Construction and Preliminary Testing of a Direct Water Methanol Fuel Cell

PRESENTED BY

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OUTLINE

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- Construction
- Results
- Conclusion

BACKGROUND

- Research in conceptual designs and applications of using fuel cell technology in vehicles, generators, and power plants has increased over the past 10 years

- Direct water methanol fuel cell technology is a hydrogen fuel cell which utilizes the chemical reactions between methanol, water, platinum, and ruthenium to create electricity

- The water methanol fuel cell is categorized as a type of proton exchange membrane (PEM) hydrogen fuel cell that can generate electro-chemical energy by some very basic chemical reactions within the membrane of the cell

BACKGROUND

- Methanol is a carbonaceous fuel which, at low temperatures, can quickly provide a large amount of electrochemical reactions when mixed with oxygen. The products at the completion of this chemical reaction are water, carbon dioxide, direct voltage (D.C.), and current

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BACKGROUND

$CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$

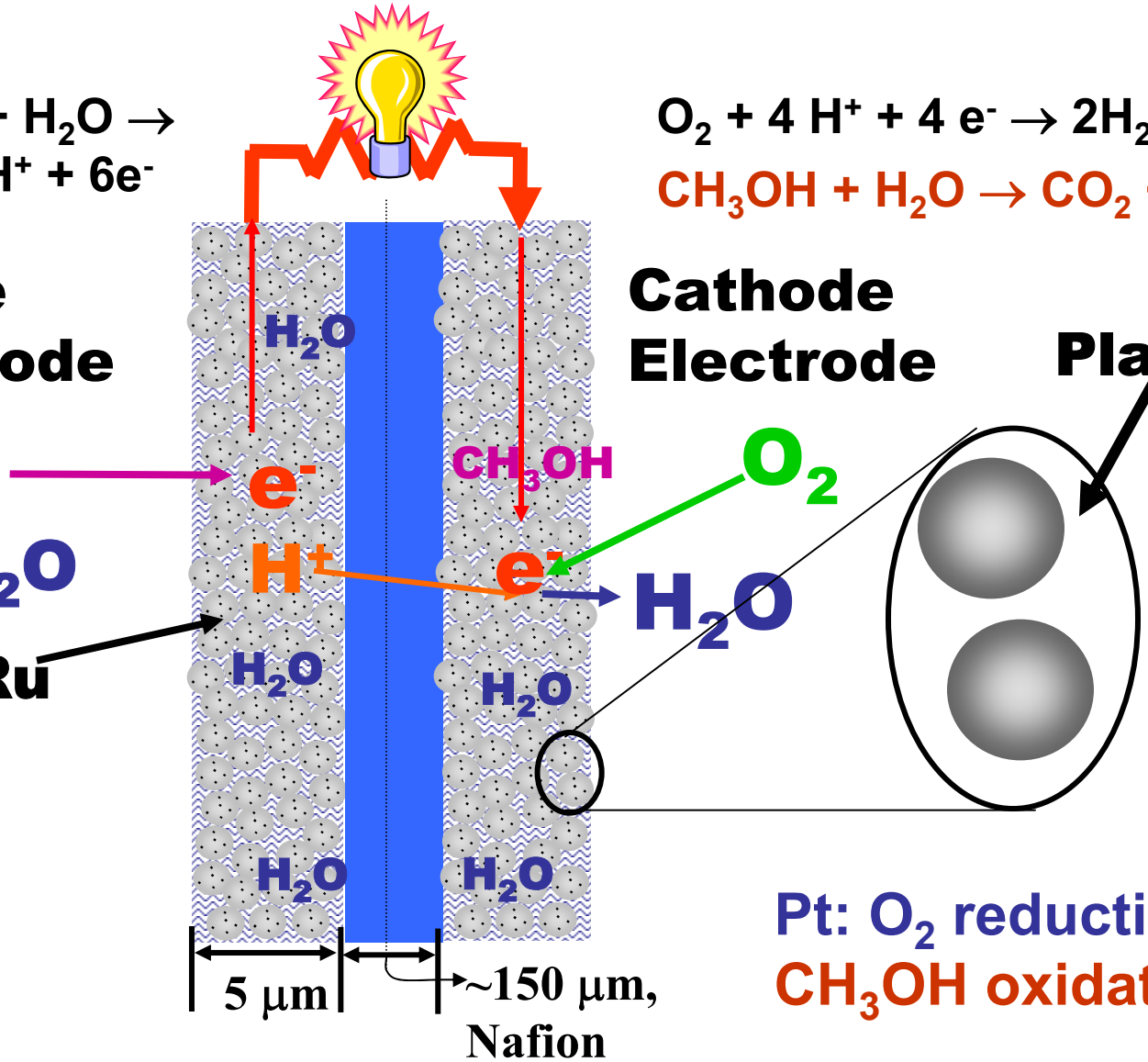
$O_2 + 4\,H^+ + 4\,e^- \rightarrow 2H_2O$

$CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$

Anode Electrode

Cathode Electrode

Platinum

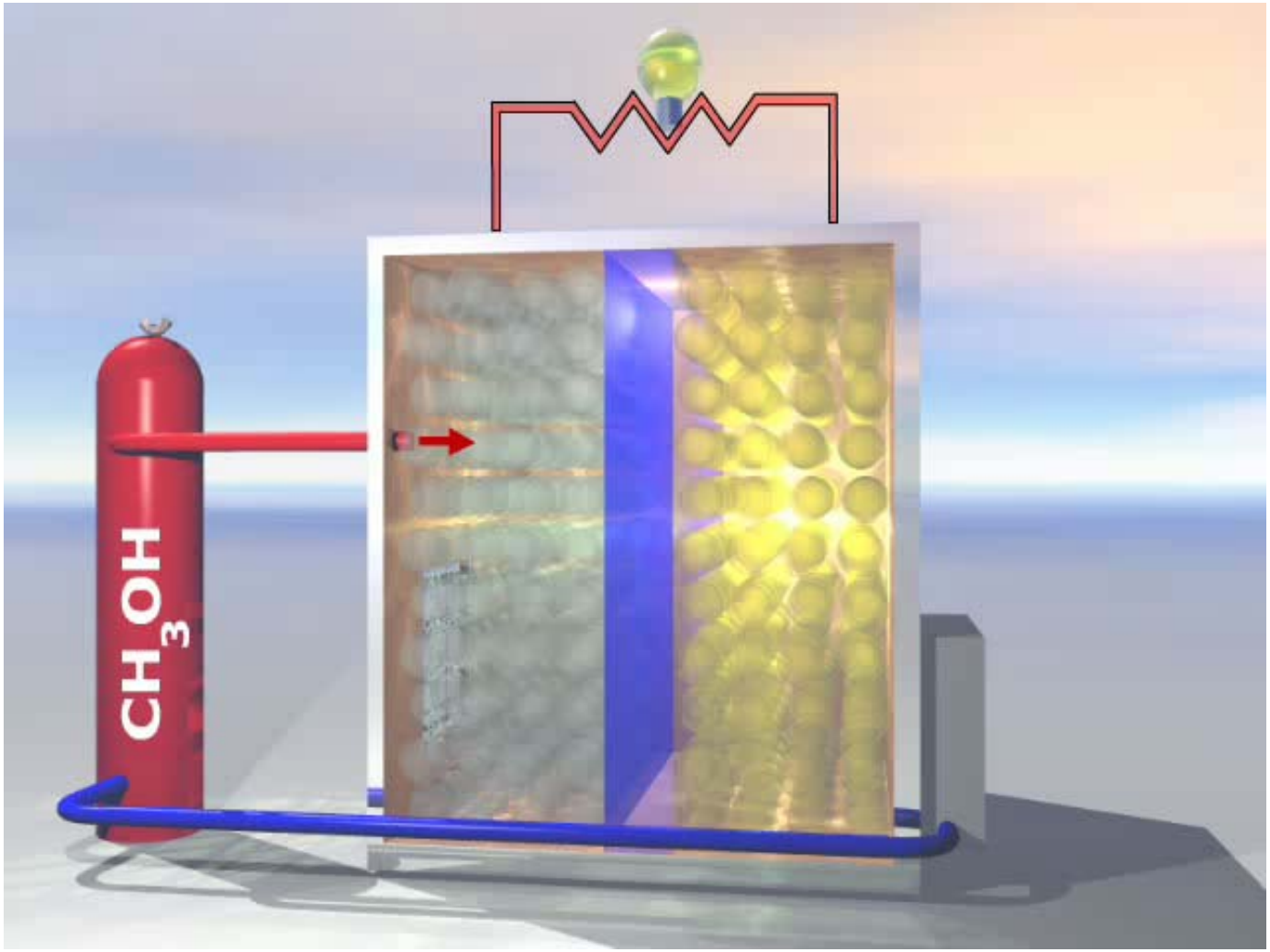


with H_2O

Pt-Ru

Pt: O_2 reduction and CH_3OH oxidation

BACKGROUND



CONSTRUCTION

- **The fuel used in this particular type of fuel cell is water and methanol. The percentage of water versus methanol can range from 90% water and 10% methanol or 80% water and 20% methanol by volume**

- **The equipment and materials needed for fuel cell construction are:**

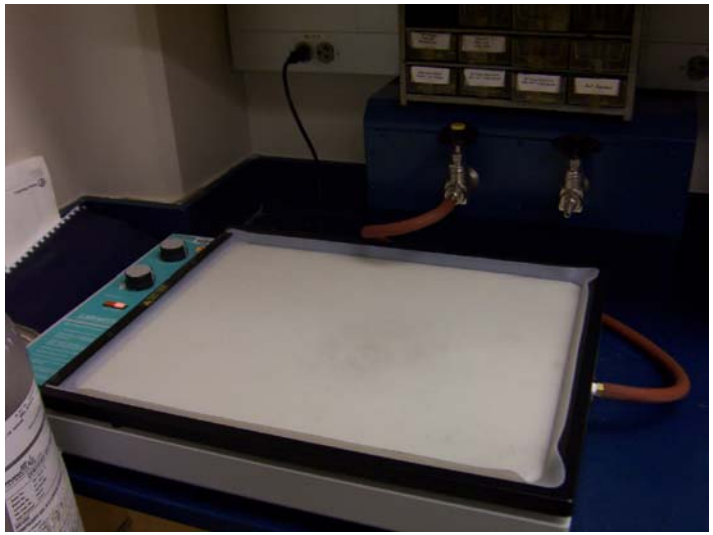
Teflon paper
Platinum
Alcohol
