The influence of synthesis parameters on the characteristics of MOs/CB composites and their effectiveness for the thermal decomposition of ammonium perchlorate

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At present, different catalysts are employed in the thermal decomposition of ammonium perchlorate (AP), and transition metal oxides and their composites are preferred materials for catalytic applications [1]. This study is focused on application of combined transition metal (iron and cobalt) oxide catalysts deposited on the surface of a carbon carrier for the decomposition of ammonium perchlorate (AP). Catalyst samples with different contents of iron and cobalt oxides were prepared by the impregnation and chemical precipitation methods at varying calcination temperatures.

The structural and morphological features of the synthesized catalysts were studied by applying the XRD, SEM, and BET methods. It has been found that at increased heat treatment temperature contributes to an increase in the crystallinity of the oxide phases. A partial reduction Co_3O_4, initially to CoO at 600 °C and then to metallic cobalt Co at 700 °C, has been observed. Under chemical deposition conditions, with an increase in the heat treatment temperature, the specific surface area and the pore volume of the catalysts decrease to the values corresponding to the carbon carrier. This can be a consequence of the nonporous structure of metal oxides, the textural characteristics of which decrease with an increase in the size of crystalline blocks of metal oxides. In an inert atmosphere, the isolated particles of the Fe_3O_4 and Co_3O_4 spinels uniformly distributed on the carbon carrier surface, are formed. For the catalysts obtained by the impregnation method, the high thermal decomposition temperatures not only speed up the process, but also promote the aggregation and sintering of oxide particles. The results of the DSC study show that the synthesized composite catalysts exhibit excellent catalytic properties for the thermal decomposition of AP. Furthermore, the appearance of reduced forms of metals in the composition of the active catalytic component of the catalysts increases their catalytic activity and the thermal effect of the AP thermolysis reaction.

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