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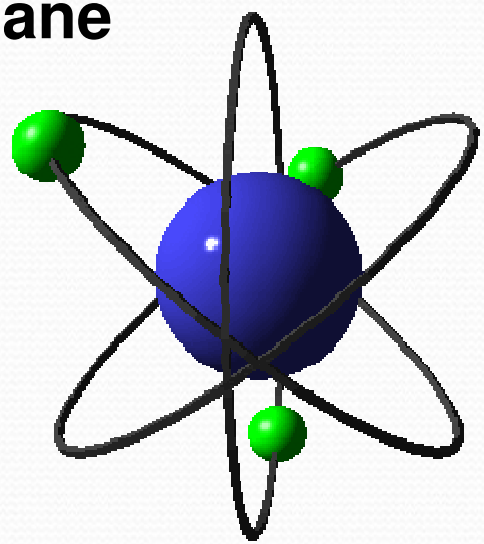
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The investigation of catalytic activity of polyoxide catalysts on the base of fiberglass in the reaction of carbon dioxide conversion of methane

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Outline

1. The synthesis of nanostructured catalysts on the base of fiberglass of carbon dioxide conversion of methane into synthesis gas .
2. Investigation of catalytic activity of synthesized polyoxide contacts .
3. Investigation of physical and chemical properties of obtained catalysts .
4. Optimization of catalysts composition, conditions for their preparation and catalytic activity.

- Today, natural gas is generally used as fuel, but the potential value of natural gas as chemical raw material is substantially higher than an energy source. Such products as ethylene, formaldehyde, benzene, hydrogen, and synthesis gas may be synthesized by direct method from natural gas.
- In our atmosphere there is enormous amount of carbon dioxide emissions because of processing of such products as coal, natural gas, crude oil and its products, which has no time to be fully processed by plants, and this leads to increasing of "greenhouse effect." As a result, the concentrations of carbon dioxide in large industrial cities and centers are much higher than the averages, so the need for disposal of CO2 is a problem, the solution of which will lead to the improvement of the environmental pool. The reaction of carbon dioxide conversion of methane:

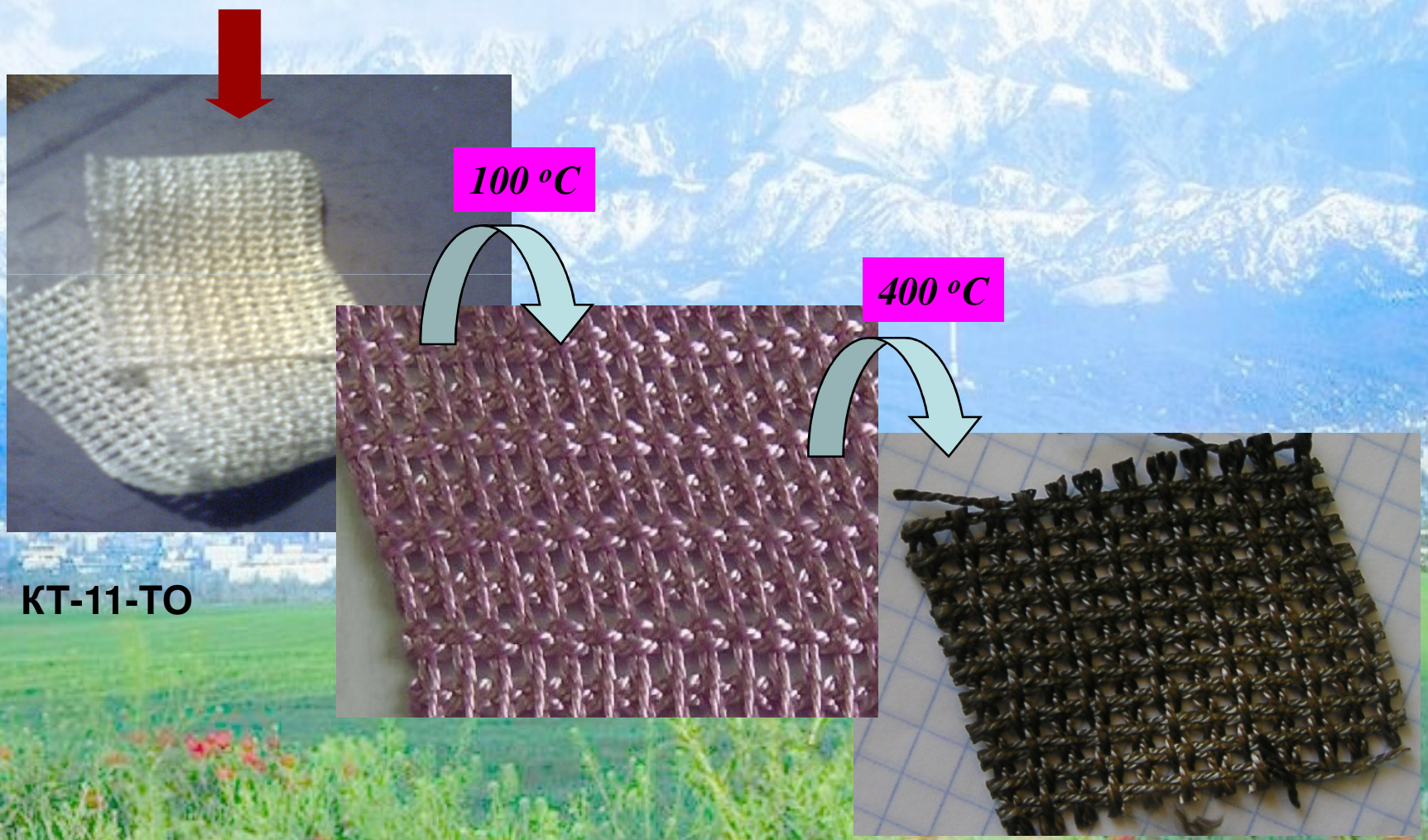
$$CO_2 + CH_4 \leftrightarrow 2CO + 2H_2$$

