DEMST and surface science studies of electrochemical CO and ethanol oxidation on TiOC supported Pt catalysts


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Abstract

Direct Ethanol Fuel Cells have been subject of numerous studies in recent years. However, the complete oxidation of ethanol to CO2 at the anode side is still one of the main challenges. Efficient electro oxidation of ethanol (EOR) requires the use of elevated temperatures >60°C [1], and catalysts are mainly supported on carbon, which can corrode under these conditions.

In this study, titanium oxycarbide (TiOC) is investigated as innovative support for Pt nanoparticles during the EOR [2,3]. The chemical composition of the TiOC surface has been characterized during its conversion from TiO2 to TiOC, using X-ray photoelectron spectroscopy (XPS), via a quasi in-situ approach and an operando study, which revealed that TiOC is thermodynamically less stable than anatase TiO2 and carbon, and that it therefore decomposes at the surface [4]. This decomposition and the formation of a TiO2 surface film upon exposure to ambient air protect the material from further oxidation when it is used in an electrochemical environment, without majorly influencing its electronic conductivity. To understand the role of TiOC as catalyst support, its surface chemistry is monitored during the EOR using quasi in-situ XPS [5]. The activity of the catalysts is determined using cyclic voltammetry, and current transients in acidic electrolytes with ethanol. For a quantitative evaluation of the EOR products, differential electrochemical mass spectrometry (DEMS) is employed. CO oxidation and EOR studies are conducted to evaluate the CO2 efficiencies of Pt nanoparticles supported on TiOC and on carbon (C). The results show that Pt/TiOC is less prone to poisoning than Pt/C which is most likely due to a stronger interaction of TiOC with ethanol [5,6] and with water. The reaction pathway of the EOR at Pt/TiOC is recorded and compared to that of Pt/C [6].

Financial support by the EU-FP7 program (DECORE, NMP4-SL-2012-309741) and the University of Innsbruck is gratefully acknowledged.

References