Immunity of the Fe-N-C catalysts to electrolyte adsorption: phosphate but not perchloric anions - DTU Orbit (09/12/2018)

**Immunity of the Fe-N-C catalysts to electrolyte adsorption: phosphate but not perchloric anions**

Non-precious metal catalysts (NPMCs), particularly the type based on carbon-supported FeN\textsubscript{x} functionalities (Fe-N-C) are a very promising material for replacing the rare and costly platinum-based catalysts in polymer electrolyte membrane fuel cells (PEMFCs). Evaluation of these materials is most often carried out, like for Pt-based catalysts, in dilute perchloric acid by assuming its non-adsorbing nature on the active sites. The assumption is however not true. In this work, a typical Fe-N-C catalyst was first synthesized by high-pressure pyrolysis in the presence of carbon support and thoroughly characterized in terms of morphology, structure and active site distribution. The subsequent electrochemical characterization of the catalyst shows strong adsorption and poisoning effect of, in addition to the known Cl-, perchloric anions on the oxygen reduction reaction (ORR) activity. On the contrary phosphate anions exhibit negligible poisoning effect on the catalyst activity. At 0.8V vs. RHE, the ORR activity of the catalyst is found to decrease in the order of H\textsubscript{3}PO\textsubscript{4} (8.6mA mg\textsuperscript{-1})>H\textsubscript{2}SO\textsubscript{4} (5.3mA mg\textsuperscript{-1})>HClO\textsubscript{4} (3.1mA mg\textsuperscript{-1})>HCl (0.7mA mg\textsuperscript{-1}). The results suggest potential applications of NPMC in high-temperature PEMFCs based on phosphoric acid doped polymer membranes, where high loading platinum catalysts are currently used. As demonstrated in the low current density range of high-temperature PEMFCs, the catalyst shows a comparable performance to the Pt/C catalysts.

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