

Comparison Electrooxidation of Ethylene Glycol and Ethanol on Platinum Alloy Nanoparticles Dispersed in Metal Oxide Matrix

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The electrochemical properties of simple organic compounds in the presence of noble metals and their alloys are attributed to constant search for new fuels and new catalysts in fuel cell applications. Liquid fuels, such as small molecular weight alcohols and formic acid together with their esters with high volumetric energy density and better energy efficiency, are easier to store and transport in comparison to hydrogen or other gaseous fuels. In spite of that direct alcohol fuel cells (DAFCs) still have considerable attention. Polyhydric alcohols, such as ethylene glycol and glycerol has been found as potential fuels which are much less volatile and less toxic than methanol. The anodic oxidation of polyhydric alcohols on a platinum electrode in acid solutions has been reported in the literature [1-3]. The splitting of the C–C bonds is particularly difficult at ambient (low) temperatures, and the surface of catalytic platinum readily undergoes poisoning with intermediates of the ethylene glycol or ethanol oxidation. This problem may be partially solved by applying bifunctional electrocatalysts. Metals, like ruthenium, tin or rhenium may activate molecules of water and supply strong oxidizing agents: –OH groups and thus remove adsorbed species from platinum surface.

Enhancement of the catalytic activity may be achieved also by modification of platinum surface with another metals (W, Mo, Rh), metal oxides (WO_3) or polyoxometallates [4-8]. The presence of other metals in the vicinity of platinum may result in mutual interactions and lead to the changes in electronic structures of platinum and thus weaken the adsorption force towards bonding carbon monoxide. In order to increase the overall kinetic of electrooxidation of ethylene glycol or ethanol, we propose modification of bifunctional, metallic catalyst with metal oxide. Our concept involves adsorption onto the surface of PtRh nanoparticles ultra-thin layers of tungsten oxide, molybdenum oxide or zirconium oxide. Presence of metals oxide (WO_3 , MoO_3 , ZrO_2) on nanoparticle have led not only to the specific interactions but also increased the catalytic surface. Introduction of metal oxide to PtRh/C nanoparticles leads to the increase of the catalytic current under voltammetric and chronoamperometric conditions.

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