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Bioenergy production using microbial fuel cell technologies

Bruce Logan

Tuesday, March 2nd

Lecture at 4:15 PM

Light refreshments follow

Room 66-110

25 Ames Street

Abstract

Certain naturally occurring microorganisms are being used in several new technologies, based on microbial fuel cells (MFCs), to produce energy and clean water. In an MFC, exoelectrogenic bacteria oxidize organic matter and release electrons to an electrode (anode). These electrons flow to the counter electrode (cathode) where they combine with oxygen and protons to form water, generating current and power. Sustained electricity generation is possible using virtually any type of biodegradable organic matter including pure compounds, complex organic matter in wastewater, and agricultural materials. The MFC architecture can be modified to use energy in the organic matter to accomplish water desalination without any electrical input or high pressures. In the absence of oxygen, and by adding voltage to that produced by the bacteria, it is also possible to produce hydrogen gas at the cathode in a device called a microbial electrolysis cell (MEC). The voltage needed is substantially smaller than that needed to electrolyze water. Hydrogen gas produced can be recovered at nearly 100% of the stoichiometric yield in an MEC for certain substrates, and two to four times more energy is recovered as hydrogen gas than used as electrical energy. By using electrotrophic microorganisms on the cathode, it is possible to produce other products from the current such as methane. In this presentation, I review what is known about exoelectrogenic and electrotophic microorganisms, summarize advances in increasing current densities and reducing materials costs, and discuss recent field trials using larger, pilot-scale MFC and MEC systems.

About the Speaker

Bruce Logan is the Kappe Professor of Environmental Engineering at Penn State University, and Director of the Engineering Energy & Environmental Institute. He has published over 240 journal papers and several books, including one on microbial fuel cells, and works in a variety of research areas including bioenergy production, bioremediation, environmental transport processes, colloidal dynamics, and microbial adhesion. Dr. Logan was recently awarded the Athalie Richardson Irvine Clarke Prize for his research to develop an energy sustainable water infrastructure. He is a visiting professor at Newcastle University in England, Harbin Institute of Technology and Dalian University of Technology in China, and an Investigator with the King Abdullah University of Science & Technology (KAUST) in Saudi Arabia.

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