Distilled water
Temperature regulated vacuum
Titanium mesh or Graphite mesh
Nafion polymer
Ruthenium
Carbon gas diffusion material
Temperature regulated press
Plexiglas

CONSTRUCTION

- MEA construction began with cutting two 3cm by 3cm pieces of Teflon paper and then coating one Teflon square with platinum black ink solution (Pt) and the other with platinum ruthenium black ink solution (PT-Ru)

CONSTRUCTION

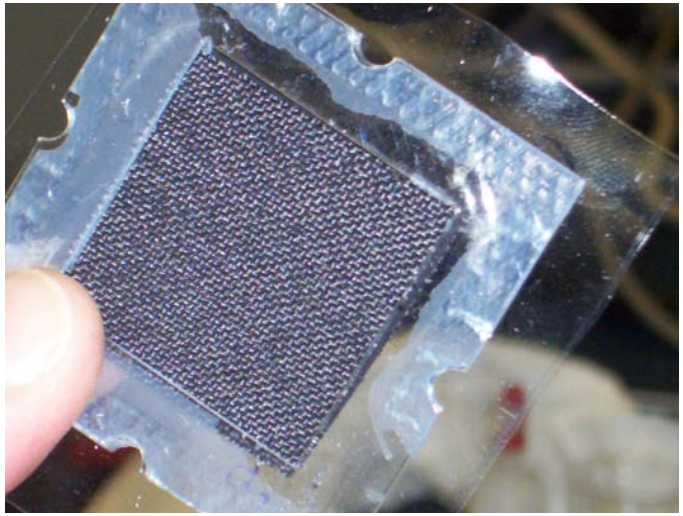
- Cut one 10 x 10 cm nafion (117) polymer square and dry it for 40minutes in a temperature controlled vacuum press at 60°C



