Direct Methanol Fuel Cells

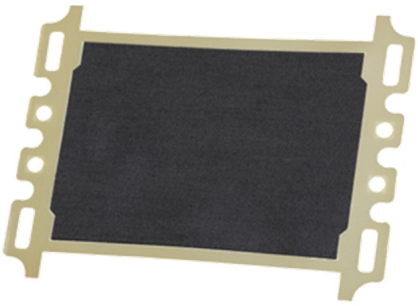
Electricity generation from methanol for light traction and UPS

Direct methanol fuel cells (DMFCs) directly convert the liquid fuel methanol into electric current.

Advantages of a DMFC:

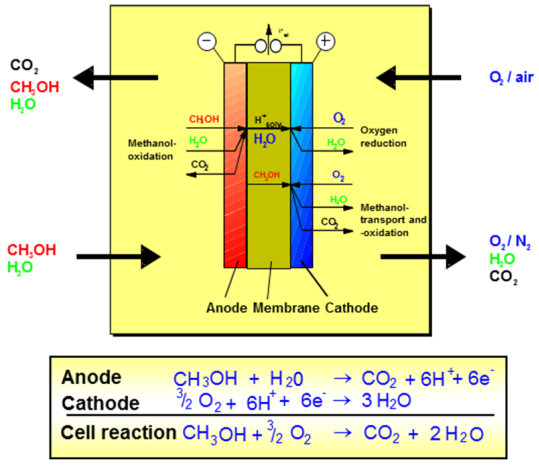
- High energy density of methanol
  - longer operating times
  - larger range
- Fast refuelling
- Simple system setup

Energy source	Energy density in MJ per liter
Methanol (liquid)	**15.9**
Hydrogen (gaseous) @ 700 bar	**4.7** (approx. 3.4 incl. Tank)
Hydrogen (gaseous) @ 350 bar	**2.7** (approx. 2 incl. Tank)

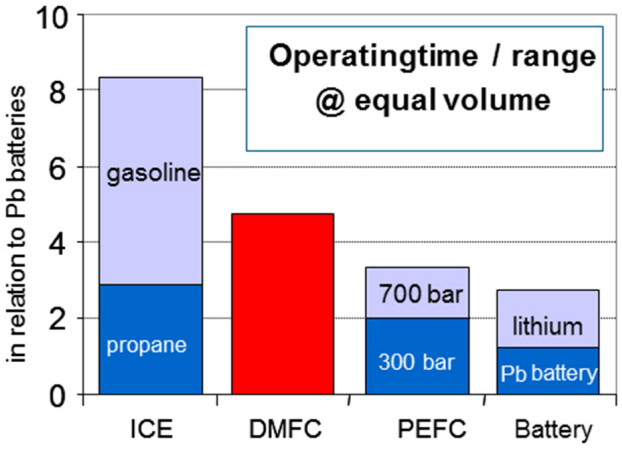


Membrane-Electrode-Assembly (MEA)

Principle of a DMFC



Anode	$CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$
Cathode	$\frac{3}{2} O_2 + 6H^+ + 6e^- \rightarrow 3 H_2O$
Cell reaction	$CH_3OH + \frac{3}{2} O_2 \rightarrow CO_2 + 2 H_2O$

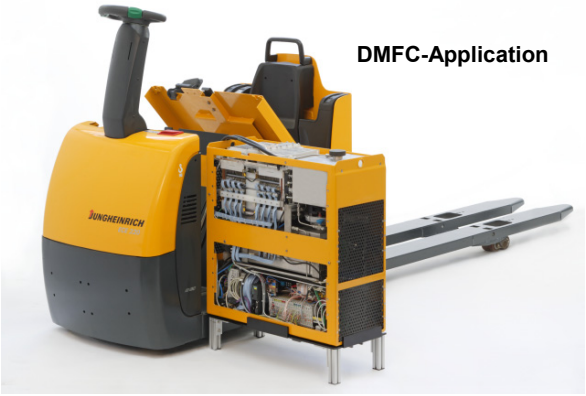


Direct methanol fuel cells are attractive for various applications, above all, however, as replacements for batteries or accumulators, since DMFC systems permit longer operating times due to the high energy density of methanol.

