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Co₃O₄ supported on different supports for N₂O decomposition

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Nitrous oxide (N₂O) is considered as an important pollutant contributing to a greenhouse effect and causing ozone layer depletion. The largest industrial sources of N₂O emissions are waste gases from nitric acid production plants. The low-temperature catalytic decomposition of N₂O (up to 450°C) to nitrogen and oxygen offers an attractive solution for decreasing of N₂O emissions in tail gas from nitric acid production plants. Important question is the choice of suitable catalytic system. Most of the studies mentioned in the literature were performed in laboratory scale in kinetic regime on the catalysts in the grain form. For industrial application, catalyst must be shaped in some way.

In this work Co₃O₄ catalysts supported on different kind of shaped supports (rings, quadrulobes) were prepared by incipient wetness impregnation method. As support materials commercial supports made of MgAl oxides, Al₂O₃ and TiO₂ were used. The catalysts were characterized by AAS, XRD, Raman, FTIR, SEM, H₂-TPR and nitrogen adsorption methods and tested for nitrous oxide decomposition. Influence of geometry and textural parameters on catalytic activity were evaluated by calculation of effectiveness factor. The influence of support composition on the obtained deN₂O catalytic activity is discussed. Samples deposited on support with a high content of Al₂O₃ (Al₂O₃ + 30 wt.% Mg) revealed lower catalytic activity for N₂O decomposition due to the negative influence of Al ions in Co₃O₄ lattice causing formation of hard reducible aluminates. The Co₃O₄ deposited on support with higher content of Mg (Al₂O₃ + 70 wt.% Mg) showed the highest catalytic activity due to favourable dissolution of Mg ions in Co₃O₄ lattice, which probably causes distortion of the spinel structure and thus enable higher oxygen desorption directly influencing N₂O decomposition activity.

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