regulated in response to electron acceptor availability, as well as redox and nutrient status. For example, levels of *pilA* transcripts were significantly higher in mutants in which one of the two Fnr-like (Flp1 and Flp2) genes was deleted, or when cells were grown under electron-acceptor limiting conditions. Deleting the *relGsu* gene also lowered *pilA* transcript levels. Genome wide analysis showed that *pilA* expression is also controlled by a two component regulatory system PilS/PilR and the sigma factor, RpoN (Juárez et al., 2009). Although the RpoN-regulatory system is the major regulatory system involved in *pilA* expression there are several factors also involved in study actually as Flp1 and Flp2 and IHF (integration host factor). The biofilm formation and the pilin expression correlating with energy production, we are interested on studying and constructing mutants in order to harvest more electricity in microbial fuel cells.

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