Contribution ID: **9** Type: **Contributed**

Proton dynamics of phosphoric acid in the catalytic layer of gas diffusion electrodes for HT-PEFC

Wednesday 20 July 2016 12:10 (20 minutes)

High-temperature polymer electrolyte fuel cells (HT-PEFC) are promising electrochemical energy converters. Because of the high operation temperature of 160℃ - 180℃ the HT-PEFCs have a high CO tolerance. [1] Recent works on the development of HT- PEFC are focused mostly on the performance and technical optimization. However, the fundamental investigation of the proton conductivity will help to optimize performance and increase sufficiency of the fuel cells. For example, the understanding of proton diffusion mechanism in membrane electrode assembly (MEA) plays a key role in proton conductivity of fuel cells.
The present study focuses on dynamical properties of phosphoric acid (PA) in the catalytic layer for HT-PEFC. The catalytic layer is a composite material containing nanoporous carbon, poly(tetrafluoroethylene) (PTFE) and platinum (Pt) nanoparticles. Since the catalyst layer is in direct contact with the PBI membrane doped with PA it also contains some amount of acid, which is needed to provide good proton conductivity in the electrode. The contact between electrodes and the membrane is one of the important parameters, which influence the cell performance [1,2]. Knowledge about local PA dynamics and understanding the distribution of PA between structural elements of the catalyst could help to design more efficient electrodes for fuel cells.

Due to adsorption of the PA on the Pt particles the diffusion of protons in the catalytic layer can be different with respect to the membrane and bulk acid and thus, should be taken into account. Using quasielastic neutron scattering (QENS), proton dynamics can be studied on local length scales from few Angstrom and up to 10 nm. Backscattering spectroscopy was used to directly probe the dynamics of protons in nanoseconds range. The three approaches are considered for description of proton dynamics: the random jump diffusion model, distribution of jump lengths and, finally, the trap model. Extracted parameters such as diffusion coefficient, activation energies and time constants gives insight about dynamical behavior of the PA and its distribution in the catalytic layer.

References:

[1] W. Lehnert, C. Wannek and R. Zeis in Innovations in Fuel Cell Technology (Eds. R. Steinberger-Wilckens, W. Lehnert), RSC Publishing, Cambridge, 2010, pp 45.

[2] C. Wannek, I. Konradi, J. Mergel, W. Lehnert, Int. J. Hydrogen Energy 2009, 23, 9479.

Author: Dr KHANEFT, Marina (Jülich Centre for Neutron Science, Forschungszentrum Jülich GmbH)

Co-authors: HOLDERER, Olaf (Jülich Centre for Neutron Science, Forschungszentrum Jülich GmbH); Dr ZORN, Reiner (Jülich Centre for Neutron Science, Forschungszentrum Jülich GmbH, Jülich, Germany); Prof. LEHNERT, Werner (Institute of Energy and Climate (IEK-3), Forschungszentrum Jülich GmbH, Jülich, Germany)

Presenter: Dr KHANEFT, Marina (Jülich Centre for Neutron Science, Forschungszentrum Jülich GmbH)

Session Classification: Session VII: Catalysis (Chair Mikhail Feygenson)

Track Classification: Energy storage & transformation