In this reaction, the contacts on the base of nickel oxide were obtained maximum distribution, but, in spite of high activity of these catalysts, their use is limited by significant carbonization processes. In this regard, at the present time the search of new catalytically-activated compounds that can be as alternative to nickel contacts is an important task.

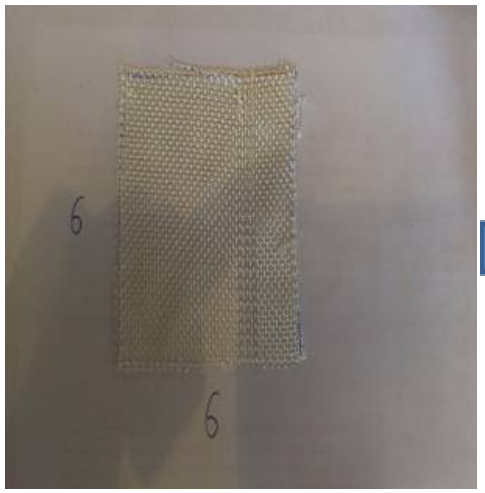
SYNTHESIS OF CATALYSTS BY SOLUTION COMBUSTION METHOD

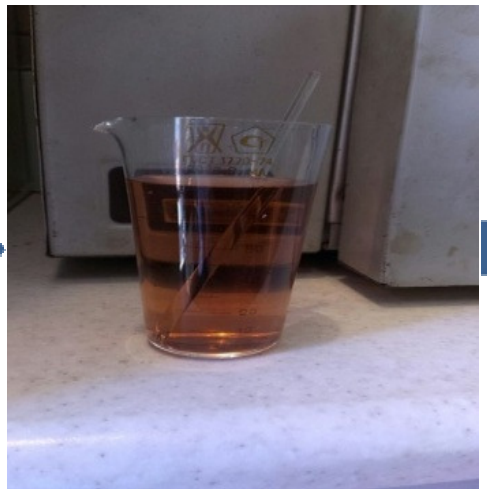
Nitrates Co and (or) Ni+ glycine

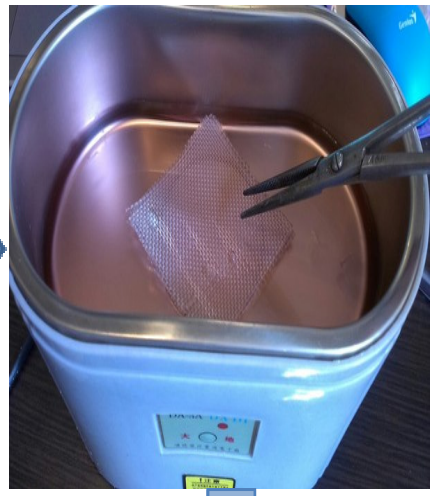
$$Me(NO_3)_2{*}6H_2O + 2NH_2CH_2COOH + 4.5O_2 \rightarrow MeO + 4CO_2 + 11H_2O + 2NO_2$$