DMFC-Stack

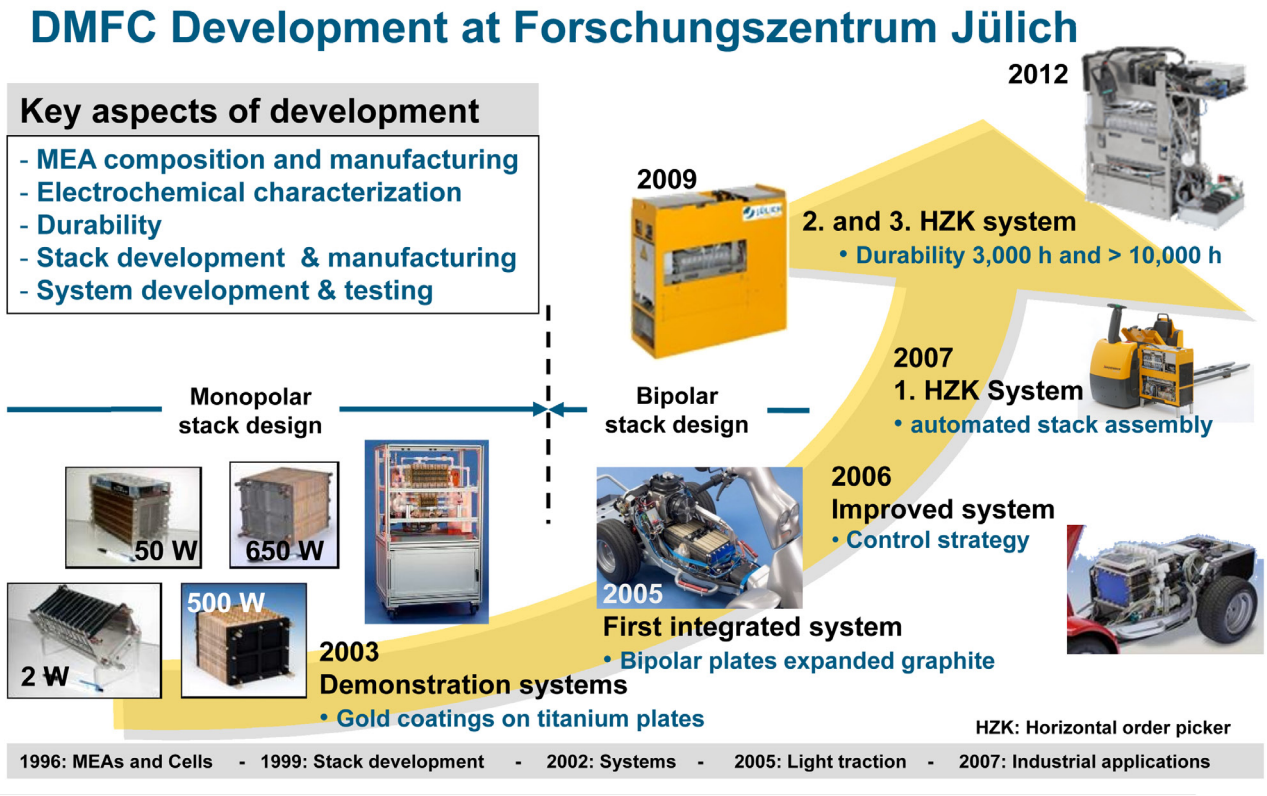
DMFC-System

DMFC-Application



Institute for Energy- and Climate Research – Fuel Cells (IEK-3)

For small, mobile applications e.g. in the field of material handling direct methanol fuel cells (DMFCs) provide thanks to their large range and the fact that they are easy to refuel an interesting alternative to lead-acid batteries. IEK-3 has therefore made the research and development of DMFC technology one of their main priorities.



Challenges / development goals for light traction (long-term)

- Long-term stability of stack/system: 20,000 h / > 10,000 h
- Performance MEA: 100 mW/cm² @ BOL*
- DMFC system efficiency: ≥ 35 %
- Water autonomous operation of the system: up to 40 °C, ambient temperature
- Prototype development system: function and cost

*BOL: beginning of life

Activities focus on increasing the overall efficiency, power density, and long-term stability of fuel cells, while simultaneously decreasing the manufacturing costs. In order to achieve these objectives, degradation mechanisms must be identified, material and manufacturing costs must be reduced for stack components and MEAs, the quality must be increased, and a highly integrated production technique must be mastered. The challenge within the scope of applications lies in optimally integrating fuel cells into energy (hybrid) systems and realizing a closed water cycle during system operation. Important flanking activities are carried out in the area of analysis in the context of research into the structure-activity relationships of functional layers and the space-resolved electro- and physiochemical characterization of fuel cell components.

Contact

Direct Methanol Fuel Cells (DMFCs)
Electricity generation from methanol for small vehicles

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