

Selective carbon monoxide oxidation on platinum-copper catalysts.

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Introduction

Carbon monoxide is a by-product of fuel processors for hydrogen production, and its concentration must be decreased to less than 10 ppm in order to avoid poisoning of Pt anode in polymer electrolyte membrane fuel cells (PEMFC) [1]. Pt/Al₂O₃ catalysts showed considerable activity for selective CO oxidation, demonstrating high CO conversion in a wide range of temperature [Erro! Indicador não definido.]. Higher activity at lower temperatures was obtained when Pt/Nb₂O₅ was used for selective CO oxidation and this behavior was related to a change in reaction mechanism over reducible supports [2]. Moreover, the addition of a second metal to Pt catalysts improved the activity and selectivity in selective CO oxidation [3]. In this work, the addition of Cu as a catalytic promoter to Pt/Al₂O₃ and Pt/Nb₂O₅ catalysts for selective CO oxidation was investigated. Cu catalysts are active for selective CO oxidation [4] and Cu presence may provide an additional site for O₂ adsorption. The Pt-Cu interaction was investigated by temperature programmed reduction (TPR), diffuse reflectance UV-Vis spectroscopy (DRS UV-Vis) and H₂ and CO chemisorption, while the activity and selectivity of the prepared catalysts were measured under model conditions.

Experimental

Pt-Cu/Al₂O₃ and Pt-Cu/Nb₂O₅ catalysts were prepared by the incipient wetness technique, using aqueous solutions of H₂PtCl₆ (MERCK) and CuCl₂·2H₂O (MERCK). The catalysts were characterized by H₂ and CO chemisorption, temperature programmed reduction, UV-Vis diffuse reflectance spectroscopy and X-ray diffraction. The SELOX reaction was performed in a temperature range of 0-300°C in a stream containing 1% CO, 1% O₂, 30% H₂, 30% CO₂, 10% H₂O and He balance. The mass of the samples were 200 mg and the total flow rate was 100 mL/min.

Results/Discussion

The results for selective CO oxidation on the several catalysts are shown in Figure 1. All the catalysts presented almost 100% of O₂ conversion above 200°C. The formed products were

only CO₂ and H₂O. The addition of copper increased the maximum CO conversion and the selectivity for the Nb₂O₅ supported catalyst. The same behavior was not observed in the case of the Al₂O₃ supported catalyst, for which the presence of Cu decreased substantially the maximum CO conversion observed and the selectivity in all temperature range. The 1%Cu/Al₂O₃ and 1%Cu/Nb₂O₅ catalysts were not significantly active under the tested conditions. The lower CO conversion observed for Pt-Cu/Al₂O₃ when compared to Pt/Al₂O₃ was ascribed to blocking of Pt active sites by the presence of Cu. The bimetallic Pt-Cu/Nb₂O₅ catalyst showed higher CO conversion at lower temperatures due to a bimetallic interaction between Pt and Cu. The SMSI effect between Pt and Nb₂O₅ also seemed to enhance the catalytic activity of the supported Nb₂O₅ catalysts at lower temperatures.

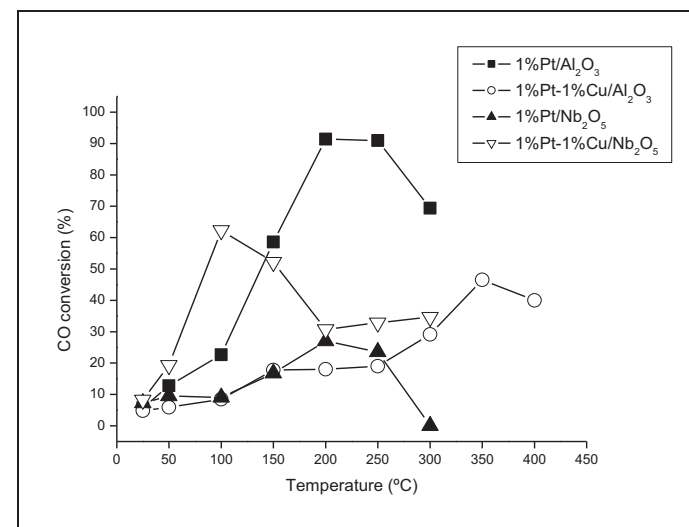


Figure 1. Selective CO oxidation on Pt-Cu/Nb₂O₅ and Pt-Cu/Al₂O₃ catalysts.

References.

1. A. Manasilp, E. Gulari, *Appl. Catal. B: Environ*, **37**, 17 (2002).
2. P. Marques, N. F. P. Ribeiro, M. Schmal, D. A. G. Aranda, M. M. V. M. Souza, *J. Power Sources*, **158**, 504 (2006).
3. O. Korotkikh, R.J. Farrauto, *Catal. Today*, **62**, 249 (2000).
4. J. L. Ayastuy, A. Gurbani, M. P. González-Marcos, M. A. Gutiérrez-Ortiz, *Int. J. Hydrogen Energ*, **35**, 1232 (2010).