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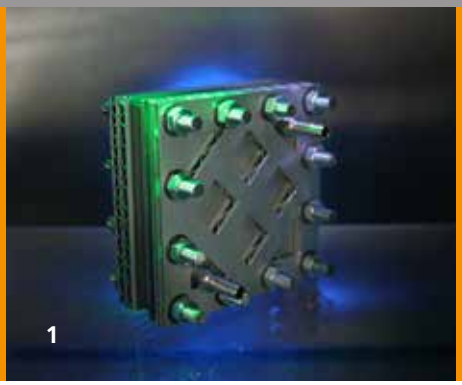
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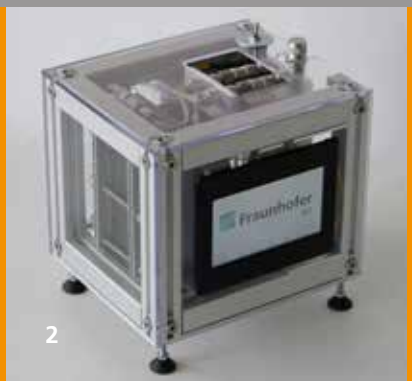
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1 *AEM-DAFC short stack with ultra-light end-plates.*
2 *10 W AEM-DAFC demonstration system.*

ANION EXCHANGE MEMBRANE DIRECT ALCOHOL FUEL CELL (AEM-DAFC)

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Direct alcohol fuel cells (DAFCs) convert the chemical energy of alcohols to electric power. They are consequently a potential alternative to conventional batteries for mobile and portable applications, which require a long service life despite frequent use. Due to high material costs, acidic direct alcohol fuel cells are not yet commercially viable.

Advantages of the alkaline environment

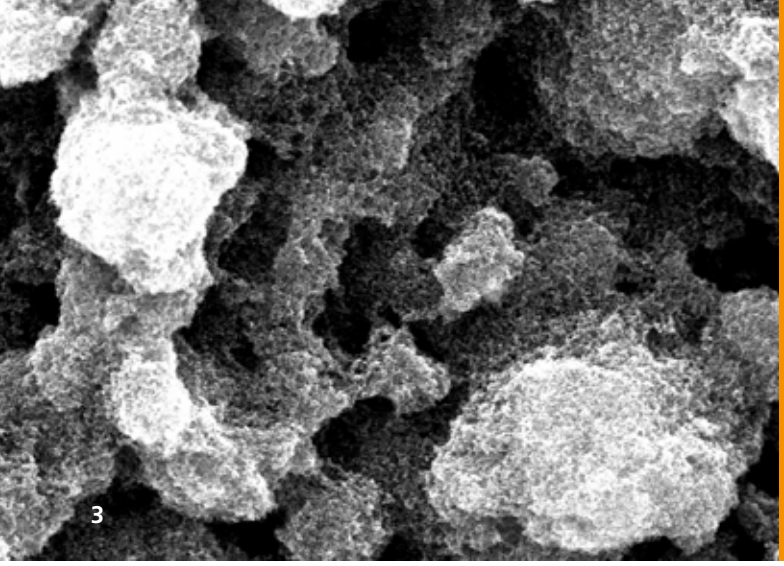
By altering the environment from acid to alkaline, and using an anion exchange membrane (AEM) rather than a proton exchange membrane, various advantages can be achieved:

- Improved reaction kinetics for both electrodes
- Use of non-platinum metals as catalysts
- Use of low-alloy steels for fuel cell stack construction
- Use of non-fluorinated polymers as membranes or binders
- Reduced cost of the system
- Higher power output
- Use of alternative fuels

Choose your fuel

Methanol is the simplest and most frequently used fuel for DAFCs. However, other alcohols, which are easier to handle and more readily available, may be employed in AEM-DAFCs – even complex alcohols like glycerine or propanol are feasible.

Besides extensive experience with common fuels such as methanol and ethanol, Fraunhofer ICT also investigates alternatives such as ethylene glycol. Ethylene glycol is provides comparable energy density, and is non-toxic and non-flammable, making it easy to transport and consumer-friendly.



