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Structure-Activity Relationship of Gold Catalysts on Alumina Supported Cu-Ce Oxides for CO and Volatile Organic Compound Oxidation

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Abstract : The catalytic oxidation of CO and volatile organic compounds (VOCs) is considered as one of the most efficient ways to reduce harmful emissions from various chemical industries. The effectiveness of gold-based catalysts for many reactions of environmental significance was proven during the past three decades. The aim of this work was to combine the favorable features of Au and Cu-Ce mixed oxides in the design of new catalytic materials of improved efficiency and economic viability for removal of air pollutants in waste gases from formaldehyde production. Supported oxides of copper and cerium with Cu: Ce molar ratio 2:1 and 1:5 were prepared by wet impregnation of g-alumina. Gold (2 wt.%) catalysts were synthesized by a deposition-precipitation method. Catalysts characterization was carried out by texture measurements, powder X-ray diffraction, temperature programmed reduction and electron paramagnetic resonance spectroscopy. The catalytic activity in the oxidation of CO, CH₃OH and (CH₃)₂O was measured using continuous flow equipment with fixed bed reactor. Both Cu-Ce/alumina samples demonstrated similar catalytic behavior. The addition of gold caused significant enhancement of CO and methanol oxidation activity (100 % degree of CO and CH₃OH conversion at about 60 and 140 ^oC, respectively). The composition of Cu-Ce mixed oxides affected the performance of gold-based samples considerably. Gold catalyst on Cu-Ce/γ-Al₂O₃ 1:5 exhibited higher activity for CO and CH₃OH oxidation in comparison with Au on Cu-Ce/γ-Al₂O₃ 2:1. The better performance of Au/Cu-Ce 1:5 was related to the availability of highly dispersed gold particles and copper oxide clusters in close contact with ceria.

Keywords : CO and VOCs oxidation, copper oxide, Ceria, gold catalysts
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