

Electro-oxidation of ethylene glycol and glycerol at palladium-decorated FeCo@Fe core-shell nanocatalysts for alkaline direct alcohol fuel cells: functionalized MWCNT supports and impact on product selectivity†

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Abstract

Half-cell reactions and alkaline direct ethylene glycol and glycerol fuel cells (DEGFC and DGFC) have been studied on Pd-based ternary core-shell (FeCo@Fe@Pd) nanocatalyst using multi-walled carbon nanotubes bearing carboxylic (MWCNT-COOH) and sulfonic acid (MWCNT-SO₃H) as supporting platforms. The core-shell-shell nature of this nanocatalyst, obtained via the “microwave-induced top-down nanostructuring and decoration”, was clearly proven from atomic resolution transmission electron microscopy (ARTEM). The functional groups of the MWCNTs show a huge impact on the physico-chemical properties of the FeCo@Fe@Pd nanocatalyst towards the electrocatalytic oxidation of EG and GLY in alkaline media. The FeCo@Fe@Pd on -COOH-treated MWCNTs showed the small particle size of ca. 7.4 nm, uniform loading of the catalyst on the support, large electrochemically-active surface area and enhanced electrocatalytic activity compared to the FeCo@Fe@Pd on -SO₃H-bearing MWCNTs. As a preliminary test, FeCo@Fe@Pd/MWCNT-COOH was used for passive, air-breathing anion-exchange membrane based fuel cells (AEM-DEGFC and AEM-DGFC). The analysis of the exhaust products, established using NMR spectroscopy, revealed a high selectivity towards the complete oxidation of both EG and GLY under benign experimental conditions.