

# **Methanol, formaldehyde and formic acid adsorption/oxidation on carbon-supported Pt nanoparticle fuel cell catalyst: A comparative quantitative DEMS study**

Z. Jusys\* and R.J. Behm\*

*Institute of Surface Chemistry and Catalysis, Ulm University, D-89069 Ulm, Germany*

The potentiodynamic and potentiostatic oxidation of methanol, formaldehyde and formic acid under continuous mass transport on a carbon supported Pt/Vulcan fuel cell catalyst, in particular the formation of the incomplete oxidation products formaldehyde and formic acid under these conditions, and the adsorbed residues formed upon exposure to these reactants were investigated by quantitative on-line Differential Electrochemical Mass Spectrometry (DEMS) measurements. The adsorbed species were identified as  $\text{CO}_{\text{ad}}$  in all cases from the about two electrons per molecule required for their oxidation to  $\text{CO}_2$ . The  $\text{CO}_{\text{ad}}$  coverages resulting from 10 min adsorption of formaldehyde, formic acid and methanol at  $0.11 \text{ V}_{\text{RHE}}$  are *ca.* 87%, 36% and 10%, respectively, relative to that of a saturated CO-adlayer obtained by CO adsorption. Oxidation of the resulting CO adlayers occurred at less positive potential than for adlayers derived from CO adsorption. The selectivities for the different reaction products, and their contributions to the total reaction current were calculated via quantitative evaluation of the product yields and their conversion into partial Faradaic currents for both potentiodynamic and potentiostatic bulk oxidation of the different  $\text{C}_1$  molecules. This reveals significant contributions of incompletely oxidized reaction products under these conditions. The time and potential dependence of the different product yields are discussed in the framework of a comprehensive reaction scheme. Consequences of the tendency for incomplete oxidation product formation for Fuel Cell applications and implications for reaction modeling are discussed.

\* Correspondence should be addressed to [zenonas.jusys@uni-ulm.de](mailto:zenonas.jusys@uni-ulm.de) or [juergen.behm@uni-ulm.de](mailto:juergen.behm@uni-ulm.de)