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Ceria mixed oxides as Gold Species Support and their performance on the CO oxidation

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Abstract: $Ce_{1-x}M_xO_2$ (M= Ru, La) nanostructured solid solutions were prepared by means hydrothermal method and using them as gold support by using the DP-Urea method. The catalysts were characterized by means TEM, SEM, XPS, XRD, UV-vis spectroscopy, titration of available surface oxygen with H_2 pulses at high temperature and in CO catalytic oxidation. The results suggest that hydrothermal method gives different morphology and surface area of nanostructured materials in comparison to the conventional sol-gel method. Also Au dispersion and CO oxidation are dependant of these characteristics.

Keywords: Ceria catalyst, Ceria mixed oxides, nanostructured materials, CO oxidation, nanotube, nanorods.

The unique properties of supported gold species were studied extensively during the past decade. The remarkable capability of these catalysts to catalyze different reactions at low temperatures is attributed both to Au nanoparticles and the nature of the oxide support used [1]. In gold-based catalysts, the support properties play a significant role in the activity of the catalyst. Has been confirmed that when there are in use reducible supports such as MnO_x, TiO_x, FeO_x, CeO_x y CoO_x, these contribute to the catalytic activity of the gold [2-4]. Cerium oxide, particularly, possesses properties redox that favors greatly the reactions of oxidation as example their implementation on the automotive three way route catalysts.

Ceria mixed oxides were prepared by sol-gel using citrate complex method as in [5] was treated in autoclave with NaOH varying temperature, time of treatment and concentration of NaOH according to [6]. The obtained samples were washed with water and calcined at 650 °C in air during 4 hr. Gold (3%) was deposited on ceria using DP technique with urea.

Samples were characterized by TEM, SEM, XPS, XRD, UV-vis spectroscopy, titration of available surface oxygen with H_2 pulses at high temperature and in CO catalytic oxidation in flow (mixture 1%CO+0.5%O_2, residence time 30 mol CO/s/g-CAT). The hydrothermal treatment of ceria in autoclave at different conditions resulted in different morphology of ceria crystals (Fig.1). The treated samples are characterized with huge increase of BET surface area (up to 50-70 m^2/g) than that for initial ceria (4m^2/g) accompanied with the decrease in size of primary ceria crystals and gap energy. The latter manifests the increase of the number of structural defects in treated samples. The presence of structural defects on ceria increases the content of reactive surface oxygen and contribution of cationic gold species and activity of samples in CO oxidation, Fig.1a) and 1b). Cerium mixed oxide solid solutions are more active than CeO_2 and also affect the shape of gold particles.

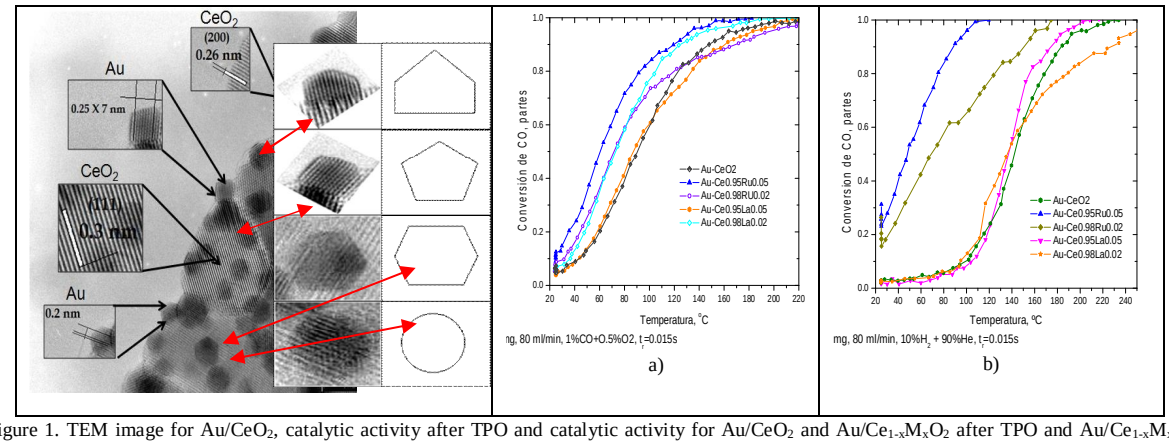

Figure 1. TEM image for Au/CeO_2, catalytic activity after TPO and catalytic activity for Au/CeO_2 and $Au/Ce_{1-x}M_xO_2$ after TPO and $Au/Ce_{1-x}M_xO_2$ after TPR.

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