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Platinum-Ruthenium Anode Catalyst for DMFC

The direct methanol fuel cell (DMFC) is a variant of the proton exchange membrane (PEM) fuel cell and uses aqueous methanol directly without prior reforming. In the DMFC methanol is converted to carbon dioxide and hydrogen at the anode. The hydrogen then reacts with oxygen, as in a standard PEM fuel cell. Conventional materials for DMFCs include platinum-ruthenium (Pt-Ru) for the electrode electrocatalysts and carbon in various forms as the electrocatalyst support. Electrocatalysts with high activity for methanol oxidation are essential for improved performance of DMFCs. Such catalysts are generally prepared as unsupported metal colloids or nanocomposites with the metal nanoparticles supported on an electrically conducting carbon of high surface area. Mixed metal Pt-containing catalysts are presently used for methanol oxidation.

Now, scientists from the Department of Chemistry at Vanderbilt University, with a colleague from the Corrosion Research Center, University of Minnesota, U.S.A., have developed a Pt-Ru/graphitic carbon nanofibre (GCNF) nanocomposite which exhibits high relative performance as a DMFC anode catalyst (E. S. Steigerwalt, G. A. Deluga, D. E. Cliffel and C. M. Lukehart, *J. Phys. Chem. B*, 2001, **105**, (34), 8097–8101).

As part of ongoing studies of new synthetic strategies for preparing metal alloy/carbon composites, they prepared and characterised a Pt-Ru/GCNF composite, where the GCNF support has the 'herringbone' atomic structure. The source of both metals was the molecular precursor $(\eta\text{-}C_2H_4)(Cl)Pt(\mu\text{-}Cl)_2Ru(Cl)(\eta^3{:}\eta^3\text{-}2,7\text{-dimethyloctadienediyl})$.

Reductive decomposition of the precursor formed widely dispersed Pt-Ru nanocrystals, and a multistep deposition procedure ensured total metal content of ~ 42 wt.% at bulk Pt/Ru atomic ratio of ~ 1:1. The metal alloy nanoclusters had average particle size of 6 nm (calculated from XRD peak widths) or 7 nm (measured directly from TEM images). Small amounts of Ru metal and oxidised Ru species were also present.

When used as an anode in a working DMFC, the composite enhances fuel cell performance by ~ 50% relative to that recorded for an unsupported Pt-Ru colloid anode catalyst. Further work on the metal alloy/GCNF anode catalysts is envisaged.

Fuel Cell Catalysts Brochure

Alfa Aesar has just published a new 4-page brochure highlighting a range of noble metal, HiSPEC™ fuel cell catalysts. Johnson Matthey manufactures HiSPEC™ brand catalysts which provide superior performance in proton exchange membrane and direct methanol fuel cells. The HiSPEC™ range consists of single and bimetallic supported and unsupported catalysts which can be used on both anodes and cathodes.

Copies of the new Fuel Cell Brochure can be obtained from Alfa Aesar: Tel: +800-343-0660; Fax: +800-322-4757; or E-mail: info@alfa.com.