Platinum Based Catalysts Modified with CeO_2 for Ethanol Oxidation

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INTRODUCTION

The absence of an effective catalyst for the electro-oxidation of ethanol is one of the critical issues for the development and wide diffusion of direct ethanol fuel cells. Ceramic oxides, such as cerium oxide, have been investigated as low cost co-catalyst for Pt for the electro-oxidation of small organic molecules in acid medium (1,2). It has been reported that cerium oxide can promote the dispersion of alloy particles (2), can suppress the CO poisoning, and thus it enhances the activity of Pt for MeOH and EtOH oxidation (3, 4). It has also been suggested that the influence of CeO_2 onto Pt electroactivity may be due to the bi-functional mechanism (5).

We have synthesized unsupported Pt catalysts "doped" with CeO_2 (1 and 5 wt% CeO_2 with respect to Pt) in order to investigate the existence of a possible effect of CeO_2 on the structure and electronic properties of Pt (6). The catalysts were prepared by the Pechini method, a polymeric precursor method, because it allows the synthesis of nanoparticles with a narrow size distribution and controlled phase segregation (7). XPS analysis and cyclic voltammetry suggested a strong interaction between CeO_2 and Pt resulting in a more oxyphilic Pt-CeO_2 1 wt% catalyst with respect to Pt. The specific activity of Pt-CeO_2 1wt% catalyst toward ethanol electro-oxidation was also enhanced with respect to Pt (6).

We have extended this study to unsupported PtRu catalysts in order to verify if similar effect of CeO_2 also occurs in this system. In this work PtRu catalysts "doped" with CeO_2 (less than 5 wt% CeO_2 with respect to Pt) were also prepared by the Pechini method. The catalysts were characterized by X-ray Diffraction combined with Rietveld refinement, N_2 physisorption analysis and X-ray Photoelectron Spectroscopy. The catalysts electro-activity was evaluated by cyclic voltammetry and chronoaperometry in H_2SO_4 0.5M with and without ethanol. These results will be presented and discuss in detail.

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