Session: Enzyme and Organism Based Biofuel Cells

Bacterial Cellulose: A Versatile Material for Bio-fuel Cell Development

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ABSTRACT

Cellulose strands secreted by *Gluconoacteobacter sp*. form nano-layers at the air-liquid interface of the growth medium. As the layers accumulate a well-defined pad of cellulose is formed that is called a pellicule. After cleaning to remove bacterial debris, a pellicule typically contains greater than 99% (g/g) water. On removal of water the cellulose collapses to a very thin membrane (<50μm). Hydrogen-bonding between the cellulose strands prevents it from re-swelling. It was discovered that bacterial cellulose catalyses the precipitation of palladium within its structure to generate a homogeneous matrix of palladium nano-clusters evenly dispersed throughout the pellicule. The properties of this novel high-surface area catalyst and other properties of bacterial cellulose will be discussed that demonstrate its versatility for bio-fuel cell applications.

A major criticism of biological hydrogen production from carbohydrates such as glucose is the low yield of hydrogen obtained compared to the amount of starting material employed. However it has been demonstrated that the maximum molar yield of H_2 from glucose can be achieved through the coupling of the enzymes of the pentose phosphate cycle with hydrogenase. Currently work is underway to clone, overexpress and purify thermophilic sources of these enzymes with a view to constructing nanoscale bioreactors that contain the complete set of enzymes necessary to metabolize 1 mol glucose to 12 mol H_2 and 6 mol CO_2. Entrapment of the enzymes in liposomes is currently being investigated as a possible vehicle to realize this goal.

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