FUEL CELL

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Abstract

In this project, the fuel cell catalytic and the other active materials reactions of the Polymer Exchange Membrane (PEM) fuel cells are investigated by simulation using MATLAB, Visual Studio 2008 and Intel Parallel Studio XE 2011 by First Reaction Method and the characteristic curve (on a basic fuel cell system) and the effect of temperature on the power generated (PC 50) are researched.

Introduction

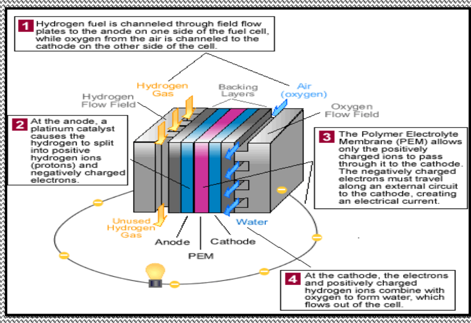
The purpose of a fuel cell is to produce an electrical current that can be directed outside the cell to do work, such as powering an electric motor or illuminating a light bulb or a city. Because of the way electricity behaves, this current returns to the fuel cell, completing an electrical circuit.

Review of Literature

A fuel cell is a device that converts the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent. Hydrogen is the most common fuel, but hydrocarbons such as natural gas and alcohols like methanol are sometimes used. There are many types of fuel cells, but they all consist of an anode (negative side) a cathode (positive side) and an electrolyte that allows charges to move between the two sides of the fuel cell. Electrons are drawn from the anode to the cathode through an external circuit, producing direct current electricity. As the main difference among fuel cell types is the electrolyte, fuel cells are classified by the type of electrolyte they use.
The most common types of fuel cells;

- Proton Exchange Membrane (PEMFC)
- Alkaline Fuel Cells (AFC)
- Phosphoric Acid Fuel Cells (PAFC)
- Molten Carbonate Fuel Cells (MCFC)
- Solid Oxide Fuel Cells (SOFC)

Fuel cell contains three primary components: two electrodes (anode and cathode) and a conductive electrolyte. The proton exchange membrane fuel cell (PEMFC) uses a water-based, acidic polymer membrane as its electrolyte, with platinum-based electrodes. Platinum exhibits high activity for hydrogen oxidation and continues to be a frequently used electrocatalyst material. One major area of fuel cell research has been the reduction in platinum content without a concurrent decrease in cell performance, giving rise to an overall increase in cost effectiveness for the device.



The diagram shows how a PEM fuel cell works.

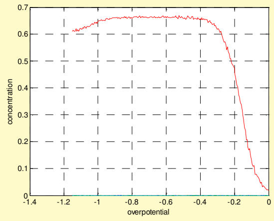
Methods

In the first meeting a brief information is given to project members by project advisors and some other scientists. Project studies were separated into three groups. The first group dealt with the software part and the second group performed the experimental part. Experiments were performed in Energy Systems Engineering Labs. Software part was executed on PCs. The results and discussions were done on the web mostly.
In the software part, the reactions which may probably take place in the fuel cell application were simulated in MATLAB using First Reaction Method. In the experimental part, the characteristic curve of the fuel cell was determined on a basic experimental set and the effect of stack temperature on the stack power was determined on an expert fuel cell (FC 50). In the third part of the studies, Pt(111) and Pt(100) surfaces in the catalyst were set as patterns.

Results

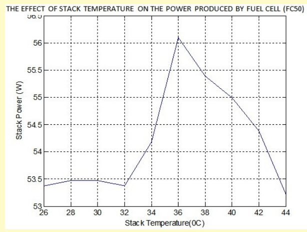
During our research, the simulation of the reactions take place in fuel cells by first reaction method in MATLAB, Visual Studio 2008 and Intel Parallel Studio XE 2011 were performed and the water formed could be determined as a function of over-potential (Fig.1).

Fig. 1. The simulation of the products (mostly water) formed in fuel cell as a function of over-potential



The experimental studies performed on FC 50 showed the effect of temperature on the power generated (Fig.2)

Fig. 2.The Effect of Stack Temperature on Power Produced by Fuel Cell (FC 50)



Conclusion

The simulation studies using first reaction method shows the maximum amount of water which can be formed in a fuel cell specified. The effect of temperature on the stack power experimentally shows that at too low temperatures the catalytic process may be restrained and too high temperatures the resistance increases, particularly from drying of the membranes.

Fuel cells are used in automobiles, vending machines, vacuum cleaners, and high way road signs. Small fuel cells are being designed for laptop computers, cellular phones, and other portable electronics devices.

Energy is an important subject. Renewable sources for energy are getting more and more attractive nowadays and fuel cell is one way of producing energy without polluting the environment. For these reasons the researches on fuel cell continue inevitably.

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