Electrocatalytic Activity of NH_4^+, Co^{2+} and Fe^{2+}- doped MnO_2 as Cathode Catalysts in NH_3-based Fuel Cells

Luiza Zudina[*1], Anna K. Mechler[1], Georgii Sokolsky[2]

[1] *RWTH Aachen University, Electrochemical Reaction Engineering (AVT.ERT), Germany*
[2] *National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine*
**E-mail: Luiza.Zudina@avt.rwth-aachen.de*

Manganese oxides are widely applied in batteries as cathode material, where it is used as an active oxygen reduction reaction (ORR) catalyst.[1] C–MnO_2 is an alternative catalyst in fuel cells.[2] Direct ammonia fuel cells (DAFCs) are an interesting technology use ammonia as a hydrogen-carrier molecule to provide electricity while only producing water and nitrogen, resulting in no direct pollution to the environment.[3] Not only the direct reduction of NH_3 is a catalytically interesting task, but also the cathode reaction, *i.e.*, oxygen reduction, needs to be reconsidered regarding the possibility of cross-over of NH_3 or NH_4^+ through the membrane. Thus, an active and NH_3 tolerant ORR catalyst need to be found.

Manganese(IV) oxides (MnO_2) have a large diversity in their structure behaviour. The variety of polymorphs and a strong dependence of (electrochemical) properties on the preparation methods have been established.[4,5] For instance, the phase composition and structural defects have influence the MnO_2materials activity. In a previous work, we presented a method for modifying MnO_2 by electrolytic doping with other cations, i.e. NH_4^+, Co^{2+} and Fe^{2+}, which influence the phase composition, morphology and hence also modify the catalytic properties.[6]

First investigations indicate that MnO_2 is affected by the presence of NH_4^+-ions in the electrolyte. Some materials, for instance with a higher amount of Co^{2+}-doping, even seem to have an improved performance in NH_4^+-containing electrolyte. We will show detailed RDE studies on different materials with and without the presence of NH_4^+ in the electrolyte to identify critical structural properties for the interaction with cross-over NH_3 in ammonia fuel cell cathodes.

References

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