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Electrochemical Evaluation of Pt-Based Binary Catalysts on Various Supports for the Direct Methanol Fuel Cell

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Abstract

Multi-walled carbon nanotubes (MWCNTs), TiO(sub2), MoO(sub2), and carbon black Vulcan XC-72 were investigated as supports for PtRu and PtSn catalysts. X-ray diffraction (XRD) confirmed that all electrocatalysts examined display characteristic patterns similar to that of the Pt/C electrocatalyst, an indication that the catalysts have predominantly the Pt face-centered cubic (fcc) crystal structure. High-resolution transmission electron microscopy (HRTEM) images showed spherical PtRu and PtSn nanoparticles with a narrow particle size distribution, dispersed on the support materials. The metal loading for the prepared electrocatalyst was estimated using energy-dispersive X-ray spectroscopy (EDS), and it was observed to be closest to that of the catalysts supported on Vulcan XC-72. Cyclic voltammograms showed PtSn/C to be the most active, as it possessed a higher electroactive surface area than that of the other catalysts, followed by Pt/C > PtRu/MWCNT > PtRu/C > PtSn/MWCNT > PtSn/MoO(sub2) > PtRu/MoO(sub2) > PtSn/TiO(sub2) > PtRu/TiO(sub2). It was also observed that catalysts supported on MWCNTs were more active than those supported on metal oxides. Furthermore, catalysts supported on MWCNTs proved to be more stable than all the other supported catalysts examined. Therefore, MWCNTs have been proven in this study to be the best material for supporting electrocatalysts for direct methanol fuel cells.