

2011

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Recommended Citation

Andries, Somer, "Electrochemical Fuel Cell Detectors: Not Just Another Battery" (2011). *Natural Sciences Poster Sessions*. 11.
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Electrochemical fuel cell detectors: not just another battery

By Somer Andries
Chemistry 102 - Francesca Antonaci

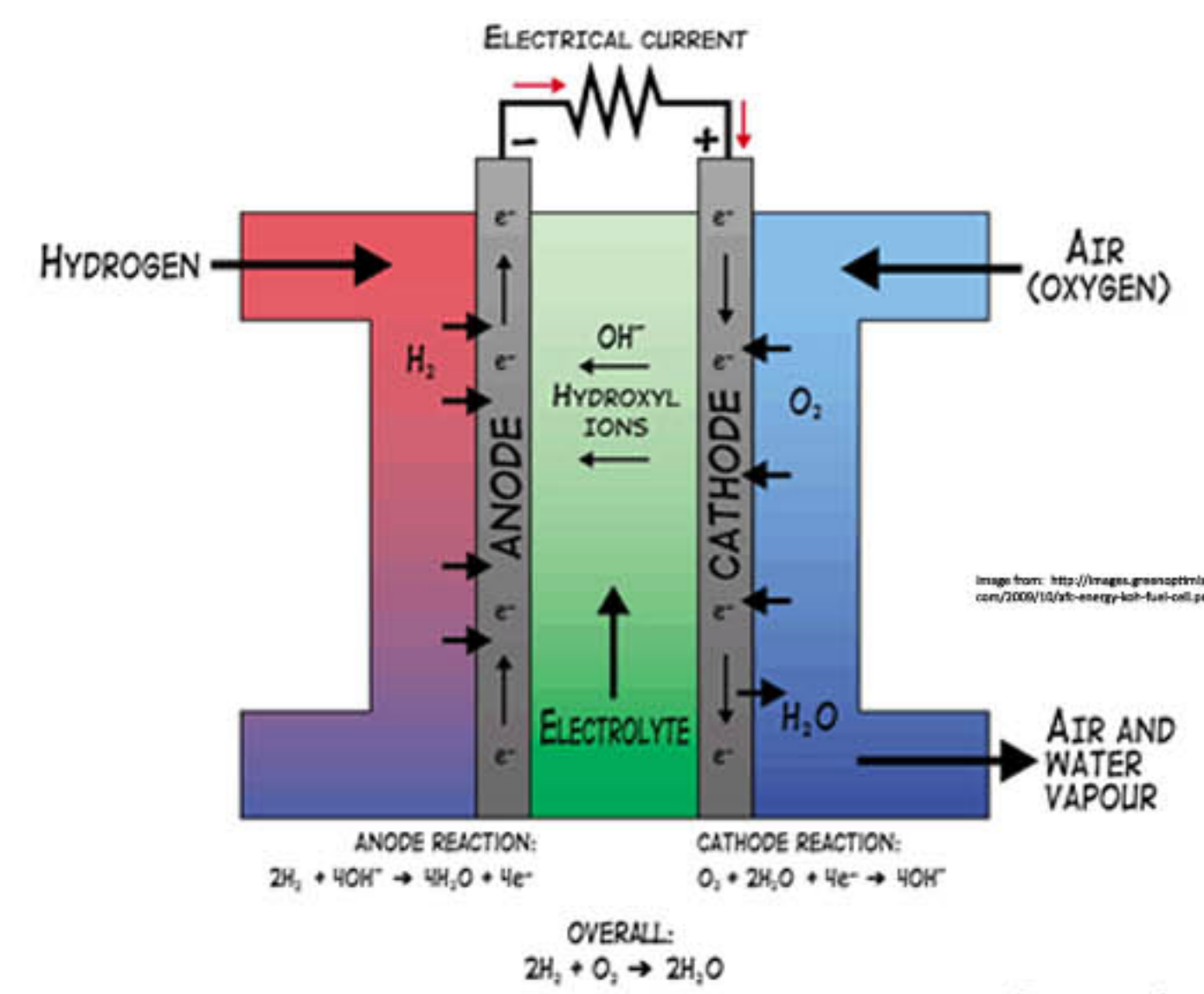


Image from: <http://images.greenoptimistic.com/2009/10/afc-energy-koh-fuel-cell.png>

