Mo_2C derived carbons catalysts and/or supports for Pt metal and Pt-Ru alloy catalysts for low temperature fuel cells

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Intensive research has been focused on the development and optimization of electrocatalysts that are used for the oxygen electroreduction reaction (ORR), taking place in low temperature fuel cells which are promising energy sources for mobile and portable applications.

ORR on Pt metal and/or binary Pt-Ru alloy deposited onto micromesoporous carbon support C(Mo_2C) was studied in 0.5 M H_2SO_4 solution using the cyclic voltammetry and rotating disc electrode method and impedance spectrometry [1-3].

Data analysis of X-ray diffraction, high resolution transmission electron microscopy, X-ray fluorescence, X-ray photoelectron and energy-dispersive X-ray spectroscopy confirms that Pt-Ru alloy has been formed and as a result the atomic fraction of Ru in the alloy was ~0.5.

The carbon support C(Mo_2C) was prepared from Mo_2C using chlorination method at different chlorination temperatures. Gas adsorption at liquid nitrogen temperature was used for the analysis of porosity and pore distribution of materials under discussion. The specific surface area of carbide derived carbon (CDC) powders varies from 1675 to 1990 $m^2\ g^{-1}$.

High cathodic current densities of oxygen reduction have been achieved. The O_2 diffusion constant (for Pt-Ru alloy catalyst 1.9 (± 0.3) × 10^{-5} $cm^2\ s^{-1}$ and for Pt catalyst 1.7 (± 0.3) × 10^{-5} $cm^2\ s^{-1}$) and the number of electrons transferred per electroreduction of one O_2 molecule (~4), calculated from Levich-Koutecky plots, are in agreement with literature data. Analysis of impedance spectra indicated that nearly capacitive behaviour was observed at very low ac frequencies, explained by slow electrical double layer formation and by adsorption of reaction intermediates and products into micromesoporous CDC, Pt-C(Mo_2C) and Pt-Ru-C(Mo_2C) catalysts.

All the results were compared with corresponding data with commercial VULCAN® XC72 carbon support measured at the same conditions.

References

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