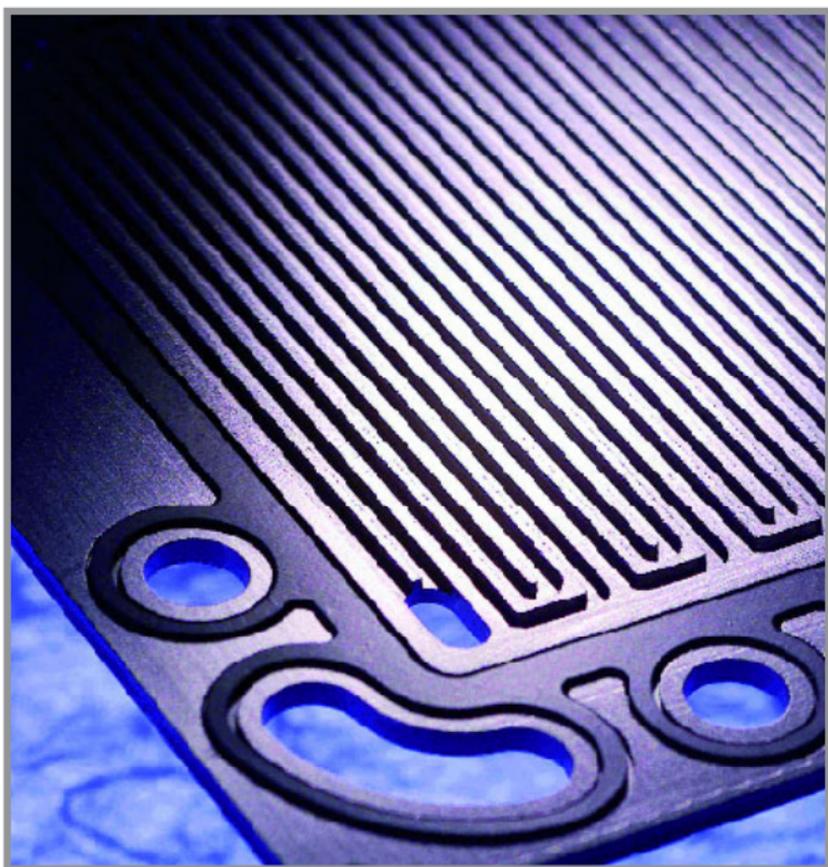


Bioethanol Fuel Cells



Bioethanol

Bioethanol is an energy source with a promising future. The clear, highly flammable liquid – pure alcohol – can be produced from almost any raw material containing sugar or starch. The raw material basis is, therefore, not only broad, but also continually renewable. The largest bioethanol plant in Europe in Zeitz, Saxony-Anhalt, uses various types of cereals and sugar beet to produce up to 260,000 m³ of bioethanol per year.

There are many good reasons to see bioethanol as the energy source of the future:

- The development of renewable energy sources contributes to reducing greenhouse gas emissions.
- Fossil energy sources are finite, whereas energy consumption continues to increase worldwide. To secure the supply of energy for the future, we must develop new sources of energy.
- The use of local energy sources contributes to a diversification of energy supply, reduces dependence on imports, and increases the security of supply.
- The emergence of a new industry sector creates and secures jobs and generates new opportunities for the agricultural sector.



Fuel Cells

Fuel cells are the technology of the future for supplying power to electrical equipment.

Decisive advantages compared to competitive technologies include:

- High efficiency even under partial load
- Low noise and pollution emissions
- Extended operating time thanks to energy-rich fuels
- Simple refilling
- Independence of power and energy content

Forecasts therefore show high growth rates in the fuel cell market in the years ahead. Bioethanol is an outstanding fuel and can facilitate the break through of the fuel cell into mass-markets.

Direct use of bioethanol in a Direct Ethanol Fuel Cell (DEFC)

The DEFC can convert bioethanol electrocatalytically and directly in the electrode. Fraunhofer Institutes are developing DEFC for portable applications, such as battery chargers. The vision of developers is the mobile phone powered by bioethanol.