Battery vs. Fuel Cell

- Both batteries and electrochemical fuel cells have anodes, cathodes and electrolytic solution
- Fuel cells are a galvanic cell that converts the chemical energy of a fuel and an oxidant (like air) into electricity, like batteries
- Fuel cells are thermodynamically open. Unlike batteries as long as there is fuel and an oxidant, the fuel cell will run⁴

Types of Fuel Cells

- The world's first fuel cell was demonstrated by British judge and scientist Sir William Grove in 1839
- Fuel cells are characterized by the types of fuel they use
- Hydrogen is the most widely used but there are many others⁴

Alcohol Fueled- Fuel Cell Detectors

"Breathalyzer" is the generic name

First, a catalyst is used to convert ethanol to ethanoic acid. The catalyst has an attraction for the molecules of ethanol-it stretches and weakens the bond (represented by X-Y).³

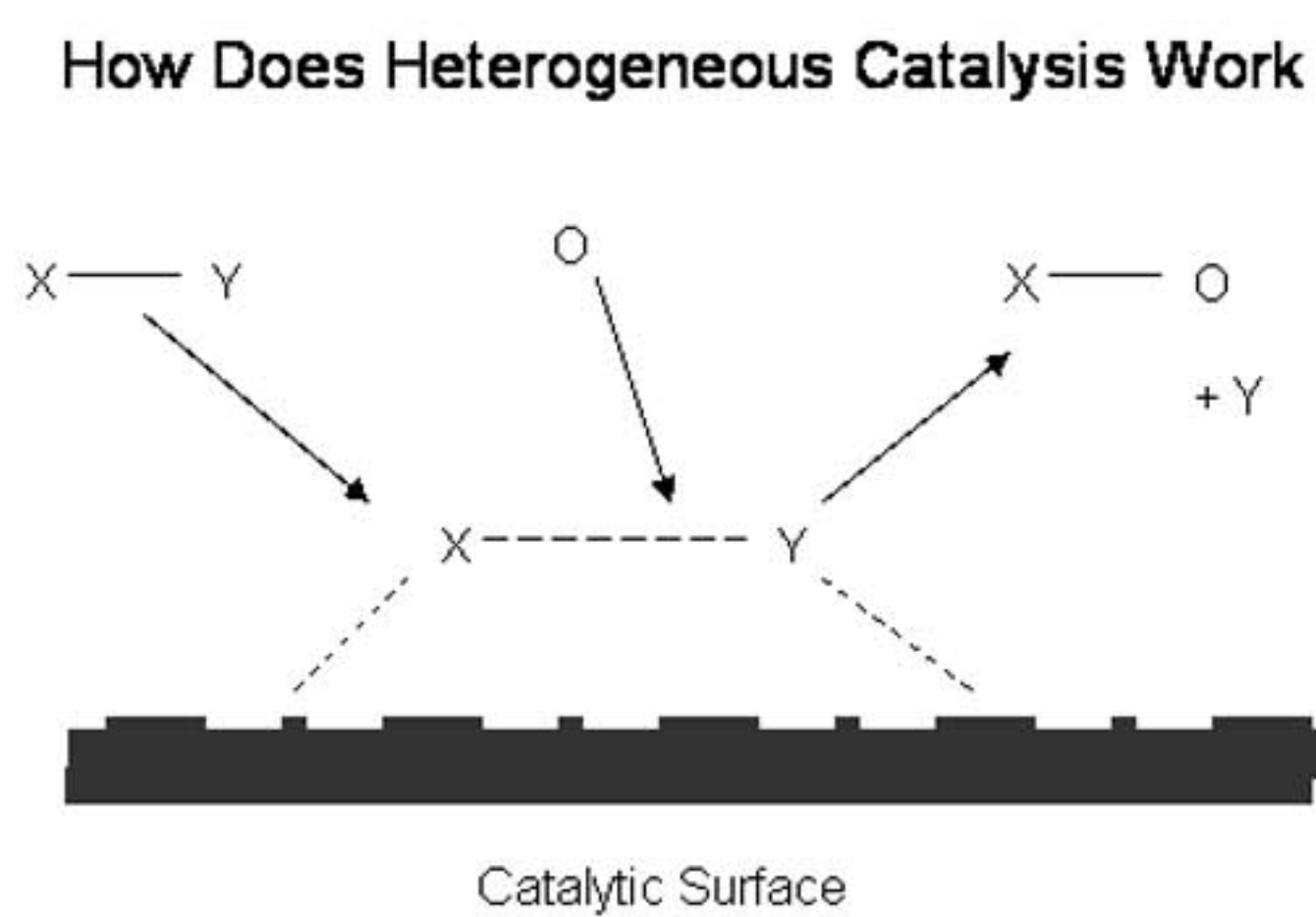


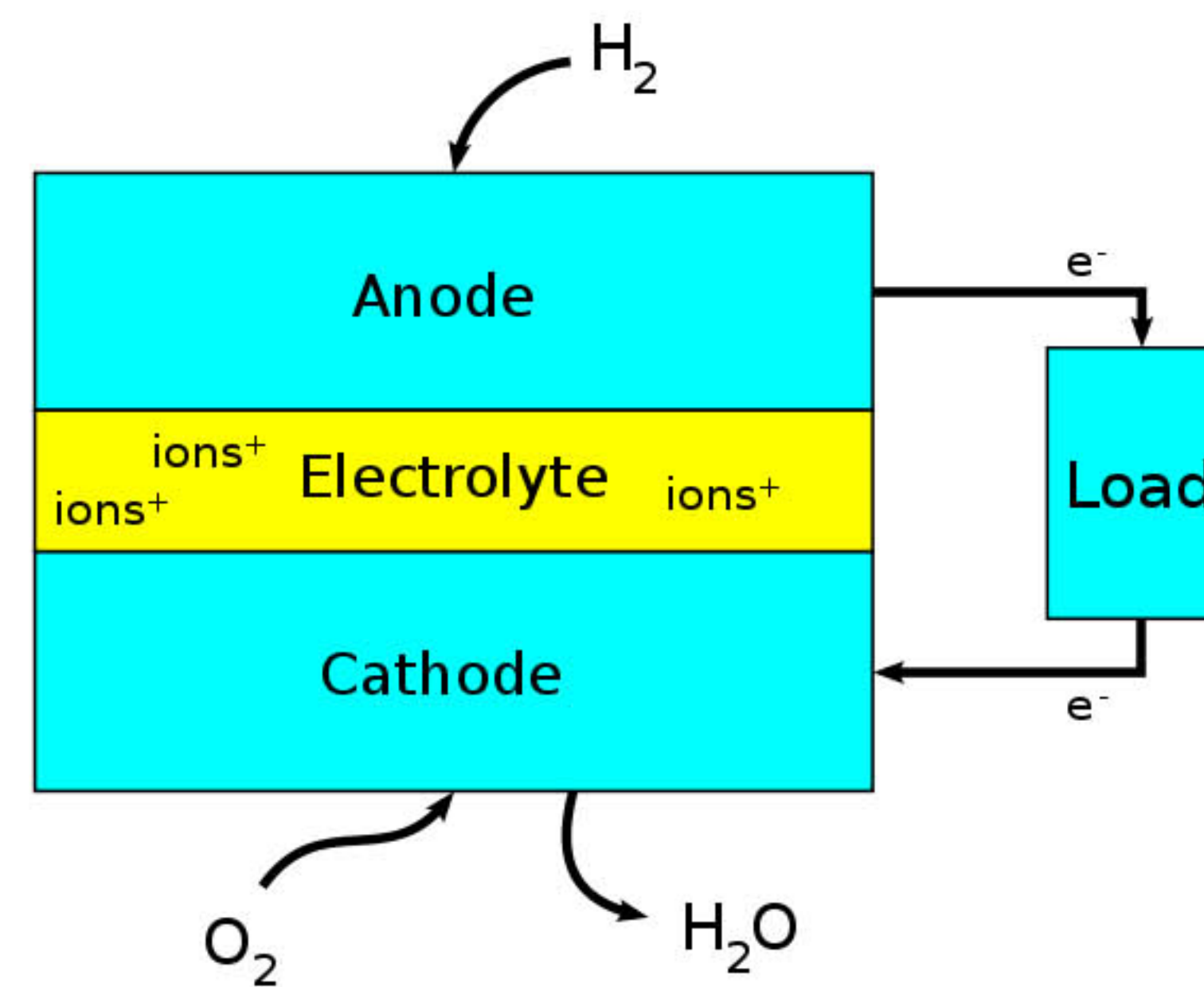
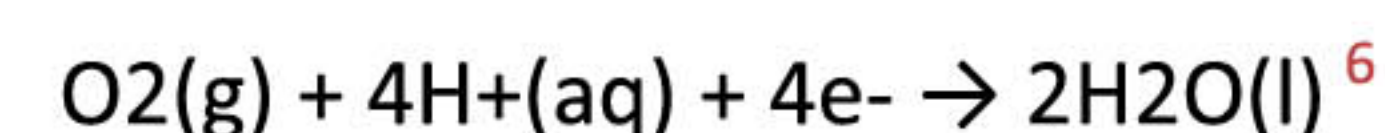
Image from: <http://www.fuelcell-sensors.com/technology.html>

