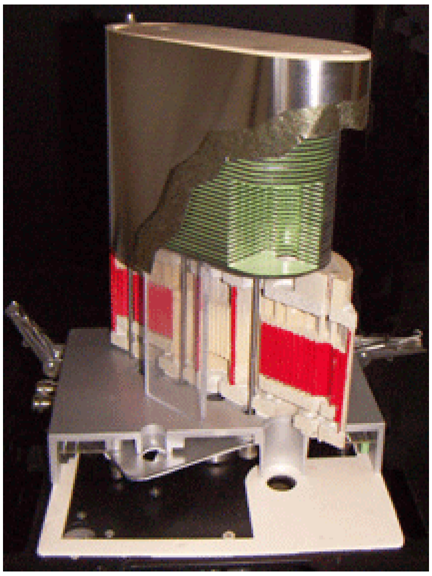
Fuelling the future cleanly

Fuel cells are ideal alternative energy sources

Considered by some as a type of renewable energy, fuel cells are energy conversion devices since they convert the chemical energy of a fuel to electrical energy and heat. Using an electrochemical process they convert oxygen, taken from the air, with hydrogen-rich fluids, or hydrocarbons, to create electrical power and heat. Fuel cells represent an ideal alternative energy source that is perfect for use in combination with renewable energies.



HTceramix fuel cell

Renewable energy sources such as water, the sun or wind cannot be relied on to provide a continuous supply of electricity. When there is a drought or the sun is hidden or wind stops blowing, the source diminishes. Electric power that will then be needed has to have been stored during production. One option is to generate hydrogen as fuel for a fuel cell by electrolyzing water into hydrogen and oxygen. So, when there is a surplus of hydro, solar or wind electricity it can be stored and then used to generate hydrogen which can be fed to a fuel cell to produce an uninterrupted power supply of electricity when there is a shortage. In this way, a fuel cell can be used to even out the supply of electricity that is generated by renewable sources.

A fuel cell is different to a conventional battery in that, instead of using chemicals contained in a closed system to generate electricity, it uses an external fuel, and, where a battery eventually either goes dead or, in the case of an accumulator, needs to be recharged, a fuel cell can continue to operate as long as fuel is supplied. The fuel supply does not have to consist of hydrogen. A fuel cell can also run with hydrocarbon fuels such as natural gas or gasoline, diesel etc. or using more ecological products such as biogas. In these cases it produces a smaller emission of CO_2 than current technologies due to its higher efficiency. With hydrogen however, particularly when it is supplied using renewable energies, there is zero impact on the environment from operating it as the only by-product in its production of electricity and heat is water vapour.

There are different types of fuel cells, the most common being low temperature PEMs (proton exchange membranes) and high temperature solid oxide fuel cells (SOFC). The low temperature fuel cells are being developed to be fuelled with hydrogen and used in mobile applications such as in vehicles where they can replace the propulsion of the engine. High temperature solid oxide fuel cells are best adapted to run as auxiliary power units (APU) in mobile applications, for example providing electricity for headlights, power assisted steering or powered windows. Typically, an APU can be used to supply the power to heat a truck while it is stopped overnight. That enables the cab driver to switch off the engine and sleep in a warm cabin while economizing gasoline and not polluting the atmosphere.

Solid oxide fuel cells work at very high temperatures, between 650 and 1 000 degrees Celsius, which makes them unsuitable for mobile use since they require a certain time to heat up and couldn't be relied on as a fast source of propulsion. They're more suitable as a generator in a home, a remote site or a commercial environment such as a telecommunications or data centre where it's important to have an uninterruptible source of power. Because an SOFC works at a high temperature, the heat it generates can also be used to supply a gas turbine for further power production or in a combined heat and power application to increase the efficiency.

One of the challenges in introducing fuel cells to the mass market is that of ensuring overall safety and compatibility with existing systems. In this respect standardization plays an important role in their commercialization. IEC TC 105, *Fuel cell technologies*, was created in 1999 (kick-off meeting 2000) to develop the necessary safety and interface standards while leaving enough room for further development in the field, not yet specifying any actual design standards for the fuel cells.

HTc with President, Alberto Ravagni, center front

The Swiss Yverdon-based manufacturer HTceramix, or HTc for short, is a specialist in high efficiency electroceramic applications. It develops solid oxide fuel cell stacks for a variety of applications. HTc is a relatively old company in the field of fuel cells since it was created in 2000 as a spin-off from the world-renowned Swiss Federal Institute of Technology, the EPFL.

Today, HTc President, Alberto Ravagni, who was recently elected as a board member of the Industry Grouping for the European Commission's Joint Technology Initiative on fuel cells and hydrogen, explains how an international group of partners is now continuing work using SOFC technology to help alleviate the problem inherent to traditional fossil-based fuels and the generation of CO_2 and produce fuel cells that can be used in more widespread applications.

"We are working with our Italian partner SOFCpower to produce jointly solid oxide fuel cells so that we can commercialize the HTc HoTbox™ on an industrial scale. The SOFCpower pilot production line in Trento, Italy should be operational and ready to go into production by the end of 2007."

The HoTbox™ allows all the high temperature components of an SOFC system to be incorporated into a single unit with standard interfaces for current cables, computer connectors, temperature insulation and voltage output controls which simplifies the task of a system integrator who needs to build a stack into a product.

Solid oxide fuel cells are stacked together (since a single fuel cell would not provide enough useful power). HTc's stacks use a unique technology which can operate in lower than normal operating temperature ranges of between 650°C and 850°C using hydrogen, hydrocarbons or synthesis gas mixtures (syngas). In addition stacks can be produced in different configurations with various footprints which means they can be adapted to a variety of uses depending on need.

HTc employs a ceramic gas diffusion layer which is placed on either side of the solid oxide fuel cell which, in turn, is sandwiched between two metallic interconnects. This reduces the cost of the overall stack by making it less complex and less expensive to manufacture as far as materials are concerned.

"In the near future", says Vice President Olivier Bucheli, "we plan to be able to produce units that will be sufficiently cost effective for them to be used as an alternative source of electrical energy for supplying electricity to houses. We've already produced a 1 kW stack and have plans for a future 2.5 kW version. The sheer fact that we can make use of a variety of fuels and that, instead of CO acting as a poison, we use it as a fuel, means that we offer a very attractive alternative solution to anyone who's concerned about protecting the environment and generating cost effective energy for everyday use."

Click here for further information on Technical Committee 105, *Fuel cell technologies*.

The various publications issued to date are:

- IEC/TS 62282-1 (2005-03), *Fuel cell technologies - Part 1: Terminology*
- IEC 62282-2 (2007-03) Ed. 1.1, *Fuel cell technologies - Part 2: Fuel cell modules*
- IEC 62282-2-am1 (2007-02), *Amendment 1 - Fuel cell technologies - Part 2: Fuel cell modules*
- IEC 62282-3-2 (2006-03), *Fuel cell technologies - Part 3-2: Stationary fuel cell power systems - Performance test methods*
- IEC 62282-5-1 (2007-02), *Fuel cell technologies - Part 5-1: Portable fuel cell power systems - Safety*

IEC/PAS 62282-6-1 (2006-02), *Fuel cell technologies - Part 6-1: Micro fuel cell power systems – Safety*