Catalysts sample preparation





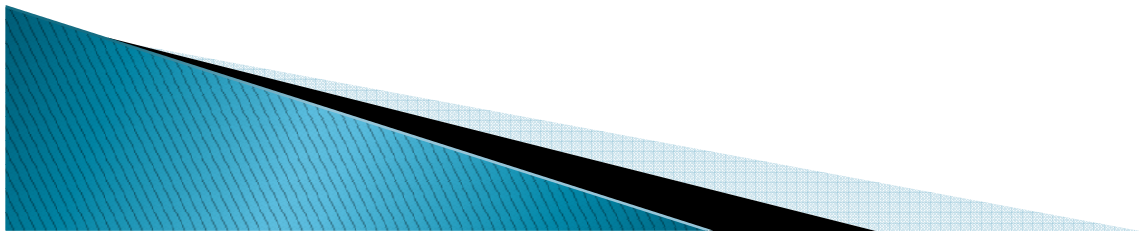


500 °C 350 °C 120 °C





Physical and chemical study of catalyst systems



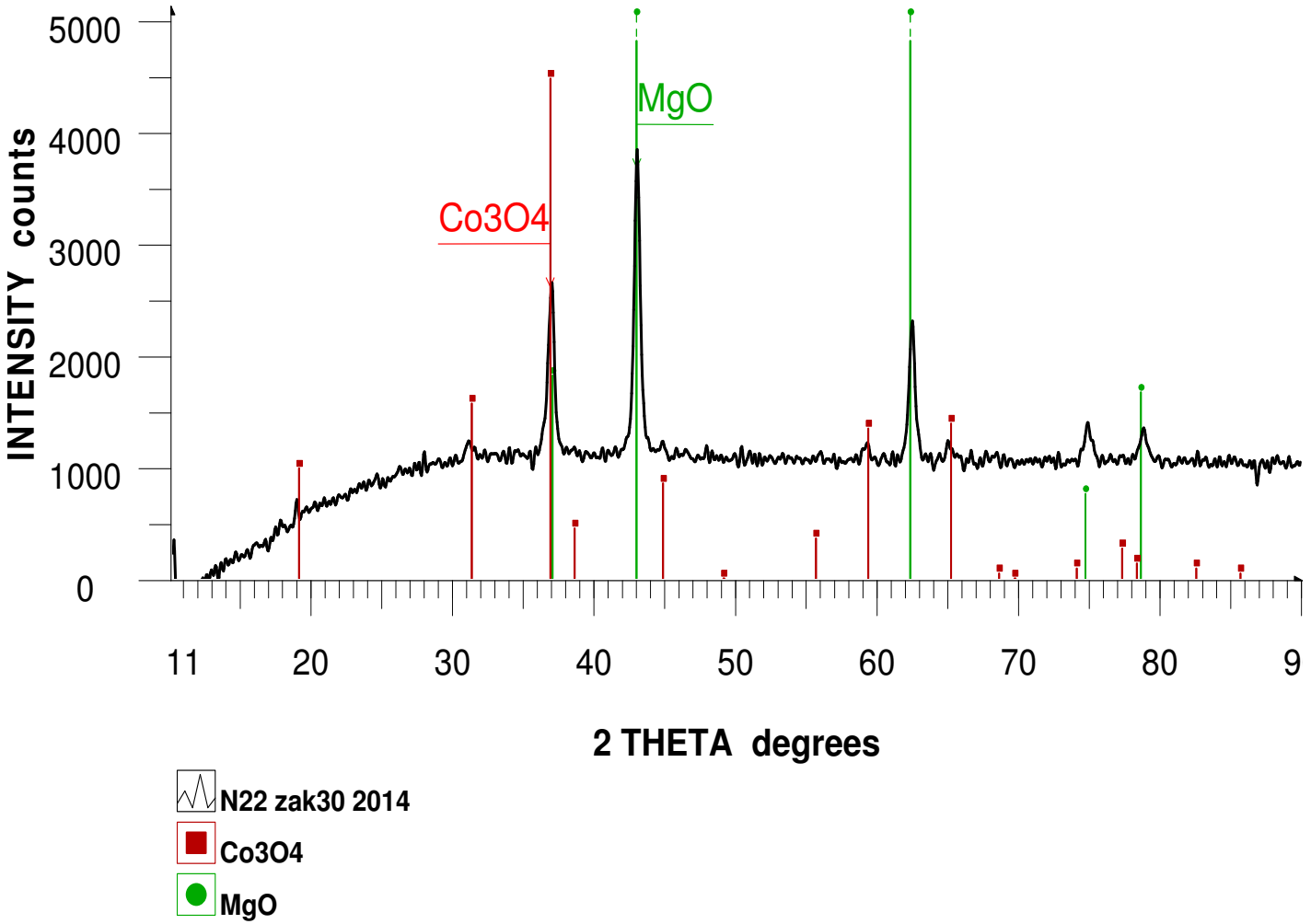