How they Work

Catalysts are usually nickel or platinum. When the user exhales into the fuel cell detector, ethanol present in their breath is oxidized by the catalyst to acetic acid, protons and electrons:



At the cathode, atmospheric oxygen is reduced:

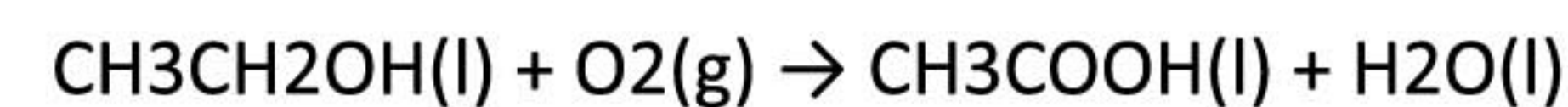


Text from: http://en.wikipedia.org/wiki/File:Fuel_Cell_Block_Diagram.svg

How they work con't.

The electrons flow through a wire from the platinum or nickel anode. The wire is connected to an electrical-current motor and to the cathode on the other side. The protons move through the lower portion of the fuel cell and combine with oxygen and the electrons on the other side to form water.⁶

The overall reaction is the oxidation of ethanol to acetic acid and water.



The electrical current produced by this reaction is measured by a microprocessor. The more alcohol that becomes oxidized, the greater the electrical current. The higher the electrical current, the higher the BAC (Blood Alcohol Content).⁶

