Integrating Technologies for the Production of Bioelectricity and Bioethanol

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Clean energy alternatives are becoming increasingly important as greenhouse gas emissions are growing and fossil fuels are being depleted. Bioenergy sources can provide renewable transport fuel and electricity, but are often commercially unviable due to issues around efficiency and cost-effectiveness. To address these concerns, a microbial fuel cell with the ability to produce bioelectricity and bioethanol from the same source was developed. Electricity was generated through redox reactions by exposing Saccharomyces cerevisiae cells undergoing anaerobic respiration to methylene blue. This hampered alcoholic fermentation and resulted in the production of metabolites other than ethanol; these were allowed to pass through a porous interface into an additional chamber, where they were re-absorbed by unstressed cells and converted to ethanol. The final prototype produced a mean voltage output of 800mV and a current density of 17.102mA/m^2, equating to an average power density of 13.682mW/m^2, over a period of approximately 72 hours. Compared to the maximum theoretical yield, the efficiency of ethanol production was 44.62%. With further development, this device has the potential to provide sustainable sources of both transport fuel and electricity and thus address some of the energy challenges facing modern society.