**Carbon dioxide conversion of methane over the polyoxide catalysts**

Kusman Dossumov\*, Zulkhair A. Mansurov, Anatoly V. Mironenko, Gaukhar Y. Yergazyieva, Dina Kh. Churina and Asel B. Kazieva

*Institute of Combustion Problems MES RK, 172 Bogenbai batyr str., Almaty 050012, Kazakhstan*

CO2 conversion of CH4 is one way of allowing to convert natural gas - methane to valuable desired products, which are a gas mixture of H2 and CO in a ratio close to 1 [1]. This reaction is the most secure process, in contrast to the partial oxidation of methane with air oxygen and steam-oxygen conversion. However the main problem is the carbonization of catalyst and so many efforts in this area directed to the development of catalysts stable to coking [2,3].

In this study were synthesized systems on the basis of NiO and Al2O3 supported on a fiberglass and oxide catalysts Ni/A l2O3, Ni-La/Al2O3. The catalysts were tested in a CO2 reforming of methane in the temperature range 600-850 °C at atmospheric pressure, and the ratio of CH4 : CO2 = 1: 1. Testing of the catalysts effectivity was carried out on an automated flow catalytic unit (PKU -1). The reaction products were identified by chromatography on the apparatus “chromos GC-1000”. Study of the catalytic activity of the system based on fiberglass in the reaction of carbon dioxide conversion of methane with the introduction of the oxides of Al and Ni (Table 1) was carried out. The difference between these systems is that at the synthesis of the first two catalyst samples produced by separately supporting of Al2O3 and NiO to the base of fiberglass by "solution combustion" method with using urea as the reductant ((CO) 2NH2). Namely, initially on fiberglass was deposited alumina and only after its complete layer formation was deposited on it a second layer of NiO. In the second case, oxides of Al and Ni were deposited on fiberglass simultaneously from a common solution.

Table 1 - Composition of samples based on fiberglass the separate synthesized (№1, 2) and joint (№3,4) applying the active ingredients and the characteristics of the catalytic activity of the catalyst at 850 °C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sample№ № | Composition | К(СН4),% | К(СО2), % | Output of Н2, % | Output of СО, % |  Сarbon formation |
| 1 | 1,5 % NiO/1% Al2O3 | 58.65 | 56.42 | 24.43 | 28.64 | -1.468 |
| 2 | 1,5 % NiO/2% Al2O3 | 70.39 | 74.16 | 31.89 | 37.19 | -1.537 |
| 3 | 1,5 % NiO-1% Al2O3 | 80.56 | 87.42 | 35.51 | 42.22 | -4.320 |
| 4 | 1,5 % NiO-2% Al2O3 | 85.35 | 94.22 | 39.14 | 45.68 | -3.262 |

The experiments showed that the catalytic activity of the samples synthesized by co-application to fiberglass alumina and nickel oxide was higher as in the conversion of the initial components and on the yields of the desired products. The table shows that the greatest catalytic activity for the conversion and the yield is characterized by a sample №4, and on the deposition of carbon on the surface of contact - samples №1 and 2. Next, NiO was supported on $γ-$ Al2O3 and modified with and LaO. The synthesized oxide catalysts (Ni/Al2O3, Ni-La/Al2O3) were tested in the reaction, the results showed that over the catalyst Ni-La/Al2O3 degree of conversion of methane increases from 28 to 67% with increasing reaction temperature from 600 to 850 0C. Conversion of CO2 is increased from 69 to 96% under the same conditions. The yield of H2 = 44, CO = 48%. The ratio of the synthesis gas at 750-800 oС =1: 1.

After the test reaction catalysts were investigated by scanning electron microscopy (Figure 1).

 a) Ni / Al2O3; b) Ni-La / Al2O3

Figure 1 – Microphotographs of catalysts

After the test in the reaction on the Ni/γ- Al2O3 catalyst surface is formed of carbon filaments. Modification of nickel catalyst by lanthanum leads to an increase in dispersion of the catalyst surface and also to reduce of carbon deposition.

Thus, these results showed that, compared with nickel catalysts, supported on glass fiber oxide catalysts exhibit relatively high activity.

 References:

1. Vesna Havran, Milorad P. Duduković, Cynthia S. Lo., 2011: Conversion of Methane and Carbon Dioxide to Higher Value Products. *Ind. Eng. Chem. Res.* **50 (12),** 7089-7100.

2. Tsolakis A., Wyszynski M.L., 2011: Biogas Upgrade to Syn-Gas (H2-CO) via Dry and Oxidative Reforming. *International Journal of Hydrogen Energy*. **36 (1),** 397- 404.

3. Fan M.S., Abdullah A.Z., Bhatia S., 2009: Catalytic technology for carbon dioxide reforming of methane to synthesis gas. *Chem. Cat.* **1,** 192-208.