pulse alternating current synthesis of pd/c catalysts and their application in PEM fuel cells thechnologies

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It is well known that platinum is the best catalyst for processes occurring in low-temperature fuel cells and, in particular, in fuel cells with direct oxidation of liquid fuels (methanol, ethanol, formic acid) [1]. An alternative to expensive platinum catalysts may be palladium, which is able to exhibit higher catalytic activity than platinum in the oxidation of alcohols, formic acid, both in acidic and alkaline media. [2].

Both Pt-based catalysts and Pd-based catalysts are often obtained by standard methods for such systems.: impregnation-reduction method [3], polyol process [4]. Electrochemical methods for the preparation of Pd-based catalysts based on the electrochemical reduction of palladium ions from a solution of its salt are presented to a lesser extent. [5].

In this paper, we showed the applicability of the pulse alternating current (PAC) method for the synthesis of a Pd/C catalyst for the proton exchange membrane (PEM) fuel cell application, which was previously successfully applied to the synthesis of Pt/C catalysts [6]. The presence of palladium complexes in the electrolyte after PAC synthesis is demonstrated by UV-vis spectroscopy, which indicates a different mechanism for the formation of Pt and Pd nanoparticles under these conditions. The microstructural characteristics and catalytic activity of synthesized Pd/C catalyst were compared with those of Pt/C catalyst which was prepared under the similar conditions. Pd NPs of Pd/C catalyst exhibited smaller average size and narrower particle size distribution. The electrochemical study highlighted that the electrochemically active surface area of Pd/C catalyst was 1.4 times higher than for Pt/C. The rate of ethanol oxidation on Pd/C catalyst exceeded the rate of ethanol oxidation on Pt/C by 2.6 times, while the rate of oxidation of formic acid was comparable on both catalysts. However, on Pd/C, there was a significant decrease in the overvoltage of the formic acid electrooxidation reaction as compared to the Pt/C sample (by 590 mV).

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