Abstract

Fuel cells, as a core hydrogen technology,have emerged as a very promising, clean substitute for selected conventional energy conversion technologies (e.g. internal combustion engine). At least on the laboratory level, carbon-supported Pt alloy catalysts have fulfilled the expectations as regards high mass and specific catalytic activities when used in contemporary PEM (proton exchange membrane) fuel cells. At the moment, a more critical concern seems to be the durability of PEMs.

With electrochemical flow cell (EFC) coupled with ICP-MS (inductively coupled plasma mass spectrometry) we measured quite substantial degradation rates of pure platinum dissolution which sheds a new light on the problem of catalyst stability. This is especially true under potentiodynamic conditions or in the presence of halide impurities such as chloride ions. Together with platinum dissolution, carbon corrosion is the main cause of a decrease in the electrochemical surface area (ESA) during typical operation of PEM.

In search of deeper understanding of this process we performed atomistic modeling which not only explained the observed degradation behavior but also gave us an answer how to prevent it. The model was verified with a range state of the art techniques and a good agreement between the theoretical prediction and experimental measurements was found. Even more, the model could be used in design a completely new generation of catalysts that could endure through geological time.

Key words: *PEM fuel cell, Pt-alloy catalysts, dealloying, corrosion, atomistic modeling*