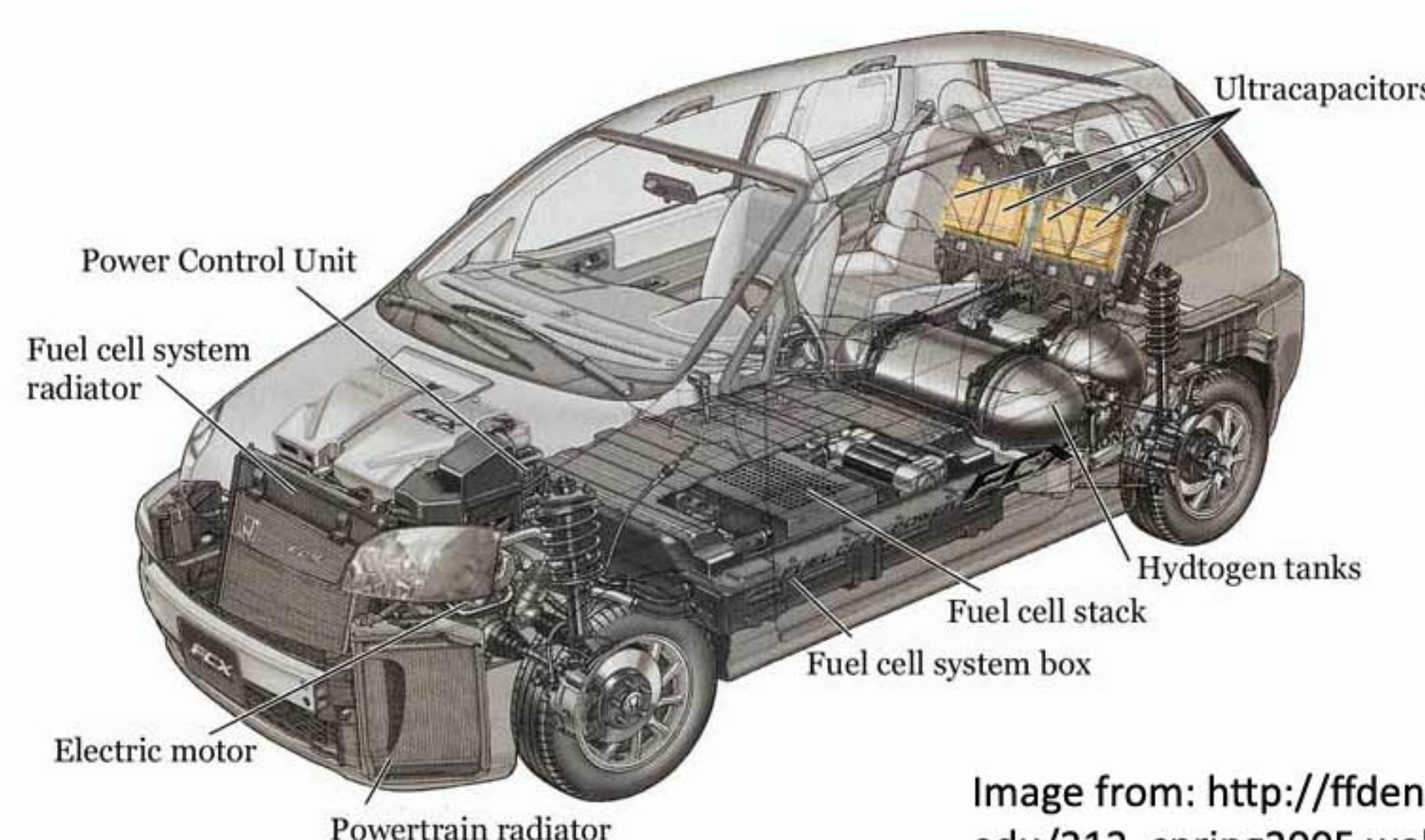


Image from: http://fden-2.phys.uaf.edu/212_spring2005.web.dir/Mike_Wright/img/car.jpg



Image from: <http://www.safetygears.net/images/alcomate-accucell-breathalyzer1.jpg>

Application of Fuel Cells

- Hydrogen fuel cells may replace imported petroleum used in transportation, in particular PEMFCs (see right)
- Micro fuel cells may be installed in Smartphones and Notebooks when they cannot be charged for weeks at a time.
- Base load power plants

