3-Dimensional Microbial Fuel Cell Anode

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Worldwide access to potable drinking remains of one the “Grand Challenges for Engineering” (National Academy of Engineering). Microbial Fuel Cells (MFCs) may be a possible solution. MFCs, in conjunction with further treatment, have the potential to inexpensively convert wastewater into potable water. MFCs are composed of inexpensive materials, they use wastewater as fuel, and they produce electricity that can be used to run the MFC itself. MFCs need to break certain barriers before they can be used on an industrial scale; the largest flaw is the low power production of MFCs. This technology uses bacteria to decompose the organics in wastewater and produce electricity. Because MFCs use bacteria, the surface area and conductivity of the anode (where the bacteria grow) is key to power production. The goal of this research project is to develop a new three-dimensional anode for Microbial Fuel Cells. This anode used a carbon cloth base, coated in both Titanium Dioxide Nano-particles (TiO_2) and Carbon Nano-Tubes (CNTs). TiO_2 was used to increase the surface area of the electrode; however this material is not especially conductive. CNTs were used to provide a conductive pathway for the electrons donated by the bacteria during cellular respiration. With this design, coating a 5cmX 2.5cm piece of carbon cloth in TiO_2 and CNTs cost 10¢, and increased the anode’s surface area by 35%. By adding these materials, the modified anode produced 26.16% more power (7654.811 mW) than the control anode (plain carbon cloth, 6067.381 mW) over the course of 25 days. This anode has not passed the criteria that would make MFCs economically more viable, but this research does introduce new materials and techniques that can be implemented into future MFC anode designs.