Place the two Teflon squares on each side of the nafion polymer (coated sides are face down on polymer) and immediately place under a heated press until the temperature and pressure increase to 257°F and 500psi, wait one minute and remove

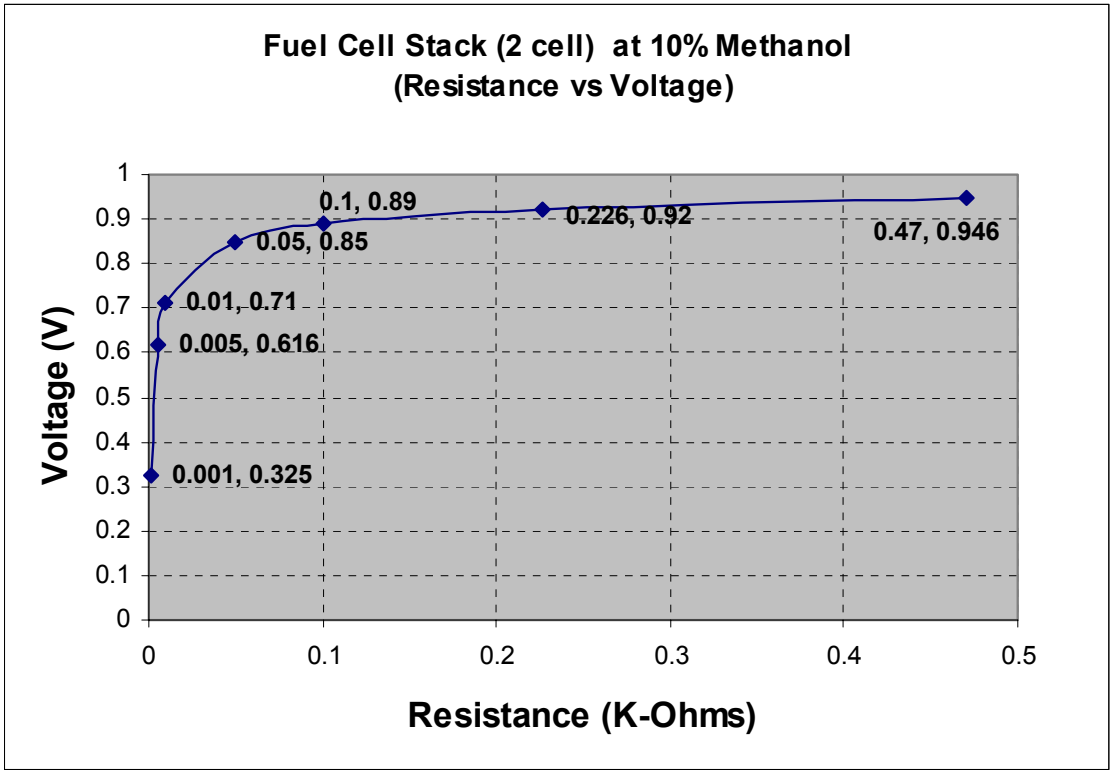
CONSTRUCTION

- Pull the Teflon squares slowly away from the nafion, the platinum and platinum ruthenium sides should stay on the nafion. Immediately immerse into water distilled water then remove



