

## Different Types of Fuel Cell

One fuel cell may not necessarily be identical in composition to another. There is a range of types of fuel cell. The differences between various fuel cells are those regarding the type of electrolyte used. The oldest of the designs is the alkaline fuel cell (AFC). This is the cell that was used in the 1960's by NASA in the Apollo space programs. It is a comparatively expensive fuel cell and is susceptible to contamination therefore it requires pure oxygen and hydrogen supplies.


General Electric was also developing fuel cell technology in parallel with NASA. The first Polymer Electrolyte Membrane fuel cell was developed through the work of Thomas Grubb and Leonard Neidrach. The original purpose of this development was to enable portable power to be supplied to US Army and US Navy personnel in the field. NASA became interested in this fuel cell technology when it heard of the developments that were being made and immediately began research and development into the application of General Electric's PEM fuel cell onboard its Gemini spacecraft. Batteries did not provide power for long enough duration and alternatives were being looked at. Problems were encountered with the fuel cell and batteries rather than fuel cells powered the first four Gemini space missions. Work was undertaken to develop this fuel cell further and Gemini space missions six to twelve all utilized fuel cells as a power supply.

Solid oxide fuel cells (SOFC) run at temperatures between 650°C and 1000°C that can mean they are not as reliable as might be desired. Whilst high running temperatures can create reliability problems they do increase the efficiency of the cells. This is due to the steam produced being channeled into turbines that generate additional electricity. The solid oxide fuel cell produces levels of power that make it best suited for large-scale stationary power generators.

The Molten Carbonate Fuel Cell, MCFC, also has properties that are suitable for a large-scale stationary power generator. The MCFC has similar strengths and weaknesses to the SOFC. A high efficiency is achieved and low emissions produced by the cells but the high operating temperature renders the cell unsuitable for residential properties. The high cost relating to the cell and concerns over the long-term durability are problems that must be overcome before these cells become commercially viable.

The Direct Methanol fuel cell is still in its infancy. There are numerous laboratory prototypes but the technology is still far away from being a commercial viability. It is a versatile technology as it can be used in portable, mobile and stationary applications. One reason for the wide range of applications for this cell is that it operates at between only 80°C and 120°C. The DMFC has numerous problems that must be overcome if it is to be a commercial success including its low efficiency and low power density. The unique point of this particular fuel cell is that it draws Hydrogen directly from liquid methanol eliminating the need for a fuel reformer. The fuel cell has a low efficiency, meaning it produces less kWe per litre of carbon fuel than other types of fuel cell. This is currently limiting the enthusiasm surrounding the developments in this technology.

Unlike the DMFC, that is only just being developed, the Phosphoric Acid Fuel Cell has been in development for a number of years. It shares similarities to the SOFC and MCFC as it has applications in providing medium to large-scale power generation. The comparatively low efficiency of this cell is providing a stumbling block to the further development of the DMFC.



The cell is commercially available, and is in use in over 200 commercial fuel cell systems worldwide<sup>1</sup>, but it faces stiff competition from the PEM.

At the current time the Proton Exchange Membrane (PEM) is the cell that is creating the most interest. The low operating temperature enables the PEM to be installed without requiring an expensive containment structure. It is this property that has interested the automobile industry amongst others to invest time and money into the development of the PEM fuel cell. This investment has led to constant improvement in the engineering and materials used in the cells. This has helped to increase the cells power density to such a level that it is plausible for the cell to power a car. Although much of the current development into PEM Fuel Cells is concentrating on the applications within the motor vehicle industry this particular fuel cell can also be used for providing portable power and for medium to large-scale power generation.

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<sup>1</sup> SEYMOUR, J (2001) **Fuel Cells' Technology, Economics Shape Coming Market**, [www.thestreet.com](http://www.thestreet.com),