

Fuel Cell Components and Material Development

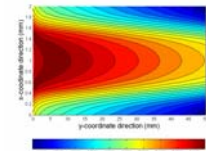
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Institut für Chemische Technologie anorganischer Stoffe
Technische Universität Graz

13.12.2007 TechGate Vienna

Laboratory for Fuel Cell Systems Graz University of Technology

- Established 2002
- Concentrates on applied research
 - Low temperature fuel cells
 - Hydrogen production / conditioning
- Twelve scientific & twelve non-scientific workers
- Infrastructure
 - Fully automatic fuel cell test rigs
 - Fully automatic hydrogen and catalyst test rigs
 - Electrochemical measurement methods, segmented cells, etc.
 - Gas online analysis systems
 - SEM, TGA, Hg-porosimeter, MS, etc.

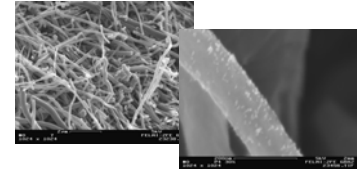
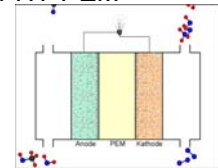


Content

- Development and characterisation of innovative materials for HT-PEM
- Investigation of degradation of fuel cell components
- FC modeling software with real time functionality for fuel cell component development
- Production of hydrogen by reduction/oxidation of metal oxides

Development and characterisation of innovative materials for HT-PEM

- Development of innovative materials for electrodes and electrolytes
- Lowering Pt-loading in electrode
- Development of a new method for production of electrodes based on nanofibres



Wallnöfer, E., et al., ECS Trans. 1, (6) 491 (2006).
Hacker, V., Wallnöfer, E., et al., Electrochem. Comm., Vol.7 (4), April 2005.
Wallnöfer, E., Hacker, V., CNF-Elektroden, Patentanmeldung, 2005.

Investigation of degradation of fuel cell components

- Membrane degradation at OCV operation
 - State of the art
 - OCV Tests at standard conditions
 - OCV Tests at low temperature
 - OCV Tests at low humidification
- Electrode degradation at OCV and low current densities
 - Effect of high potentials at the cathode outlet at low current densities
 - Current densities / electrochemical potentials at dead end operation



Investigation of degradation of fuel cell components

- In-situ membrane degradation tests under OCV conditions
- Five fuel cells are tested simultaneously
- Duration of OCV tests: 33 days (800 h)



Hacker, V., et al., Electrode and membrane ageing mechanisms in PEMFC, Degradation Issues in Fuel Cells, Crete, Greece, September 19-21, 2007.
Baumgartner, W., Wallnöfer, E., Schaffer, T., Hacker, V., Painsicco, V., Prenzinger, P., ECS Trans. 3, (1) 611 (2006).

Investigation of degradation of fuel cell components

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Performance Loss

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Investigation of degradation of fuel cell components

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Change in membrane resistance

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Investigation of degradation of fuel cell components

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Hydrogen Diffusion

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Fluoride Emission Rate

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Investigation of degradation of fuel cell components

- Electrode degradation at OCV and low current densities
 - Effect of high potentials at the cathode outlet at low current densities / critical Potential
 - Current densities / electrochemical potentials at dead end operation

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Investigation of degradation of fuel cell components

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FC modeling software with real time functionality for fuel cell component development

- Development and integration of FC models with RT capability into GenFC
- GenFC: *Generic Fuel Cell Modeling Environment* (EC project)
- Tasks:
 - Development of FC models with RT capability (PEMFC & SOFC)
 - Interface GenFC/LabVIEW
 - Integration into LabVIEW
 - Visualization with Application Terminal
- Available online in autumn 2008
www.genfc.org

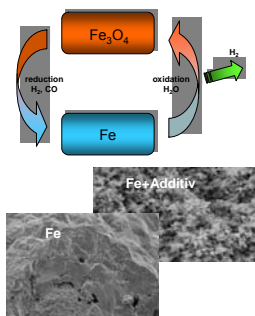


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Production of hydrogen by reduction/oxidation of metal oxides

- Renewable energy carriers
- Cyclic process at elevated temperatures
 - Degradation of the contact mass due to sintering
 - Improving lifetime by the addition of foreign, structure stabilizing metals



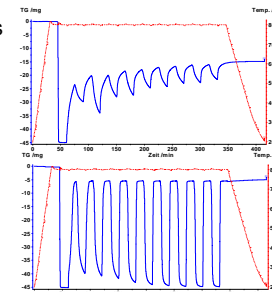
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Fraser, S., Monsberger, M., Hacker, V., *J. Power Sources*, Vol. 161, Issue 1, 20 October 2006.
Hacker, V., Vallant, R., Thaler, M., *Ind. Eng. Chem. Res.* 2007.

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Production of hydrogen by reduction/oxidation of metal oxides

- Renewable energy carriers
- Cyclic process at elevated temperatures
 - Degradation of the contact mass due to sintering
 - Improving lifetime by the addition of foreign, structure stabilizing metals
 - Stability of 500 cycles achieved



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Thank you for your attention!



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