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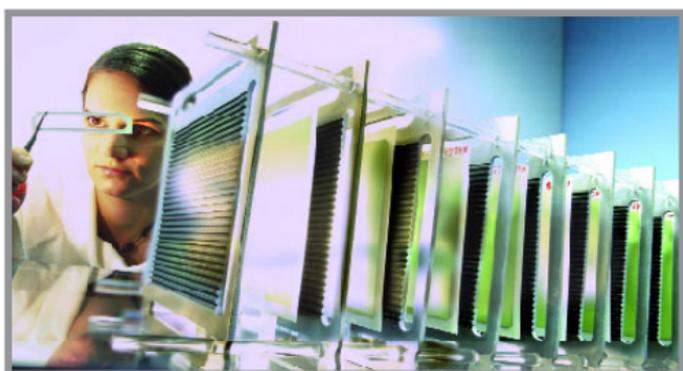
Fraunhofer Team Direct Ethanol Fuel Cell, www.defc.de



Direct use of bioethanol in a high temperature fuel cell – Solid Oxide Fuel Cell (SOFC)

The SOFC converts fuels to power and heat under high temperatures and is well suited for stationary applications, such as power stations (1 to 200 kW). The technology is also of interest for auxiliary power units in trucks, buses, cars and for leisure/camping applications.

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Use of bioethanol as a hydrogen source

The reformer technology catalytically generates hydrogen from fuels such as bioethanol. The hydrogen can then be used in a fuel cell to generate power or heat. For example in a cogeneration unit which supplies power to homes.

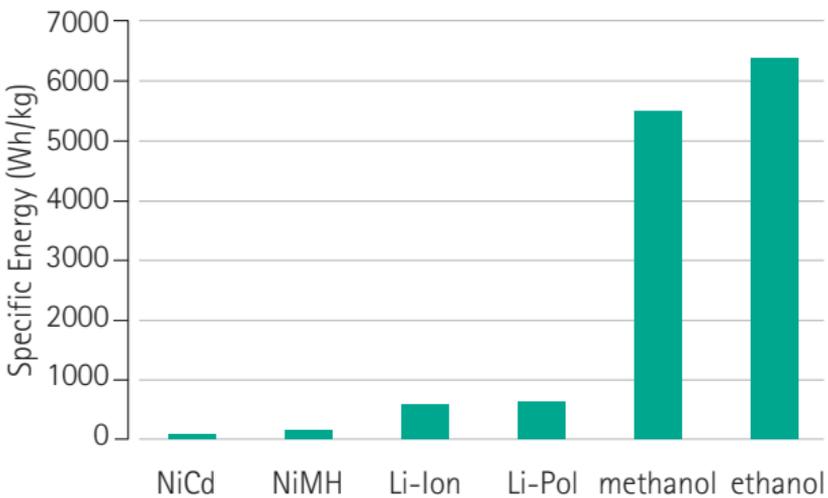
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Advantages of Bioethanol for Fuel Cells

Bioethanol ...

- has a high specific energy density; it significantly exceeds that of methanol
- can be used in an aqueous solution in fuel cells; this facilitates the operation of fuel cells, saves investment and energy expense for the dehydration of bioethanol
- is very environmentally friendly compared to other fuels. Using bioethanol does not demand any new operational techniques or processes
- is a fluid energy source, for which an established comprehensive infrastructure is already available, with the necessary operational expertise
- can be transported and stored relatively easily. Unlike for hydrogen and methanol, the entire logistics chain for bioethanol is easy to set up.
- is produced increasingly in the EU; companies like CropEnergies AG – part of the Südzucker-Group – ensure the supply of pure bioethanol



Energy density of different battery types and fuels

The Partners

On behalf of CropEnergies AG, the Research and Development Department of Südzucker AG Mannheim/Ochsenfurt (ZAFES) will work closely with several institutes of the Fraunhofer-Gesellschaft in the future to promote the use of bioethanol in fuel cells.

Fundamental physical and electrochemical research will be carried out on the operation of fuel cells with bioethanol. In addition to this, various bioethanol fuel cell concepts for technical operations are tested and further developed. CropEnergies AG, one of the leading European manufacturers of bioethanol, will continue to actively participate in the further development of this sector.

CropEnergies AG

CropEnergies AG uses local renewable raw materials to produce bioethanol, which – as an automobile fuel – sustainably secures mobility, while contributing to climate protection.

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Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is the leading organisation for applied research in Europe. It undertakes applied research of direct benefit to companies and society as a whole.

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Südzucker AG Mannheim/Ochsenfurt

Südzucker AG Mannheim/Ochsenfurt specialises in industrial processing and marketing of agricultural produce. Research activities focus on the development of top quality nutritional products and technical applications.

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