



IEK-3 Report 2013

Durable Electrochemical Process Engineering

Forschungszentrum Jülich GmbH
Institute of Energy and Climate Research (IEK)
Electrochemical Process Engineering (IEK-3)

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Institute of Energy and Climate Research - Electrochemical Process Engineering (IEK-3)

IEK-3 is one of nine subinstitutes within the Institute of Energy and Climate Research (IEK) at Forschungszentrum Jülich GmbH. IEK-3 aims to conduct research that is socially, ecologically and economically relevant and thus generate ground-breaking results on an international level. This quality of work is achieved through basic research, which is closely coordinated with technical development work in relevant scientific and technical fields of expertise. International cooperations with partners from research and industry are particularly important in this respect.

By implementing research results in innovative products, procedures and processes in cooperation with industry, IEK-3 hopes to help bridge the gap between science and technology. Collaboration with universities, universities of applied science, training departments and training centers is designed to promote opportunities for further education and training.

With a staff of approximately 110, IEK-3 concentrates on the basic topics of electrochemistry and process engineering for fuel cells and electrolyzers. In an integrated approach, the five key areas of work in the institute – solid oxide fuel cells, fuel processing systems, high-temperature polymer electrolyte fuel cells, direct methanol fuel cells, and polymer electrolyte membrane electrolysis – are accompanied by systems analysis and theoretical investigations, basic modeling and simulations, and by experimental and theoretical systems evaluations. The information generated in these areas is used to design and verify functional systems. In addition, particular attention is given to the development, configuration and application of special measuring techniques for the structural analysis of membrane electrode assemblies, for flow simulation and visualization, and for the characterization of stacks.



The 20 kW test stand pictured here is a compact SOFC system that can be used to supply heat and power. It comprises four 5 kW modules, which contain all of the hot system components ($> 500\text{ }^{\circ}\text{C}$). In this first development stage with simple process engineering, the system can achieve a net electrical efficiency of between 41 % and 48 %.

The fuel processing module pictured here comprises an autothermal reformer, a two-stage water-gas shift reactor, a catalytic burner, a heat exchanger and two electric heating cartridges. The system has a volume of 85 liters and can supply HT-PEFC stacks with fuel gas. The latter then generate an electric power of up to 10 kW.

The energy supply module pictured here can be used as an alternative to large batteries for light traction. The hybrid system with direct methanol fuel cells is supported by a small battery and achieves a continuous output of around 1 kW. It is operated with pure methanol and achieves an efficiency of 29 % when operated under high dynamic loading. The system has been in continuous operation for more than 10,000 hours.