



## A Pt<sub>3</sub>Sn/C Electrocatalyst with Superior Activity toward Direct Ethanol Fuel Cells

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**Abstract** – A carbon-supported binary Pt<sub>3</sub>Sn catalyst was prepared using a modified polymeric precursor method. This material was characterized using X-ray diffraction (XRD), and the results showed that Pt<sub>3</sub>Sn is the dominant phase. The transmission electron microscopy showed good dispersion of the electrocatalyst and small particle sizes (3.6 nm ± 1.1 nm). The polarization curves for a DEFC using Pt<sub>3</sub>Sn/C as the anode presented an improved performance compared to that with PtSn/C E-TEK. The maximum power density for Pt<sub>3</sub>Sn/C electrocatalyst (55 mW cm<sup>-2</sup>) is nearly twice as great as that of PtSn/C E-TEK electrocatalyst (33 mW cm<sup>-2</sup>). This behavior may be explained by an electronic effect which is responsible for the increasing in the efficiency toward EOR as indicated in the literature.

In various applications, fuel cells [1] are widely recognized as very attractive devices to obtain electric energy directly from the combustion of a chemical product. Low temperature fuel cells, generally conceived around a proton electrolyte membrane, seem to be usable for a large range of power applications. Alcohols, particularly methanol, are widely proposed as possible fuels for mobile applications, such as in electric vehicles [1,2]. Ethanol offers an attractive alternative as a fuel [3] in low temperature fuel cells rather than methanol because it can be produced in large quantities from agricultural products, it is the major renewable biofuel from the fermentation of biomass, and it has also higher mass energy density when compared to methanol. In this work, single direct ethanol fuel cells (DEFC) experiments were performed using a material prepared by polymeric precursors method, 20 % (w/w) on carbon and with PtSn mass ratio (3:1).

The PtSn/C electrocatalysts were prepared using the polymeric precursor method using carbon support [4,5] using (metal/citric acid/ethylene glycol in an appropriated amount). This material was characterized using X-ray diffraction (XRD), and the results showed that Pt<sub>3</sub>Sn is the dominant phase. The transmission electron microscopy (TEM) showed good dispersion of the electrocatalyst and small particle sizes (3.6 nm ± 1.1 nm).

In the experiments of a single direct ethanol fuel cell, the configurations were: T = 100°C, nafion 117, with a pressurization of 2 Bar, ethanol 2 mol L<sup>-1</sup>, and inlet ethanol flow = 2 ml min<sup>-1</sup>. The polarization curves for a DEFC using Pt<sub>3</sub>Sn/C as the anode presented an improved performance compared to that with PtSn/C E-TEK, especially in the intrinsic resistance-controlled region and mass transfer region, which is probably associated with the Pt<sub>3</sub>Sn phase. The maximum power density for Pt<sub>3</sub>Sn/C electrocatalyst (55 mW cm<sup>-2</sup>) is nearly twice as great as that of PtSn/C E-TEK electrocatalyst (33 mW cm<sup>-2</sup>). This behavior may be explained by an electronic effect which is responsible for the increasing in the efficiency toward EOR as indicated in the literature [6,7].

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