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Electrocatalysts of Pt-TiO_2 Prepared by Sol-gel and Microwave-assisted Polyol Method for the Oxygen Reduction Reaction in 0.5 M H_2SO_4

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ABSTRACT

Electrocatalysts of Pt-TiO_2 were prepared by sol-gel and microwave assisted polyol method for the oxygen reduction reaction in acid media. The prepared electrocatalysts were morphologically and structurally characterized by X-Ray Diffraction, Scanning Electronic Microscopy and EDX analysis. Cyclic voltammetry and rotating disk electrode techniques were employed for electrocatalytic evaluation. It was found that electrocatalysts consisted of crystalline particles with nanometric size, and those obtained at pH=9 showed an acceptable activity for the oxygen reduction reaction in acid media.

KEYWORDS: Electrocatalysts, microwave irradiation, oxygen reduction reaction (ORR)

INTRODUCTION

Fuel cells technology has prompted a great effort for the development of renewable sources of energy in recent decades in an attempt to diminish the global climate change issue, stemming from the combustion of fossil fuels to generate electricity and power for transportation. A key issue with the commercialization of fuel cells technology is the low electrocatalytic activity of materials used for the oxygen reduction reaction (ORR) [Antolini et al., 2006; Jitianu et al., 2007]. Platinum is still the main metal in electrocatalysts for ORR. Also, Pt alloys with transition metals have been proposed for this application, and some of them have showed a higher activity than that of pure Pt [Xiong et al., 2002; Shukla et al., 2001]. Pt is not an abundant metal and is also expensive. Therefore, an enormous effort has been made by many researchers to find materials that can substitute for platinum in ORR.

It has been reported that electrocatalysts activity depends strongly on preparation methods because of their influence on the structure of materiales that can improve the electro catalytic properties [Mukerjee et al., 1995; Min et al., 2000]. Therefore, many techniques to prepare electrocatalysts for ORR have been proposed, including physical, chemical, mechanical and electrical processes, such as metal reduction, precipitation, impregnation, sol-gel, complex formation, mechanical alloying, chemical vapor deposition and sputtering [Ma et al., 2006; García-Contreras et al., 2010].

The sol-gel process has been utilized for many years because of its special characteristics in preparing ceramics and organically modified materials. On the other hand, the polyol process has been used to obtain metallic nanoparticles; ethylene glycol and other polyols act as reducing agents and as solvents in the same reaction. Additionally, in the last decade microwave