

Ethanol Oxidation at Elevated Temperatures
in the Gas Phase: a DEMS study
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Ethanol is an interesting fuel for fuel cells as it exhibits high energy density and low toxicity leading to easy handling and as it can be produced easily from renewable sources. However, the required complete oxidation could not be accomplished in low temperature fuel cells. High temperature fuel cells such as SOFC can run on ethanol but are often not suitable for the application of interest like back-up power or range extender requiring short start-up times. In order to realize high performance direct ethanol fuel cells for these applications the use of HT-PEM technology could be an option. To evaluate this option however, it is necessary to investigate the ethanol oxidation in the gas phase under simulated HT-PEMFC conditions monitoring the product distribution.

In this contribution a design of a cell for differential electrochemical mass spectrometry which allows performing such measurements will be presented. The cell consists of a gas diffusion electrode (GDE) of about 1 cm in diameter with an inlet capillary of a mass spectrometer located in proximity to its surface (cf. fig 1). The GDE is pressed onto a H₃PO₄ impregnated PBI membrane (fumatech) by which it is separated from the counter and reference electrode compartment filled with concentrated H₃PO₄. The distance between GDE and mass spectrometer could be kept small enough to allow for almost differential conditions.

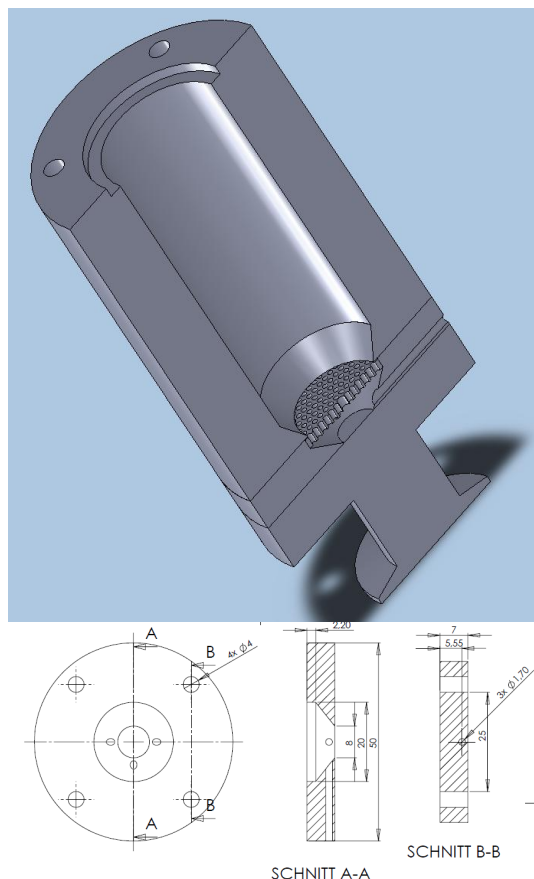


Fig 1: 3D and 2D CAD drawings of the cell set-up.

The cyclic voltammograms measured in the cell show an onsite potential for the ethanol oxidation at about 400 mV vs. RHE which is comparable to the ethanol oxidation in sulfuric acid solution

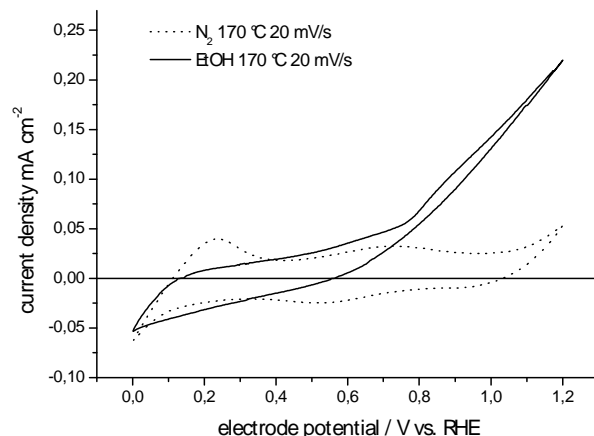


Fig 2: CV of an electrode consisting of 10 wt% Pt/C catalyst by Johnson & Matthey bound with PBI in ethanol water and in nitrogen atmosphere

First preliminary DEMS results on the oxidation of ethanol at supported and unsupported platinum catalyst indicate that no significant amounts of acetaldehyde are formed (cf. fig 2).

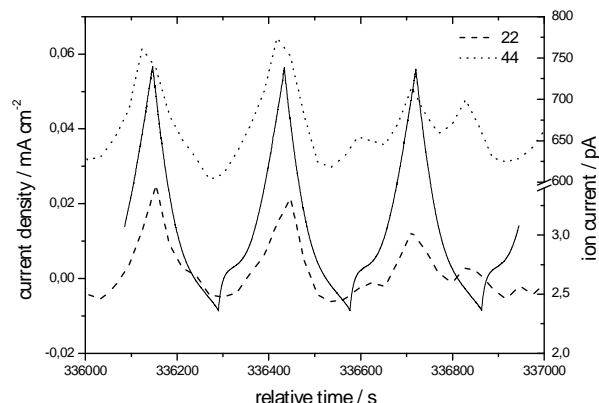


Fig 2: Current response and MS ion current response for $m/z = 22$ and $m/z = 44$ measured during a CV measurement at a Pt/C PBI electrode in ethanol water vapour, 500 g ethanol per litre at 160 °C

In the contribution details on the effect of temperature on the vapour phase ethanol oxidation will be reported together with further results of the DEMS investigation of the product composition.

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