A Durable, Portable and Biodegradable Microbial Fuel Cell that Utilizes a Native Plant Based AC Electrode and Optimized Sizing

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The goal of this research was to develop an efficient, portable and cheap MFC that utilizes untreated bacteria, found in natural resources, as an energy source. The electrode and carbon sponge located in the anode were replaced by plant formulated activated carbon, made from orange peels and cumin seed that was printed onto paper for support. The anode was then filled by untreated swamp mud, an abundant resource widely available around the world. The design of the cells was custom made to increase the surface area of the electrodes and membrane, in order to decrease internal resistance in the cell. These changes drastically lowered the size of each chamber in the cells and allowed for the bacterium to be bonded directly to the electrode, therefore increasing the transfer of electrons. In order to make the cells portable, the medium in the anode was filled with thick swamp sediment, and an air based cathode was used. The ~3.2 cubic inch cells containing .78 cubic inches of mud produced 118.2 mW at 1-ohm resistance. A single cell has a total capacity of 322 mAh and has an optimum operating current of under 120 mA and its electrical characteristics were comparable to a standard 1.5V battery. The milliamp hours were measured using a constant resistance method. Multiple cells arranged in voltaic stacks can meet various application requirements. The MFCs were 3D printed using heat treated polyamide powder in order to be biodegradable, efficient, and applicable in developing regions.