

273d Laminar Flow-Based Biofuel Cells: Independent Control of pH at the Anode and Cathode for Optimal Electrode Activity

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Recently, many advances have been made in the development of biofuel cells [1]. One of the major advances has been the use of electrocatalysts that increase the rate of electron transfer from an enzyme or redox mediator to the surface of an electrode. One recent report includes the electropolymerization of methylene green at an electrode surface to form an electrocatalyst to mediate electron transfer from NADH to a bioanode [2]. The catalysis of NADH oxidation to regenerate NAD⁺ is an important reaction, as NAD⁺ is an important cofactor for many enzymes, including alcohol dehydrogenase and aldehyde dehydrogenase. These enzymes can be used for the electrooxidation of ethanol or methanol at the anode of a biofuel cell [2]. Recently, we have developed membraneless microfluidic fuel cells that exploit laminar flow at the microscale to separate the fuel and oxidant streams [3]. Because the streams mix only by diffusion, fuel and oxidant streams of different pHs can be used such that the anode and cathode both operate at their optimal pH. One issue with biofuel cells, however, is the fact that different enzymes have optimal activity at different pHs. Using a fixed pH electrolyte may maximize the enzyme activity at one electrode while resulting in poor enzyme activity (or even denaturing of the enzyme) at the electrode. Ideally, one would like to operate the anode and cathodes at different pHs such that both electrodes could operate optimally. We will show our work in designing and operating laminar flow biofuel cells that are run using alcohol and oxygen, with buffered alcohol solution (pH~7) and aqueous sulfuric acid solution (pH~0) as the anolyte and catholyte, respectively.

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2. Akers, N.L., Moore, C.M., Minter, S.D. *Electrochimica Acta* 2005, 50, 2521-2525.
3. Choban, E.R., Spendelow, J.S., Gancs, L., Wieckowski, A., Kenis, P.J.A. *Electrochimica Acta* 2005, in press.