Hydrogen purification for fuel cells: Preferential CO oxidation in excess of hydrogen

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Most of the energy used today comes from fossil fuels that cause serious environmental problems, one of the most attractive options that is being considered is the use of H_2 as fuel, both for issues of power generation (fuel cells) and for direct use in internal combustion engines (heat engines H_2). The production of electrical energy from H_2 feed directly electric motor engines, either by direct combustion or use in fuel cells. The H_2 is a clean way to generate power, as the only product obtained in the process is H_2O

Combustion Engine

$H_2 + ½\ O_2 \rightarrow H_2O$ + Heat generation

Fuel Cell

$H_2 + ½\ O_2 \rightarrow H_2O$ + Electric Power

The reforming of methane with water vapor is the most widely used for the production of H_2 with 95% usage. There is other methods, but in all these processes always involve the simultaneous CO formation. Although the water gas shift reaction is effective to oxidize CO, efficient elimination of trace amounts of CO is required due to small amounts of CO present in the H_2 streams poison the Pt electrocatalysts of PEM fuel cells: an objective which can be achieved by the preferential oxidation reaction of CO (PROX), because its low-cost, effective, available method for reducing CO to a desired level (less than 50ppm of CO) without excessive hydrogen consumption

In the present work we have studied the effects of the gold load, as well as the O_2/CO ratio, using gold catalyst supported on cerium and zirconium oxides, on the catalytic performances in PROX reaction. The catalysts of Au-CeO_2-ZrO_2 were prepared by the pseudo sol-gel method from the thermal decomposition of a mixed resin precursor metal propionates. The synthesized catalysts were characterized by various techniques in order to determine the main physic-chemical and structural properties and then related with the results of selective CO oxidation reactions. The specific surface area of the catalysts was determined by N_2 adsorption desorption at 77K and interpreted using the Brunauer - Emmet -Teller (BET). The crystalline phases and the determination of the degree of crystallinity of the synthesized materials were identified by X-ray diffraction (XRD). The texture, shape and size of the materials was studied by scanning electron microscopy - SEM and analyzed by elemental microcomposition energy dispersive spectroscopy X-ray - EDXS coupled to SEM.

The catalytic activity and selectivity measurements in PROX over the studied gold catalysts were carried out using a quartz glass U-shaped reactor, equipped with a temperature programmed controller. The reactor effluent was analyzed on-line by an assembly of two, in series, gas chromatographs. The first was a GC HP 5890 series II equipped with a HP-PLOT/Q column (0.53mmID and 30 m length, Agilent Technologies, USA) and the second was a GC HP 5890 A equipped with a Molecular Sieve 5 A° column (Agilent Technologies, USA). The reaction was evaluated in a temperature range of 70-300 ° C, the catalytic tests were performed at ensuring higher GHSV 40000 h-1 hourly space velocity, the activity, hydrogen yield and products distribution was analyzed.