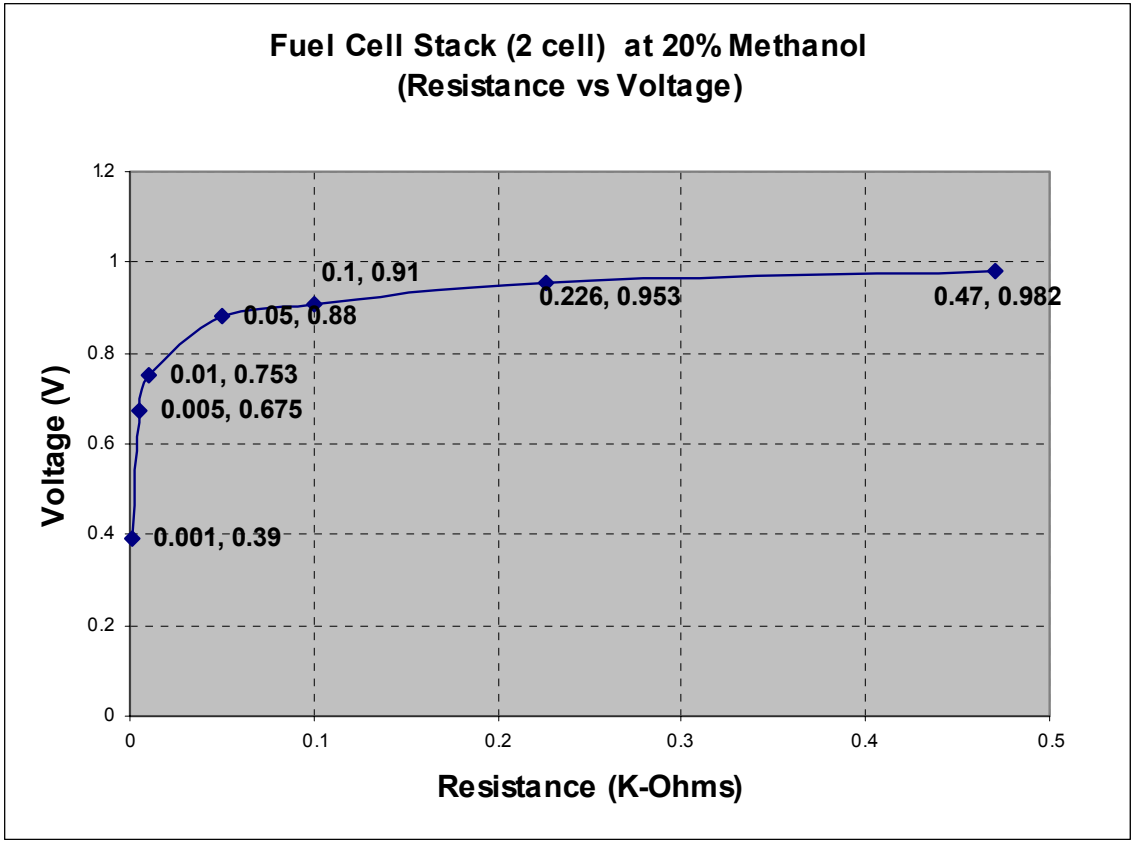
- MEA construct is now complete; non corrosive materials such as titanium or graphite can be used to secure the MEA in the cell housing and is the medium that will transmit the D.C. voltage created by the chemical reactions around the membrane. The cell housing can be constructed by using Plexiglas, glass, or any non corrosive water impermeable material.

RESULTS



- **These results indicate that this particular cell can produce nearly 1 volt DC at 470 ohms and 1 amp at 0.33 volts DC.**

RESULTS



- **Fuel source of 20% methanol is used, these results indicate that this particular cell can produce nearly 1 volt DC at 470 ohms and 1 amp at nearly 0.4 volts DC**

- **The 20% methanol solution results in approximately a 3% increase in voltage and power as compared with the 10% methanol solution.**

CONCLUSION

- Direct water methanol fuel cell application can currently be used in small scale DC electrical components; however, further studies must be conducted to find a way to counteract either the methanol crossover occurrence with solutions higher than 20% and the chemical reaction that occurs when the heating and bubbling occur at 1 ohm resistance

- More studies are needed in construction and configuration in order to power higher current and voltage products which are used today