Figure 2 – Diffraction pattern of sample № 22

X-ray diffraction analysis

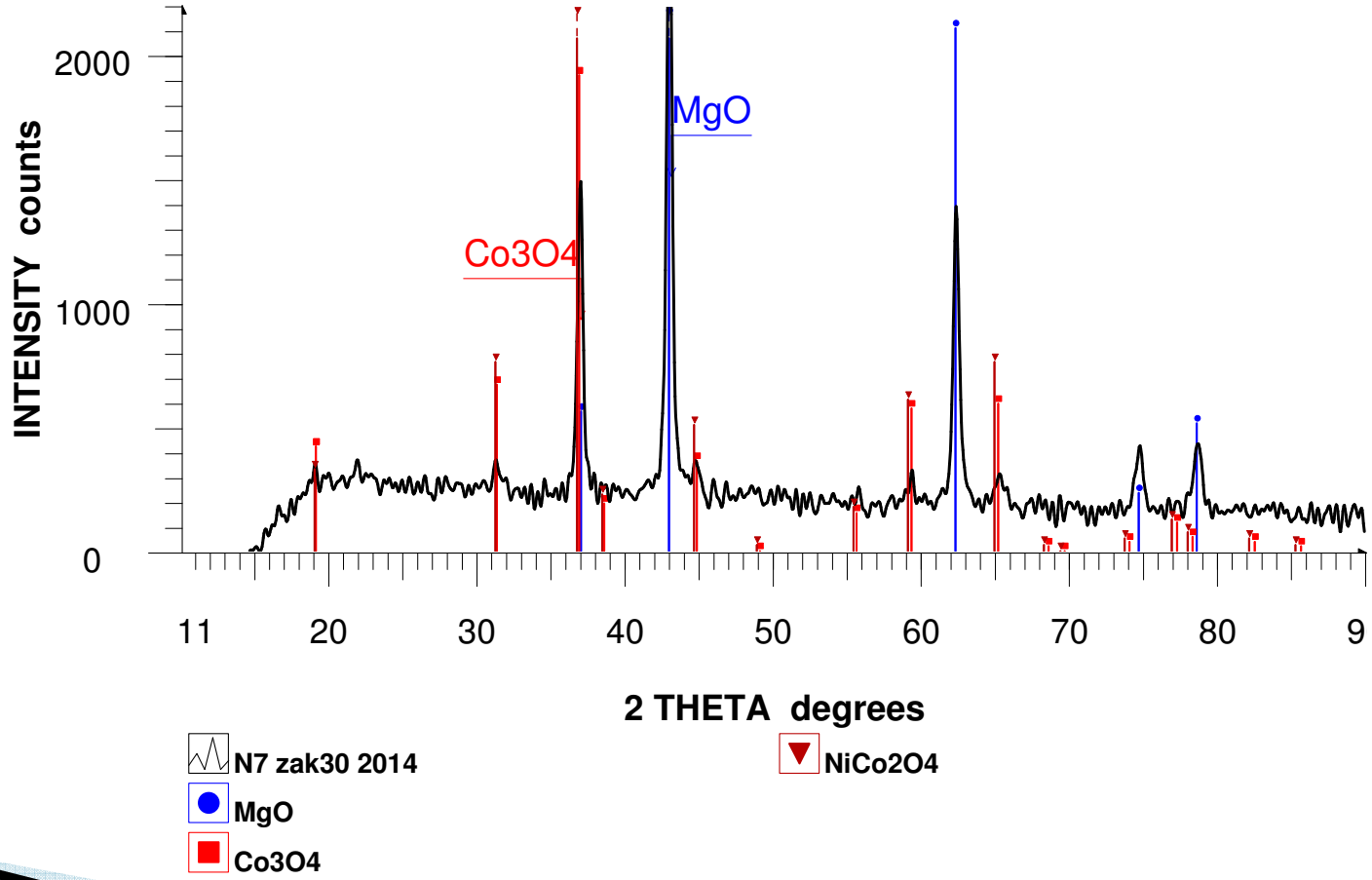


Figure 1 - Diffraction pattern of sample № 7

