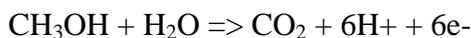


Short Notes on Direct Methanol Fuel Cells (DMFC)

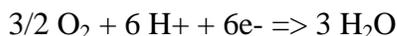
The technology behind Direct Methanol Fuel Cells (DMFC) is still in the early stages of development, but it has been successfully demonstrated powering mobile phones and laptop computers—potential target end uses in future years.

DMFC is similar to the PEMFC in that the electrolyte is a polymer and the charge carrier is the hydrogen ion (proton). However, the liquid methanol (CH_3OH) is oxidized in the presence of water at the anode generating CO_2 , hydrogen ions and the electrons that travel through the external circuit as the electric output of the fuel cell. The hydrogen ions travel through the electrolyte and react with oxygen from the air and the electrons from the external circuit to form water at the anode completing the circuit.

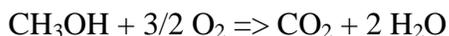
Anode Reaction:



Cathode Reaction:



Overall Cell Reaction:



Initially developed in the early 1990s, DMFCs were not embraced because of their low efficiency and power density, as well as other problems. Improvements in catalysts and other recent developments have increased power density 20-fold and the efficiency may eventually reach 40%. These cells have been tested in a temperature range from about 50°C - 120°C . This low operating temperature and no requirement for a fuel reformer make the DMFC an excellent candidate for very small to mid-sized applications, such as cellular phones and other consumer products, up to automobile power plants.

One of the drawbacks of the DMFC is that the low-temperature oxidation of methanol to hydrogen ions and carbon dioxide requires a more active catalyst, which typically means a larger quantity of expensive platinum catalyst is required than in conventional PEMFCs. This increased cost is, however, expected to be more than outweighed by the convenience of using a liquid fuel and the ability to function without a reforming unit.

One other concern driving the development of alcohol-based fuel cells is the fact that methanol is toxic. Therefore, some companies have embarked on developing a Direct Ethanol Fuel Cell (DEFC). The performance of the DEFC is currently about half that of the DMFC, but this gap is expected to narrow with further development.

Portable Fuel Cells: Coming Soon?

New technology may lead to smaller, cheaper, and lighter alternative power sources.

Martyn Williams, IDG News Service

Tuesday, January 20, 2004

A California start-up has made an advance that it says stands to make Direct Methanol Fuel Cells--envisioned as a future power source for mobile electronics devices--smaller, cheaper, and lighter.

PolyFuel's development of a new [Direct Methanol Fuel Cell](#) (or DMFC) membrane comes as several of the world's largest electronics companies are developing fuel cells with a view to commercializing them later this year or next year.

The membrane is a small piece of plastic that looks something like sandwich wrap, according to PolyFuel President and CEO Jim Balcom. It sits at the heart of the DMFC separating a mixture of methanol and water from a catalyst. It's the electrical potential across the membrane that is the key to power creation however the current most popular membrane isn't well suited for use in DMFC applications, Balcom says.

"Until now all of the manufacturers, and we've counted 35 organizations working on DMFCs, have been hampered because they have had to use a hydrogen fuel cell membrane that was developed 40 years ago. It has been the only one available for DMFC applications and they are very different technologies," he says.

Increased Concentration

The biggest problem developers have is stopping methanol crossing over the membrane--something that lowers overall efficiency of the fuel cell because fuel is wasted and it also results in generation of heat. To combat this problem researchers have kept methanol concentrations relatively low, at around 10 percent although a higher concentration would be better, says Balcom.

His company's new membrane allows for much higher concentrations--between 50 percent and 100 percent--and this should mean DMFCs can be made one-third smaller, lighter, and less expensive, he says. Increasing the methanol concentration has been a stated goal of several companies developing DMFCs for some time.

Product Plans

NEC, which plans to commercialize a [DMFC for notebook computers](#) this year, is currently using a methanol concentration of around 10 percent in its prototype, and Toshiba, which has shown a prototype battery charger based on DMFC technology, says it uses a concentration of between 3 percent and 6 percent.

Hitachi [plans a DFMC](#) for use in PDAs and says it hopes to raise methanol concentration from around 20 percent to 30 percent by the time the produce is commercialized in 2005.

PolyFuel's new membrane is already in sample production and initial feedback from the company's potential clients is good, says Balcom. The company's current production capacity in Silicon Valley is anticipated to be enough to handle customer demand though 2005 and further expansion will be based on demand, he says.