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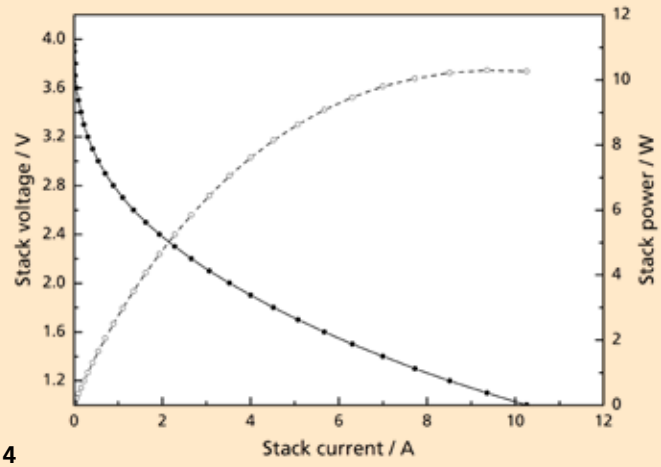

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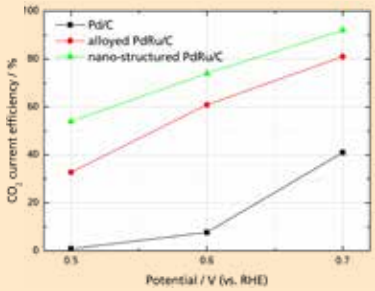
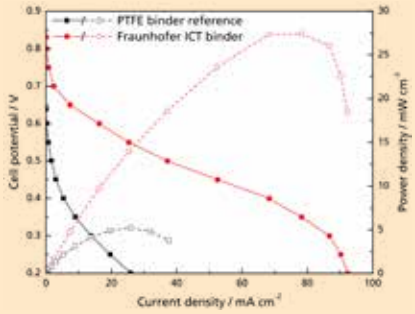
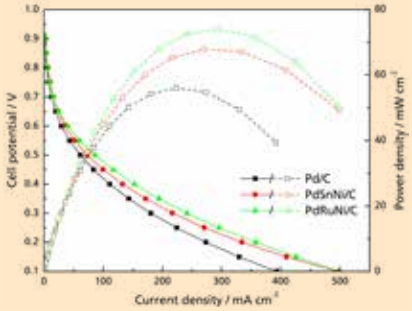
CO_2 current efficiency of Pd/C reference and PdRu catalysts developed at Fraunhofer ICT at different oxidation potentials.



U-I curves and cell performances of membrane electrode assemblies with PTFE binder or the binder developed at Fraunhofer ICT (no addition of KOH to the methanol fuel).



U-I curves and cell performances of AEM-DAFCs fueled with ethylene glycol (+KOH), which employ Pd/C or trimetallic Pd-based catalysts as anode catalysts.



Our profile

At Fraunhofer ICT, materials for AEM-DAFCs are developed and investigated in detail. To improve the overall cell performance, the institute successfully developed alloyed and nanostructured platinum-free anode catalysts. These have high conversion efficiencies for several alcohols: for example, a core-shell structured Pd-based catalyst developed at Fraunhofer ICT achieved CO_2 current efficiencies of up to 92 % for methanol electrooxidation. Our expertise in the field of electrochemical oxidation of alcohols enables us to collaborate with scientific researchers worldwide.

Besides catalysts, Fraunhofer also develops catalyst binders, as a link between the AEM and the catalyst. Particular emphasis is placed on adapting the binder to the operating conditions of the fuel cell. Through the development of a binder with a high chemical stability and ionic conductivity, based on polyphenylene oxide, the power output of an AEM.DAFC fueled only with methanol (with no added KOH) could be increased fivefold.

Besides material development, Fraunhofer ICT has long-standing experience in preparing AEM-DAFC membrane electrode assemblies, developing stack components and testing AEM-DAFC membranes, single cells and stacks.

Fraunhofer ICT is looking for partners to further develop anion-exchange membrane direct alcohol fuel cells.

Our expertise

- Synthesis of electrocatalysts and binder materials
- Investigation of electrochemical processes at the anode and cathode
- Online analytics to determine product distributions
- Test of membrane materials for use in AEM-DAFCs
- Development of membrane-electrode assemblies
- Building and testing of AEM-DAFC systems

Desired partners

- End-users wishing to implement AEM-DAFCs in their applications
- Manufacturers of electrocatalysts, membrane materials and fuel cell systems

3 *Scanning electron microscopy image of a catalyst layer bound by an anion-exchange binder developed at Fraunhofer ICT (5.000x magnification).*

4 *U-I curve of a methanol-fueled 5-cell AEM-DAFC short stack with platinum-free electrodes.*