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Sensitivity analysis on the impact of air contaminants on automotive fuel cells

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Abstract

In order to achieve a successful market introduction of series fuel-cell vehicles, detailed knowledge about the impact of external influences on the fuel cell, in particular the cathode catalyst must be appropriated. Common air contaminants cause power loss, decreasing lifetime or a complete MEA failure.
To get a data basis for further decisions in handling with noxious gases, the influences of air contaminants on PEMFC have been analysed extensively under automotive operating conditions systematically using a full factorial matrix test for the first time. The specific variation of temperature, voltage and harmful gas concentration resulted in 27 operating points for each used harmful gas.
First, the experiments were performed with a single cell, active area of 45.14 cm^2, straight flow channels and a loading of 0.4 mg cm^{-2} Pt/C at the cathode. Subsequently, similar experiments were carried out with a ten-cell stack. This stack was different from the single cell due to a modified flow field, larger active area of 300 cm^2 and the gas distribution. Hence, it is closer to the real application.
The results generated with the single cell indicated significant degradation but as well the possibility of regeneration. The degradation caused by different harmful gases is both dependent on temperature and potential. The currently performed analysis with a stack shows differences in degradation behaviour in comparison to the single cell. These outcomes reveal the necessity of stack tests to provide application-oriented reliable results. The results give an overview of the cathode harming potential of the most relevant air contaminants, including an estimation of the degradation influence depending on the harmful gas concentration. Hence, the work provides a basis for the development of cathode air filter and regeneration techniques for automotive applications.

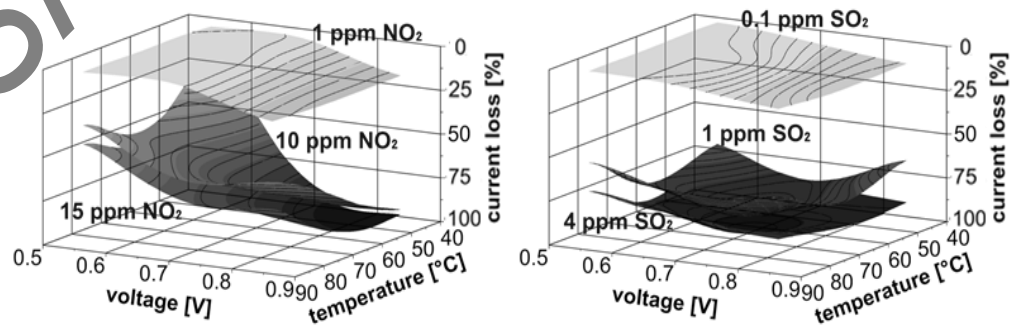

Figure 1: Current loss depending on voltage, temperature and concentration of contaminant (left: NO_2; right: SO_2)