Electromicrobiology is a rapidly emerging field of study that investigates microbial electron exchange with electrodes, minerals, and other organisms, as well as novel properties of microorganisms that are of interest for developing electronic devices. For example, direct interspecies electron transfer (DIET), is a recently discovered form of extracellular electron transfer in which microorganisms exchange electrons to cooperatively degrade organic compounds under anaerobic conditions. DIET appears to be an important mechanism for electron exchange in wastewater digesters converting organic wastes to methane, a proven bioenergy strategy. Artificially enhancing DIET can accelerate and stabilize methane production.

A new bioenergy strategy which capitalizes on the ability of microorganisms to directly exchange electrons with electrodes is microbial electrosynthesis, an artificial form of photosynthesis in which electrical energy derived from solar technologies is used to feed electrons to microbial biofilms on electrodes. The microbes use the electrons to reduce carbon dioxide to multi-carbon organic compounds that are excreted from the cells. Producing commodity chemicals and transportation fuels with microbial electrosynthesis is much more efficient and potentially more environmentally sustainable than biocommodity strategies that rely on biological photosynthesis.

Electrically conductive pili, known as microbial nanowires, are one of the most surprising discoveries in electromicrobiology. Microbial nanowires are important components in microbe-electrode and microbe-microbe electron exchange. The nanowires of *Geobacter sulfurreducens* have metallic-like conductivity, similar to that observed in synthetic, organic conducting polymers. The possibility of metallic-like conductivity in a biological protein is a paradigm shift, differing dramatically from typical biological electron transfer, which is accomplished via electron hopping/tunneling between discrete redox-active proteins. Recently elucidated structural insights into nanowire metallic-like conductivity are leading to new synthetic biology strategies for enhancing microbial electrical connections in a growing diversity of applications, including biocomputers and biosensors.