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# CATALYSIS: FROM SCIENCE TO INDUSTRY

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# Developing block catalysts for ozone decomposition

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Ozone is one of the major pollutants of atmospheric air generated by sunlight photochemical reactions [1]. Such ozone harms agriculture and cities as well as human health: it causes respiratory and cardiovascular diseases. The outdoor ozone pollution leads to indoor pollution. Since most of the time people are indoors, a rapid purification of indoor air from ozone is an urgent task.

Among the existing methods of air purification from ozone (adsorption by activated carbon, thermal decomposition, etc.), catalytic decomposition is a promising approach, since it is characterized by low energy consumption and the absence of secondary pollutants. Supported transition metal oxides attract increasing interest in heterogeneous catalysis, since such catalysts are not inferior in activity to those based on Pt and Pd, and they are significantly less expensive [2]. The use of ceramic blocks makes it possible to integrate such catalysts into air purification systems from ozone, which expands the areas of their practical application.

The aim of this work is to synthesize and study the catalysts based on a composition of transition metals (Mn, Cu, etc.) deposited on a ceramic substrate (cordierite) as well as to study their catalytic properties in the ozone decomposition. Noble metals were not used during the catalyst preparation.

Since the primary support does not possess a developed specific surface area, the synthesis of catalysts was carried out in two stages. The first stage was the preparation of the support, i.e., etching with a weak organic acid to increase the specific surface area of the support. At the second stage, the support was impregnated with a mixture of precursors of active components (transition metal nitrates).

The samples were studied by a complex of physical-chemical methods: low-temperature $N_2$ adsorption (-196 ºC), powder X-ray diffraction (XRD) analysis, temperature-programmed reduction by $H_2$ (TPR-$H_2$), etc. The catalytic characteristics of the samples were studied in ozone decomposition.

According to the low-temperature $N_2$ adsorption data, the original support features a specific surface area below 1 $m^2/g$, while the support activation by acid increases the specific surface area up to 99 $m^2/g$. Further impregnation of the samples leads to a decrease in the specific surface area and pore volume to up to 60–50 $m^2/g$ and 0.015–0.010 $cm^3/g$, respectively. All samples are characterized by the presence of both micro- and mesopores.

XRD data showed that the support was presented by a cordierite phase, and both activation of support by acid and deposition of active components did not change the sample phase composition. This indicated the formation of weakly crystallized finely dispersed particles of deposited oxides. An increase in the loading of active oxides from 2 to 4 wt.% led to an increase in interfacial interaction between these oxides that was shown by TPR-$H_2$ data.

The catalytic activity of the synthesized catalysts was studied in ozone decomposition at room temperature and at 50 °C. The ozone conversion was over 90% at a primary ozone concentration of 2.5 ppm.

Thus, the synthesized catalysts based on ceramic blocks and supported transition metal oxides feature a number advantages that make their use for purification of polluted air and ozone decomposition rather promising. Blocks can be made of various shapes, and not only do the developed approaches allow increasing the specific surface of blocks, but also distributing transition metal oxides in a highly dispersed active state on their surface.

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**References**

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