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Effect of Pt_x-Ru_y-Ir_z Electrocatalyst Composition for Oxygen Electrode in an Unitized Regenerative Fuel Cell

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ABSTRACT

The effect of variations in the composition for the type Pt_x-Ru_y-Ir_z ternary catalysts toward Oxygen Reduction Reaction and Oxygen Evolution Reaction (ORR and OER, respectively) is reported. According to the formula, there are variations in x and z values with 4.5, 3.5, 2.5, 1.5 and 0.5. The catalysts were prepared by chemical reduction method with a constant amount of Ruthenium (y=4) in the five compositions and characterized by X-Ray Diffraction (XRD),Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and energy dispersive X-Ray (EDX) analyses. A displacement of the diffraction patterns were observed on the materials by the formation of alloys between Pt, Ru and Ir. A conventional three electrode cell was used to evaluate the materials in 0.5 M solution of H_2SO_4 and tested in a Proton Exchange Membrane Fuel Cell (PEMFC) in FC and WE mode. Cyclic voltammograms shows an inhibition of the hydrogen adsorption/desorption peaks and ORR activity due to the presence of Ruthenium. $Pt_{1.5}Ru_4Ir_{3.5}$ and $Pt_{0.5}Ru_4Ir_{4.5}$ material shows a similar mechanism like Iridium. Repetitive Steady-state polarization experiments (Tafel plots) showed that the $Pt_{3.5}$-Ru_4–$Ir_{1.5}$ material is the most stable bifunctional catalysts for oxygen electrode.

Keywords: Oxygen Reduction Reaction; Oxygen Evolution Reaction, PEMFC