Interaction of C1 Molecules with a Pt Electrode at Open Circuit Potential, a Combined Infrared and Mass Spectroscopic Study

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Abstract: The interaction of CO, HCOOH, HCHO and CH₃OH molecules with a Pt surface initially covered with a layer of oxide under open circuit potential (OCP) is studied by combined infrared and mass spectroscopy. We found that after switch to the fuel containing solution and concomitantly switching off the electrode potential control at 1.2 V. i) the OCP decays from 1.2 V down to values of 0.58 V (CO), 0.12 V (HCOOH), 0.08 V (HCHO) and 0.24 V (CH₃OH); ii) CO is the only adsorbate at the Pt surface produced from the fuels; iii) the rates for the decay of OCP and for the built up of CO₂ adlayer decrease in the order of CO > HCHO > HCOOH > CH₃OH; iv) the final OCP decreases in the order of CO > CH₃OH > HCOOH > HCHO; v) the rate of CO₂ production and the amount of CO₂ produced decrease in the order of HCOOH > CO > HCHO > CH₃OH, a significant amount of HCOOH is formed for the case with HCHO, and the main by product from reaction with CH₃OH is HCHO. Our results indicate that the change in OCP is mainly determined by the net charge change due to electrons produced by fuel oxidation or consumed by Oₐd/OHₐd reduction, and that even without an externally potential control the reactions occuring at the interface are mainly controlled by their electrochemical potential of the respective reactants and products.

Keywords: infrared spectroscopy, differential electrochemical mass spectroscopy, open circuit potential, Pt electrode

![Fig.1 Time evolution of (a) open circuit potential, (b) m/z=44 mass signal for CO₂ and (c) integral infrared band intensities of COₐ and COₘ at the Pt/0.5 M H₂SO₄ + 0.1 M CH₃OH interface after holding the potential at 1.2 V for 1 min and subsequent switching off the potential control at 0 s together with changing to 0.1 M containing CH₃OH electrolyte. The right panel illustrates the signals at an expanded time scale from 21 to 25 s after switching off the potential control.](image-url)