Modeling degradation mechanisms in low temperature fuel cells

Thomas Jahnke(1), Georg Futter(1), Arnulf Latz(1,2)

(1)German Aerospace Center (DLR), Institute of Engineering Thermodynamics, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany
(2)Helmholtz Institute Ulm for Electrochemical Energy Storage (HIU), Albert-Einstein-Allee 11, 89081 Ulm, Germany
Tel.: +49-711-6862-8033
Fax: +49-711-6862-747
thomas.jahnke@dlr.de

Low temperature fuel cells show a great potential for a variety of future technologies, including automotive and stationary applications. However, high costs and severe performance losses during aging still pose major challenges, which have to be overcome before these technologies are ready to enter the market on a grand scale. A better understanding of the underlying degradation mechanisms and the possibility to predict performance losses under given operating conditions via numerical modeling and simulation is crucial to reach this goal.

Here, we present two physical models developed to describe the degradation of the catalyst and of the membrane. Catalyst degradation is modeled by means of a platinum particle growth, which is related to the formation and reduction of platinum oxides. Chemical degradation of the membrane incorporates the formation and decomposition of hydrogen peroxide and the consequent radical attack of the membrane. Both degradation models are embedded into cell models to investigate the effect on the cell behavior. Remaining challenges and open issues concerning these degradation models are discussed.

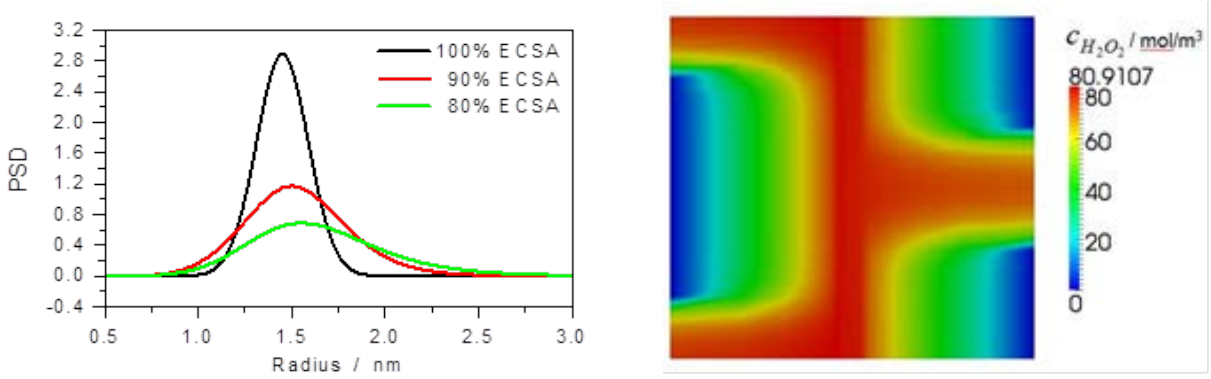

Figure: simulated change of the catalyst particle size distribution during aging (left); simulated hydrogen peroxide distribution (right).