NO REDUCTION BY CO OVER NANOSTRUCTURED GOLD CATALYSTS SUPPORTED ON CERIA AND CERIA MODIFIED BY ALUMINA

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The catalytic reduction is a widely applied method for NO_x removal. Recently it was established that nanostructured gold catalysts are active in NO_x reduction by H_2, CO or HCs at low temperatures. The present study deals with NO reduction by CO over gold catalysts supported on CeO_2 and CeO_2-Al_2O_3. A high and stable catalytic activity of these catalysts has been shown by some of us in the reactions of WGS and complete benzene oxidation.. In the present study the co-precipitation method was chosen for the mixed support preparation. The effect of pre-treatment conditions and feed gas composition on the catalytic activity and selectivity of NO reduction by CO was investigated. The gold-based catalysts were characterised by XRD, TPR, XPS and Raman spectroscopy aiming to look for a relationship between the structural features and catalytic behaviour and especially to clarify the role of alumina for the catalytic activity and stability. A series of three catalysts was studied: Au supported on CeO_2 and on CeO_2-Al_2O_3, containing 10 or 20% alumina. The gold (3 wt%) was loaded by deposition precipitation method. The catalysts were tested in a wide temperature interval using IR and UV analysers as well as MS for monitoring of the reactants and the products. The results have shown that the pre-treatment in H_2, O_2 or inert atmosphere did not have a substantial effect on the catalytic activity, which could be significantly improved by H_2 addition to the gas feed. Several factors such as the Au and CeO_2 particle size as well as the formation of oxygen vacancies have importance for the reactivity. The TPR and Raman spectroscopy results confirmed that higher amount of oxygen vacancies was generated adding increasing amount of alumina. The decrease of ionic gold component and the increase of the Ce ($^{3+}$) species, as observed by XPS of gold catalyst on mixed support with 20 wt% alumina, were also indicative of the oxygen vacancy creation. In correspondence of this structural change, a higher catalytic activity was observed for gold catalyst on the mixed support with 20 wt% alumina as compared to the corresponding sample with 10 wt% alumina. Moreover, the presence of alumina prevented catalysts agglomeration during the catalytic operation. The 100% selectivity towards N_2, obtained at about 200^{o}C makes the studied gold catalysts promising for DeNO_x process, concerning emissions immediately following the start-up of the vehicle engine (“cold start” phase).