



Micro Fuel Cells – Dwarves with the Energy of Giants



Design study of a micro fuel cell system used as a power supply for a mobile telephone. The fuel cell is equipped with an open cathode for passive air supply. Methanol fuel is supplied to the anode by capillary force.

Feel free to ask!

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Today the trend is towards increased mobility and, at the same time, constant availability. As a result, portable electronic devices have become more powerful with each new generation. The market is on the look-out for innovative, miniature energy systems that meet the growing energy demand of modern electronic products.

Fraunhofer ISE develops micro fuel cells that can be operated with hydrogen, methanol or ethanol. With such fuels, the energy density of batteries can be significantly surpassed. We adapt the technology to fit the production of our clients. We develop concepts for film etching, ceramic technologies, conductive plates, wafer or injection molding technologies. In order to reduce the complexity and cost of the system, we concentrate on a passive operation principle.

Does your application have special boundary conditions? We match our micro fuel cell systems to fit your specifications.

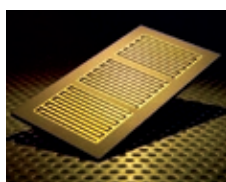
Do you prefer an alternative to hydrogen? No problem. We use alternative fuels like methanol, ethanol or chemical hydrides.

Are you looking for a complete energy supply? We are happy to integrate our micro fuel cell system into a complete concept with battery and other electricity supplies like photovoltaics and thermoelectrics, including a power management system.

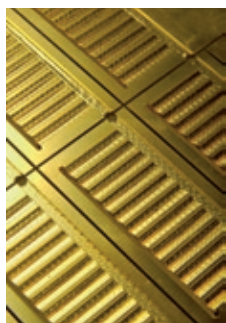
Are you interested in production and marketing? We transfer our know-how to your production and qualify suitable suppliers. We are happy to provide you the exploitation rights associated with our technologies.



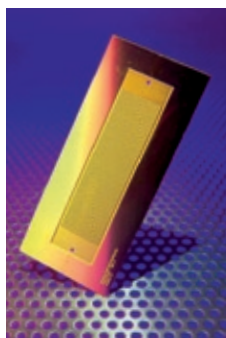
DMFC with USB port
(development sponsored by BMW).
The fuel cell was
manufactured by
injection molding
(client: FWB, Germany)



PEMFC in multi-layer
ceramic (client:
Kyocera, Japan)



FR4 circuit board with
fuel cell flowfield
(cooperation with ILFA,
Germany)



Flowfield investigations
on metal foils
(Fraunhofer research)

Technologies

We develop hydrogen fuel cells as well as direct methanol and direct ethanol fuel cells. Our constructions are oriented on the production technology of our clients. We have experience with series procedures for graphite or ceramic materials, circuit boards, injection molding, wafer technologies and metal foils.

One focus of our work lies in passive reactant delivery methods for fuel cells. We have investigated in detail the diffusive or capillary inflow and outflow of gases and liquids. We layout our flowfields based on CFD simulation results, thermal models and validated mathematical models. Further, we make use of spatially resolved characterization of current, impedance and temperature combined with visual considerations of the water transport in the flowfield.

A decisive factor for the marketability of fuel cells is a long lifetime. For degradation investigations, we apply gas chromatography for exhaust gas analysis, cyclovoltammetry, ICP-MS to identify the elements in the liquid phases or ESEM with EDX to characterize the membrane electrode unit.

An optimized system concept considers both the operating behavior of each component as well as their interaction. Therefore, in developing our components and operating strategy, we take into account the global system requirements.

In addition to the cell technology, we also work on integrating the metal hydride, or pressurized, canisters or tanks for holding liquid methanol or ethanol. Further, we develop hydrogen generators on the basis of chemical hydrides as well as micro-reformers for liquid and gaseous fuels.

In the area of system development, we carry out continuous investigations on commercial materials and components. We foster an intensive transfer of know-how with our numerous suppliers.

Using high-quality fuel cell test stands, we perform load qualification tests on our own developments and on external components. In a climate chamber, we test the operation under temperatures between -40°C and $+80^{\circ}\text{C}$.

Competence

Since the 1990s, Fraunhofer ISE has been carrying out research and development on fuel cells and hydrogen generation. We are continuously active in international research networks and we cooperate closely with industry partners. Fraunhofer ISE is certified according to DIN EN ISO 9001:2000.

In reference projects, we have developed fuel cell systems for camcorders, laptops, sensors and GPS devices.

What can we do for you?