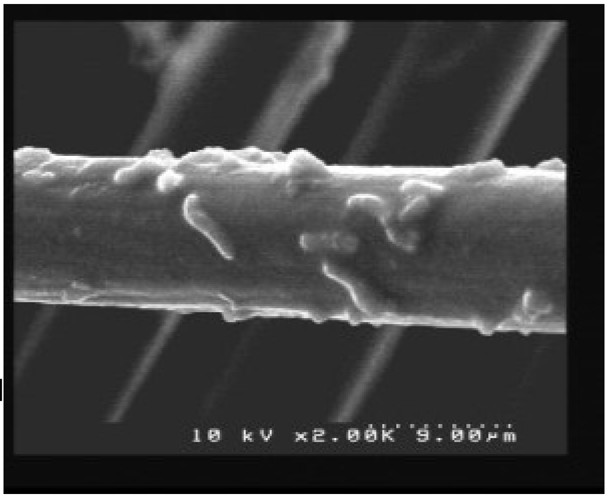
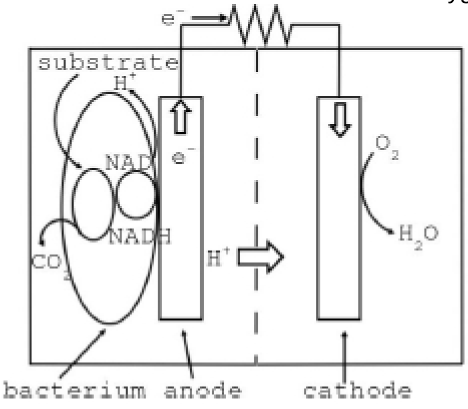
Powered by pee

Posted on ***March 17,2015*** *by* ***admin***

[caption id="attachment_5422" align="alignright" width="300"]

Bacteria on one of my anode fibres (too few unfortunately) taken using a scanning electron microscope.[/caption] A few weeks ago I heard a story about loos powered by Pee and an appeal for students to use the toilets. I recognised what they were talking about since this is the area I did my doctorate in- that is microbial fuel cells. Microbial fuel cells (MFC's) use the potential energy available in molecules such as glucose and derive energy from it -a process called respiration. All forms of respiration end up with electrons being transferred from the energy rich molecules to a terminal electron acceptor (a process of chemical reduction). This transfer of electrons is coupled to the formation of the universal energy currency of all living things, ATP, therefore generating energy for the organism. In humans our terminal election acceptor is oxygen, which is reduced to water. Bacteria vary in their terminal electron acceptor. Some can use oxygen, some anaerobic bacteria cannot but instead use a other molecules such as nitrates, organic compounds to a variety of metals. Some can use both oxygen and other electron acceptors depending on conditions. In microbial fuel cells we get bacteria to transfer their electrons to the anode and then we can use some of these electrons to do work (see diagram below). Some of the electrons must be combined with oxygen and protons produced as part of the respiration process to make water. 

There are two methods of electron transfer from the bacterium to an anode, indirect by naturally produced molecules or some organic dyes or by direct transfer via proteins on the surface of the bacteria. The latter method is preferred since its more efficient and dyes need periodic replacement. However not all bugs have this direct transfer ability (the ones I tried in my doctorate didn't). In our bodies cells the final stages of electron transfer take place inside the cells and the same is true of most bacteria. Only bacteria with additional protein extensions to the outside of the cells can transfer the electrons to the anode. In a toilet powered by pee bacteria use urea to make electricity, the MFC could either be seeded with electrogenic bacteria or wait for a natural population to build up. The advantage of microbial fuel cells is they are at their best almost 100% efficient as energy conversion devices. The disadvantage is they produce very small amounts of current at low voltages (and unlike chemical fuel cells no heat). This low power output means they would need a huge surface area to do anything useful. Various niche uses have been proposed or tried, remote sensing buoys, treating brewery waste or producing electricity from sewage. Something such as lights in a refugee camp powered by pee is a simple but effective idea. The energy source is constantly replenishing. MFC's are certainly not the answer to peak oil or climate change but may find some uses yet. Neil

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