CO Tolerance of Pd Rich Platinum Palladium Carbon Supported Electrocatalysts for PEMFC Applications

D.C. Papageorgopoulos, M. Keijzer, J.B.J. Veldhuis and F.A. de Bruijn
ECN clean fossil fuels, P.O. Box 1, 1755 ZG Petten, The Netherlands

Further advancement in the technology of PEM fuel cells (PEMFC) is essential for the development of an efficient power source for electric vehicles or residential applications. For many practical reasons, the hydrogen for the fuel cell anode is obtained by processing fossil fuels, such as methane and gasoline. The product gas in these processes contains more or less carbon monoxide, to which the PEMFC is extremely sensitive. This occurs since the most commonly used electrocatalyst, Pt/C, is susceptible to CO poisoning. The potential use of carbon supported $PtPd_y$ (y=1-6) electrocatalysts as CO tolerant anodes for proton exchange membrane fuel cell (PEMFC) applications has been investigated by cyclic voltammetry and fuel cell tests.

PtPd catalysts, supported on carbon Vulcan XC-72 with a 20 wt.% metal loading, were prepared by a process relative to the one claimed by Degussa AG for PtRu [1]. Deposition of the metals from aqueous solution took place by chemical reduction of their corresponding salts, with platinum nitrate (Merck) and palladium chloride (Aldrich) used as precursors and formaldehyde as the reducing agent. The catalysts were dried at 80 °C.

Cyclic voltammetry experiments where conducted in 1N H_2SO_4. CO stripping voltammetry reveals that at 80 °C, the operating temperature of the PEM fuel cell, while CO saturation leads to the total displacement of adsorbed hydrogen from Pt, the inclusion of Pd leads to a reduction of the saturation coverage of CO. By increasing the Pd content this effect becomes more pronounced and the main CO oxidation peak potential moves to more anodic values as well.

Fuel cell tests demonstrated that the need of reasonable hydrogen oxidation currents with and without CO necessitates the presence of Pt in the catalyst. Anodes consisting of $PtPd_y$ catalysts exhibit enhanced CO tolerance compared to Pt, under operating conditions, with $PtPd_4$ providing the best results. More importantly, improved performance to PtRu is demonstrated, with 100 ppm or more of CO in the fuel stream.

Reference:

[1] E. Auer, A. Freund, T. Lehmann, K.A. Starz, R. Schwarz, U. Stenke, US Patent 6,007,934 (1999).