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Study of conductive bacterial nanowires: Fundamentals and applications for both environmental and energy sustainability

Jun Yang
The University of Western Ontario, Canada

Development of a sustainable strategy for energy from natural renewable resources is a long-term challenge. Thanks to nature, some species of bacteria have the capability of producing energy from organic waste, which is realized in microbial fuel cells (MFCs). MFCs are not yet commercialized but they show great promise as a sustainable mean for energy generation and wastewater treatment. Electron transfer is fundamental to the metabolism of biological systems. Microorganisms extract electrons by oxidizing a wide range of electron sources, like wastewater, and transport them to electron receptors. Extracellular electron transfer takes place in dissimilatory metal-reducing bacteria (DMRB) when electron acceptors are not soluble and not accessible to intracellular enzymes. Various mechanisms of extracellular electron transfer have been reported for DMRB. Recent reports suggested that extracellular electron transfer may be facilitated by pilus-like appendages also called bacterial nanowires because they are conductive. However, there is no evidence presented to verify electron transport along the length direction of bacterial nanowires. The mechanism of electron transport in such conductive bacterial nanowires is still not clear. Here we apply multiple nanotechnological tools to study electrical and other physical properties of such conductive bacterial nanowires. We also demonstrated the potential applications of such bacteria for energy and environmental applications. The function of bacterial nanowires implies many applications in environment, energy and bioelectronics, and the development of MFC demonstrates great potential for a renewable energy source and pollutant treatment. This talk also introduce a novel method to optimize the efficiency of bioenergy reactors.

jyang@eng.uwo.ca