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CERIA-ZIRCONIA COATED STAINLESS STEEL MESHES AS SUPPORTS OF COBALT OXIDE CATALYSTS

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Ceria-zirconia shows excellent oxidation-reduction properties and high temperature stability. For that reason, the Ce-Zr mixed oxides are often used as interlayers of structured supports having low surface area. Our preliminary study of cobalt oxide catalysts prepared over stainless steel meshes showed low adhesion of the deposited cobalt oxides to the supports. In this study we attempted to increase stability of the cobalt oxide layer on the stainless steel support by application of ceria-zirconia interlayer.

Ceria-zirconia with various Ce:Zr molar ratios (2:1, 1:1, 1:2, 1:5, and 1:10) were prepared by sol-gel method[1]. Powder XRD showed shortening lattice parameters of the Ce-Zr mixed oxides with increasing Zr content. The highest surface area (S_{BET}) was measured for CeO_2 and was decreasing with increasing content of Zr; the lowest value was found for ZrO_2. The highest surface area of mesopores (S_{meso}) showed the sample with Ce:Zr molar ratio of 1:1. Micrographs of ceria-zirconia coatings showed a partial segregation of the deposited products. The best homogeneity was observed for the mixed oxide with Ce:Zr molar ratio of 1:5 and, therefore, this product was used for deposition on stainless steel meshes by the dip-coating method.

The ceria-zirconia sol was dip-coated in more deposition steps and an effect of thermal treatment between the steps was studied. Two procedures were applied: (i) calcination at 500 °C after each deposition step and (ii) drying at 100 °C after each deposition step and final calcination at 500 °C. After the simple adhesion tests performed in an ultrasonic bath, the samples prepared by procedure (i) showed lower weight loss of the deposited oxide (about 30 wt. %) in comparison with samples prepared by procedure (ii), when weight loss of about 50 wt. % was found.

The stainless steel meshes coated with ceria-zirconia layer (obtained by procedure (i) with six dip-coating/calcination steps, Ce-Zr mixed oxide content of 0.4 wt. %) were impregnated with cobalt nitrate aqueous solution and calcined at 500 °C to reach 1.3 wt. % Co_3O_4 in the catalysts. The stainless steel meshes without ceria-zirconia interlayer showed lower content of the deposited Co_3O_4, as well as lower adhesion of Co_3O_4 to the support. The supported Co_3O_4 catalysts were tested in deep oxidation of ethanol and showed very good catalytic activity.

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References:

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