PEMFC Pt-Alloy Cathode Catalysts: Characterization of Kinetic Gains and Long-Term Corrosion Issues

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In recent years, much progress has been made in reducing the Pt-metal loading in PEM fuel cells, resulting in the currently achieved rather low loadings of 0.5-0.6 mg_{Pt}/cm^2_{MEA} in *state-of-the-art* fuel cells [1]. Large-scale automotive applications, however, will require an additional Pt-loading reduction of a factor of 2 to 3 in order to be economically feasible [2].

Currently, Pt-alloys promise to be the only feasible approach toward lowering PEMFC Pt-loadings without a concomitant reduction of the voltage efficiency. Two- to three-fold activity enhancements measured in terms of A/mg_{Pt} have been reported for certain Pt/transition-metal alloys [3, 4, 5], but their long-term stability in the PEMFC-environment is not yet clear. Particularly crucial is the leaching-stability of the transition-metals in Pt-alloys, since the release of small amounts of cationic contaminants in the electrodes leads to a much reduced catalyst utilization. This effect is very pronounced in PEMFCs because of their low acid-storage-capacity in the electrodes (ca. 0.5 $\mu mol_{H+}/cm^2$, much lower than in, *e.g.*, PAFCs), thereby leading to significant voltage losses as protons in the polymer-electrolyte are being exchanged with cations (this effect is, *e.g.*, shown in Reference 6).

In this contribution we will determine the fundamental activity of Pt-alloy catalysts using the thin-film rotating disk approach [5, 7] and examine their stability in the PEMFC-environment using both *ex-situ* leaching experiments as well as 50 cm^2 fuel cell performance testing. Analysis of Pt-alloy-performance in MEAs will be supported by in-situ voltammetry, AC-impedance, and H_2/O_2 and H_2/air performance diagnostics. To more clearly understand the phenomena associated with MEA contamination by cationic impurities which may be derived from Pt-alloy catalysts, parallel experiments will be conducted where known amounts of cationic contaminants are introduced deliberately.

References

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