Hydrogen in a Fuel Cell

In simplest terms, a fuel cell is similar to a battery. Both operate by electro-chemically converting a fuel to usable energy (electricity and heat) without the use of combustion. The main difference is that a battery has a finite supply of reactants, while in the ideal sense, fuel cells can run indefinitely as long as their reactants are replenished. By feeding a fuel such as hydrogen through one porous electrode (the anode) in the presence of a catalyst, electrons are stripped from the fuel and make their way through the external circuit. The remaining positive ions travel through the electrolyte to the other porous electrode (the cathode), where they combine with oxygen ions, formed when the free electrons combine with oxygen fed in at the cathode. The by- products of the reaction are heat and water for a PEM fuel cell. See Figures 1 through 4

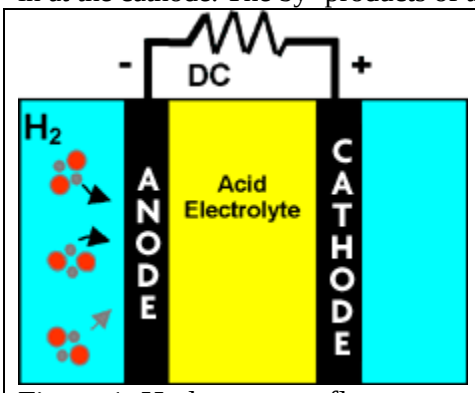

Figure 1. Hydrogen gas flows over the anode.

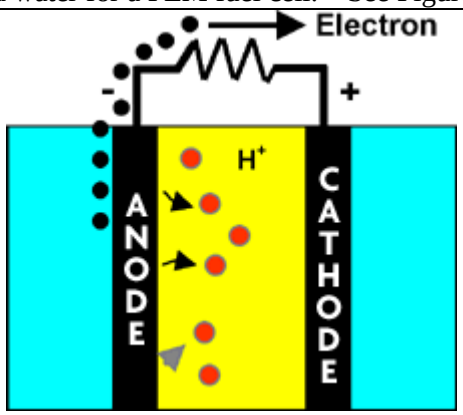

Figure 2. Electrons are stripped from the hydrogen and flow through the anode to the external circuit.

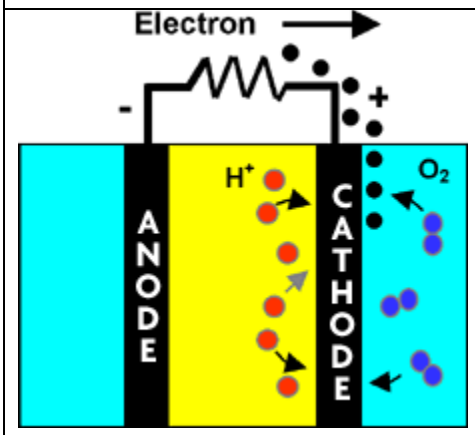

Figure 3. Hydrogen ions move through electrolyte to cathode. Electrons move into cathode from load. Oxygen is introduced to the cathode.

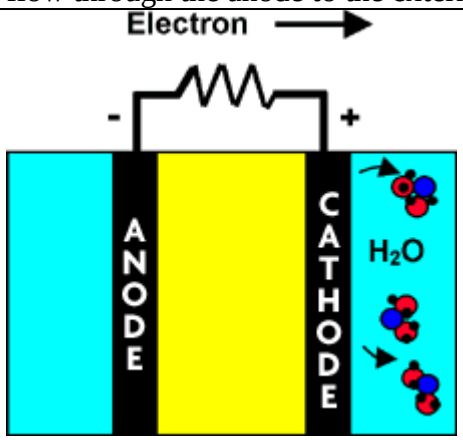

Figure 4. Hydrogen ions, electrons, and oxygen combine to form water (steam).

The above information taken from **http://www.dodfuelcell.com/paper2.html** and slightly modified

Other Important Concepts:

1. **Oxidation** occurs at the **anode** $H_2 \longrightarrow 2H^+ + 2e$ oxidation number of $H^+ = 1$
2. **Reduction** occurs at the **cathode** $O_2 + 4e \longrightarrow O^{-2} + O^{-2}$ oxidation number of $O^{-2} = -2$
3. The electrons stripped from the H atoms are used to do **electrical work**.
4. The reaction between the hydrogen and oxygen in a fuel cell is called **cold combustion**
5. Note that the electrolyte is an **acid electrolyte** - because H^+ ions available