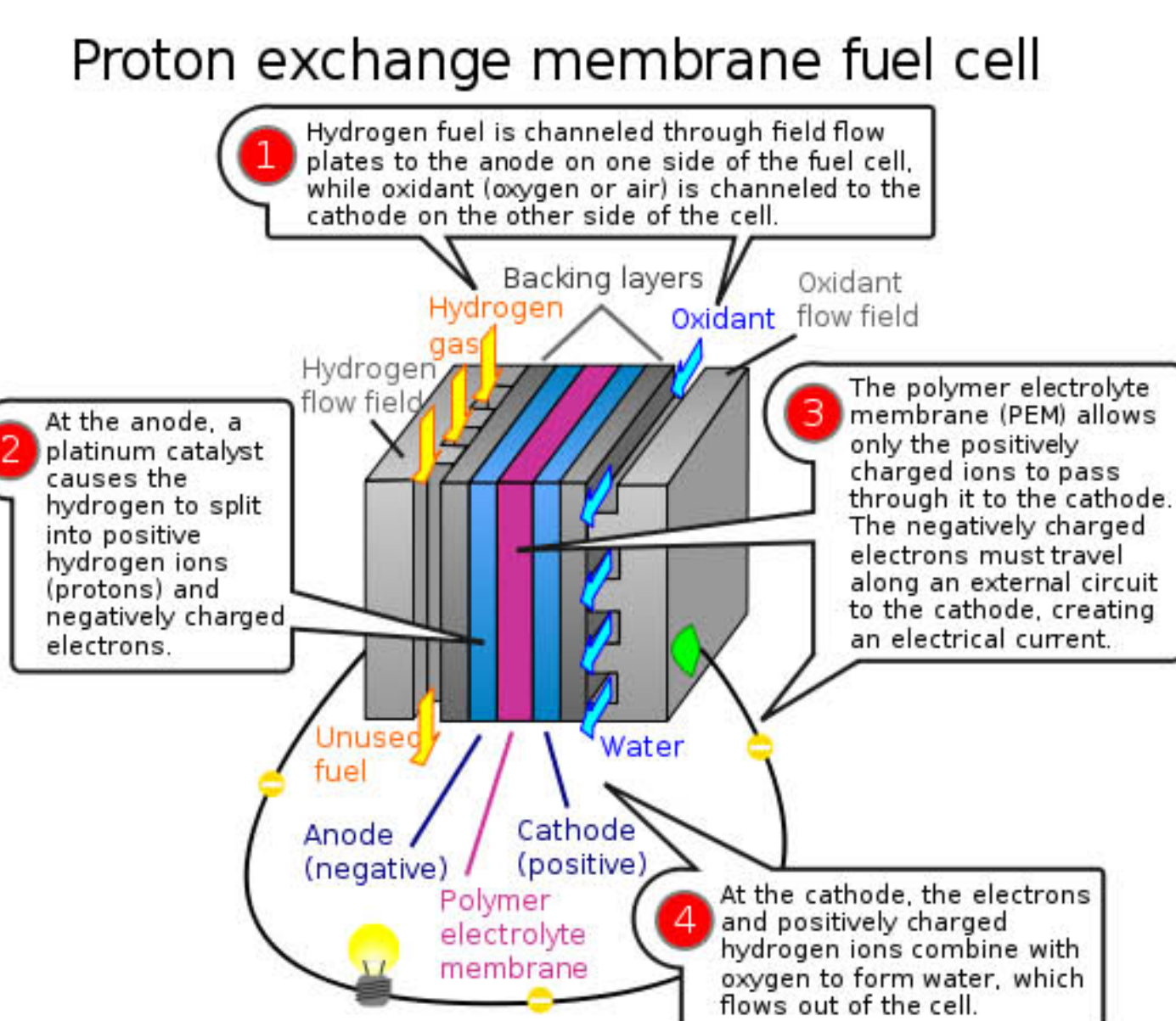


Image from: http://en.wikipedia.org/wiki/File:PEM_fuelcell.svg

Conclusion

Besides the commercial and industrial applications of fuel cells, fuel cell detector technology could be used for medical purposes. Fuel Cell detectors may someday analyze other chemicals on the breath, such as VOCs (Volatile Organic Compounds) which are biomarkers (odor profiles) and metabolic products in the breath. It appears cancer cells emit different metabolic waste products than normal cells. For instance, someone with lung cancer has increased alkane and benzene levels in their breath, similar to how untreated diabetics have ketones on their breath. Additionally, VOCs may vary among patients with different cancers.⁷ Fuel cells could also be used to detect high levels of acetone for diabetic patients and those with kidney disease.³

Bibliography

- 1 No Author. Fuel Cell Basics. <http://americanhistory.si.edu/fuelcells/pem/pemmain.htm> (Accessed March 31, 2011)
- 3 Marle, Leanne. Breathe easy for cancer diagnosis. http://www.rsc.org/Publishing/Journals/cb/Volume/2010/01/breathe_easy.asp (accessed Jan 28, 2011)
- 4 Freudenrich, Craig. How Breathalyzers Work. <http://electronics.howstuffworks.com/gadgets/automotive/breathalyzer3.htm> (Accessed March 31, 2011)
- 5 No Author. <http://www.fuelcellsensors.com/technology.html> (Accessed March 31, 2011)
- 6 No Author. http://www.craigmedical.com/Breathalyzer_FAQ.htm#Scientific%20Method%20and%20Technology (Accessed March 31, 2011)
- 7 Wu, Corrina. The Smell of Cancer. <http://www.technologyreview.com/biomedicine/21296/page1/> (Accessed April 6, 2011)