

## Comparison of Two Methods of Synthesis of Bifunctional Platinum-Iridium Electrocatalyst for Unitized Regenerative Fuel Cells

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### ABSTRACT

The Unitized Regenerative Fuel Cell (URFC) is an electrochemical device that generates hydrogen and oxygen through electrolysis, and produces an electric current when operated in fuel cell mode using the gases obtained by electrolysis. For the URFC, it is necessary to use an electrocatalyst without carbon-support, since the high voltages during the oxidation processes, causes carbon degradation leading to rapid cell performance decrease. An alternative, is to use bifunctional electrocatalysts which combine the properties of two metals resulting in an increased performance.

In this work, two methods of the synthesis of bifunctional electrocatalysts of Pt supported on IrO<sub>2</sub> were compared. In the first method, platinum was supported onto IrO<sub>2</sub> by a reduction of chloroplatinic acid (H<sub>2</sub>PtCl<sub>6</sub>) with sodium hydroxide (NaOH), dissolved in ethyleneglycol. For the second method, deionized water was used to dissolve the sodium hydroxide, and pH was adjusted to 9 by adding sodium carbonate (NaCO<sub>3</sub>), with formaldehyde being used as reducing agent. The obtained materials were mixed with platinum black to a 1:1 ratio.

The iridium oxide support material was synthesized by reduction of an iridium salt (H<sub>2</sub>IrCl<sub>6</sub>) in the presence of NaOH. Pt black was synthesized from H<sub>2</sub>PtCl<sub>6</sub> mixed with sodium nitrate (NaNO<sub>3</sub>) dissolved in water and reducing with sodium borohydride (NaBH<sub>4</sub>).

The materials obtained were characterized by EDS for evaluation of the elemental composition of the components, and by XRD to determine its structure. The electrocatalytic performance was evaluated electrochemically by cyclic voltammetry. The electrochemically active area and specific power were determined from these methods.

Finally, the best-performing electrocatalytic materials of Pt-IrO<sub>2</sub> were used as a catalyst in the oxygen side of an URFC, with Pt black in the hydrogen side, and the URFC performance was evaluated.

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**Keywords:** IrO<sub>2</sub>; electrocatalysts; URFC.

