(02-137) - Nanostructured Co3O4 oxide for low temperature co selective oxidation

JAIRO ALBERTO GOMEZ CUASPUD - Doutor
Gómez-Cuaspud, J.A. (1); Schmal, M. (1)
NUCAT/COPPE/UFRJ, Centro de Tecnologia, Bloco G, sala 228, CEP 21945-909, Rio de Janeiro/RJ, Brazil

Among the various advantages of fuel cells operated with hydrogen that uses solid oxides as catalyst are low operating temperatures, high power density, and easy start-up. However, the principal requirement for an ideal performance is the promoting of on-board reforming for cleaning the residual CO in a hydrogen-rich stream, because CO can degrade the electrochemical performance of anodic components severely, even at ppm levels. It is generally recommended that the CO concentration be controlled to less than 10 ppm. In this context, different methods have been suggested for the preparation of catalysts with high surface areas. The most conventional is based on a solid-state reaction, where the metal oxides are mechanically mixed, resulting in finely divided powders. However, these materials present low surface areas and need high temperature of calcination and long reaction times. On the other hand, alternative methods as combustion using citric acid has been proposed to synthesize nanosized materials and is particularly useful in the production of ultrafine ceramic powders with small average particle size. This is an easy and fast method, with the advantage of using inexpensive precursors, producing homogeneous nanosized crystallites, and highly reactive materials. The large amount of gases released during the reaction produces a flame that can reach temperatures above 1000 °C resulting in nanocrystallites with high surface area and homogeneity. So, the aim of this work is to investigate the synthesis of nanozised Co3O4, oxide by the polymerization-combustion method, the morphological and structural properties were evaluated in the selective oxidation of CO under rich H2 atmospheres at low temperatures. Physicochemical characterization of obtained material before and after catalytic test under chosen conditions were determined by X-ray diffraction, scanning electron microscopy SEM, temperature programmed reduction TPR-H2, Raman spectroscopy and Diffuse reflectance infrared Fourier transform spectroscopy of adsorved CO (DRIFTS-CO). The Co3O4 oxide was synthesized by means polymerization-combustion technique using citric acid as quelant of metal cation dissolution in low molar relation with respect to total quantity of metal cation (Hcit:M 0.5:1.0). Obtained material after combustion process was tested in the low temperature selective oxidation of

CO using a gas mixture of H2:O2:CO (60:1:1 v/v%) and a GSHV = 22000 h-1. All reaction parameters chosen here such as the reaction temperature, the feed gas composition and the gas space velocity strongly influenced the performance of catalyst during CO oxidation and also the rate of catalyst deactivation. However, the deactivation behavior does not show appreciable changes in the surface area of material after 500 minutes of reaction. Consequently, the study on the deactivation of catalysts during oxidation and with the chosen reaction parameters and guest gases can lead to an understanding of effect of synthesis method over deactivation process by carbon deposition in the selective oxidation of CO. These results were fundamental in understanding of chemical energy conversion into electricity from hydrogen and oxygen feedings for fuel cells.