**Oxide catalysts for production of synthesis gas and its conversion to liquid hydrocarbons**

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Now one of vexed environmental problems is Earth climate global warming in consequence of greenhouse gases emission in the atmosphere. The most widespread among them are carbon dioxide (CO2) which is produced substantially by fuel, energy branches, and methane (CH4), being the main component of natural and associated petroleum gases [1]. Therefore, the methane and carbon dioxide utilization in valuable products will allow removing a big range of the economic, environmental and social problems which are available around the world [2]. One of the valuable products resulting from the conversion of methane with carbon dioxide is synthesis gas. Synthesis gas consisting of a mixture of CO and H2 in various proportions is an alternative source of raw materials for the petrochemical industry. The main areas of use of synthesis gas [3] are hydrogen production, methanol production, Fischer-Tropsch synthesis, oxosynthesis and reduction of iron ore in metallurgy. Synthesis gas can be effectively used in the energy sector for the production of heat and electricity in gas turbine and combined-cycle plants, etc. There are several catalytic technologies for producing synthesis gas of different compositions, such as steam methane reforming (SMR), partial methane oxidation (POM), autothermal reforming (ATR) and dry reforming of methane (DRM). Synthesis gas can also be obtained by coal gasification [4].

DRM is of particular interest because it allows to simultaneously dispose of two greenhouse gases - methane and carbon dioxide. The main problems of DRM are the low activity of catalysts and their instability to carbonization [5], as a result of which its lose the efficiency. Nickel catalysts are the most widely studied for these reactions, their main advantage is low cost [6]. However, the main problem of nickel catalysts is fast deactivation due to coke formation. Therefore, the question of development of the active and resistant to carbonization catalyst for the dry reforming of methane is open still. An important step in the creation of highly efficient catalysts is the search for the carrier, the active phase, modifying additives and the method of preparing the catalyst, which affect their structure and catalytic properties.

For Fischer – Tropsch synthesis, cobalt systems are considered as promising catalysts, which make it possible to obtain liquid and solid paraffin hydrocarbons from CO and H2 with selectivity up to 90%. It is known, that the activity and selectivity of cobalt catalysts in the production of liquid hydrocarbons from synthesis gas are influenced by a large number of different factors, for example, the nature of the carrier, promoter, method of preparation, conditions of reduction, etc. [7]. Despite the large number of studies on the choice of carrier, the active phase of cobalt catalysts, the study of influence of the preparation method, conditions for the activation of catalysts. There is no single point of view of the influence of the above factors on the activity of catalysts in the process of producing liquid hydrocarbons by the Fisher-Tropsch method. Therefore, research in this area are relevant.

In this work, the influence of carrier’s nature, oxides of transition elements, and the method of preparing catalysts on the direction of DRM to synthesis gas were studied. The transformation of synthesis gas into liquid hydrocarbons on cobalt catalysts was also investigated.

Among carriers (θ-Al2O3, γ-Al2O3 and 4А, 13Х, HY, HZSM-5) studied in the production of synthesis gas by DRM, γ-Al2O3 is most effective, the CH4 conversion is 20 % was determined. It is established that the carrier's efficiency in CH4 conversion depends on their specific surface. Among the studied oxides (Ni, Cu, Mo, V, Co, Cr, Zr, La, Ce) as the active phase of the catalyst, NiO was the most active in the of DRM. Studying the effect of the preparation method on the efficiency of 3 wt.% NiO / γ-Al2O3 showed, that the preparation of the nickel catalyst by the “solution combustion” compared to the impregnation method leads to an increase of catalyst’s specific surface from 153 to 161 m2/g. Which contributes to an increase in efficiency catalyst, CH4 conversion increases from 83 to 90% (Tr-850 °C). Effect of modifying additives (MoO3, La2O3, ZrO2) on the operating efficiency of 3 wt.% NiO / γ-Al2O3 was studied. It was established

that the introduction of MoO3 into 3 wt.% NiO / γ-Al2O3 leads to an increase in its efficiency in the reaction of the DRM, due to the increase in the textural characteristics of the catalyst. The CH4 conversion increases from 90 to 96.2% (Tr-850 ° C). Modification of 3 wt.% NiO /γ-Al2O3 with MoO3 leads to an increase in the carbonization stability of the catalyst. Under optimal reaction conditions: CH4:CO2 = 1:1, GHSV = 1500 h-1, Tr = 700 °C on a catalyst 4 wt.% NiOMoO3 / Al2O3, CH4 conversion is 86.5%, CO2 conversion is 79%, concentration of H2-50, СО-45 vol.%.

Conversion of synthesis gas to liquid hydrocarbons on the cobalt containing catalyst was studied. Catalyst was prepared by impregnation and “solution combustion” methods. The results of a physicochemical study (TPR-H2, SEM and BET) showed that synthesizing cobalt-containing catalysts by “solution combustion” method leads to a decrease in the catalyst recovery temperature, also to an increase in the specific surface of the catalyst from 166 to 171 m2/g compared to the impregnation method. Synthesis of a cobalt catalyst by "solution combustion" increases the dispersion of the catalyst, in the composition of the catalyst nanophases with sizes of 10-50 nm are observed. When a H2/CO = 2/1 mixture is converted on a cobalt-containing catalyst with REE additives prepared using the “solution combustion” method, at Tr= 300 °C and P= 6 atm, methanol, ethanol and dimethyl ether are formed as liquid products (10-15 vol.%).

The data obtained can be used in the development of new promising catalysts for the direct production of liquid hydrocarbons from methane through synthesis gas.

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