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Energy from water: Microbial fuel cell technologies meet salinity gradient energy

Abstract: The ability of certain microorganisms to transfer electrons outside the cell has created opportunities for new types of energy generation based on: microbial fuel cells (MFCs), to produce electrical power; microbial electrolysis cells (MECs), to produce fuels such as hydrogen and methane gases; microbial desalination cells (MDCs) to partially or fully desalinate water; and microbial reverse electrodialysis cells (MRCs) that can additionally be used to obtain salinity gradient energy. In an MFC, exoelectrogenic microorganisms oxidize organic matter and release electrons to the anode. These electrons flow to the counter electrode (cathode) where they combine with oxygen and protons to form water, generating current and power. Sustained current generation is possible using virtually any type of biodegradable organic matter. The current produced by exoelectrogenic microorganisms can also be boosted to electrochemically produce hydrogen gas at the cathode. The voltage needed (>0.2 V) is substantially smaller than that needed to electrolyze water. By including a stack of membranes into MFCs or MECs, sources of salt and fresh water can be used in the membrane stack to produce additional energy from this salinity gradient. In this seminar, I will present key findings in the area of electromicrobiology and summarize advances in the materials and architectures used to make these different types of bioelectrochemical and electrochemical systems.

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Biography: Dr. Logan is an Evan Pugh Professor, Stan & Flora Kappe Professor of Environmental Engineering, and Director of the Engineering Energy & Environmental Institute at Penn State. His research efforts are in bioenergy production and the development of energy sustainable global water infrastructure for both industrialized and developing countries. Dr. Logan has authored over 340 refereed publications and several books. He is a fellow of the International Water Association and the Water Environment Federation, and he was awarded the Clarke Prize in 2009. He received his Ph.D. in 1986 from the University of California, Berkeley. Prior to joining the faculty at Penn State in 1997, he was on the faculty at the University of Arizona in the Department of Chemical and Environmental Engineering.