Transmission electron microscopy

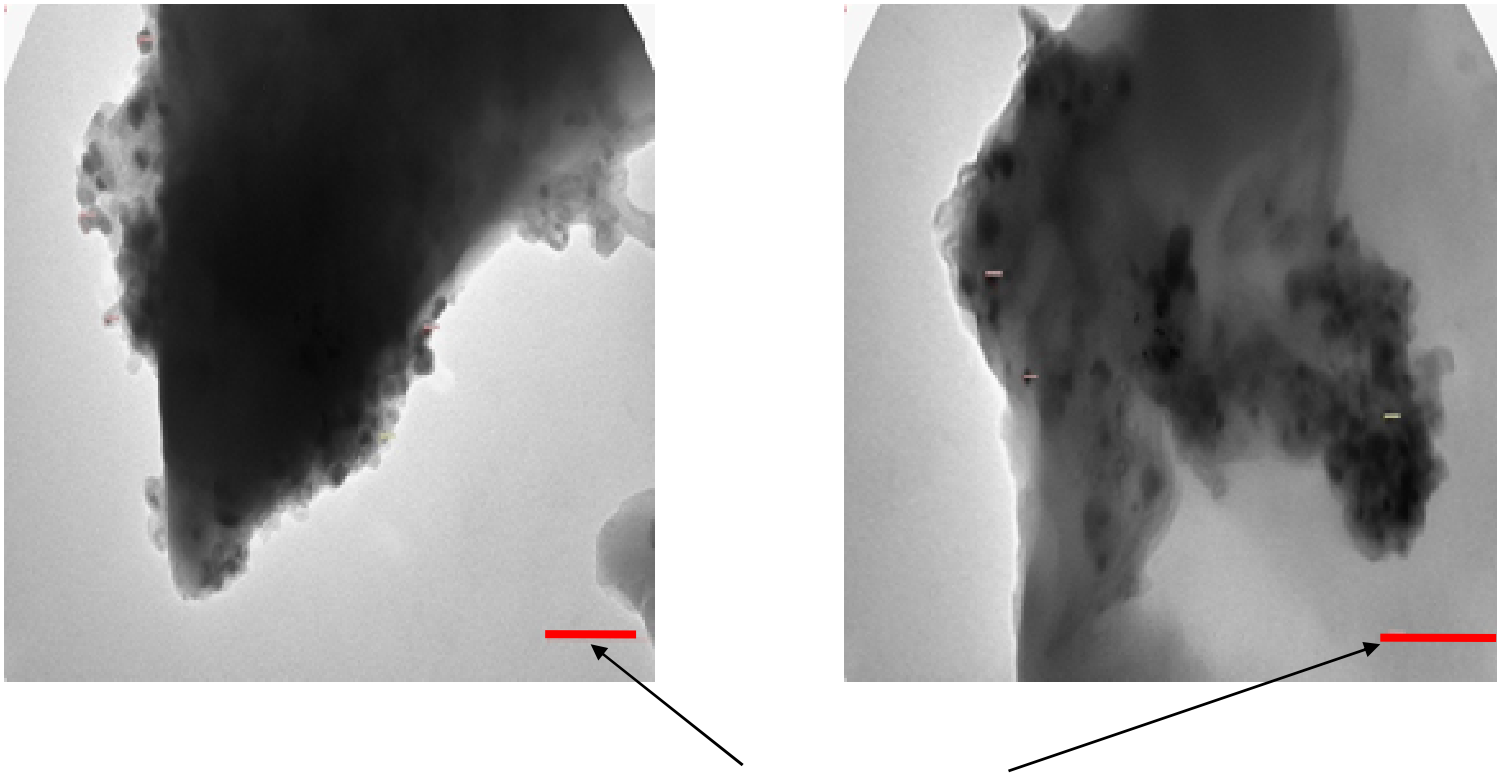


Figure3 – TEM images of catalysts № 5 and№ 9

The analysis of catalysts by temperature-programmed recovery method (TRM)

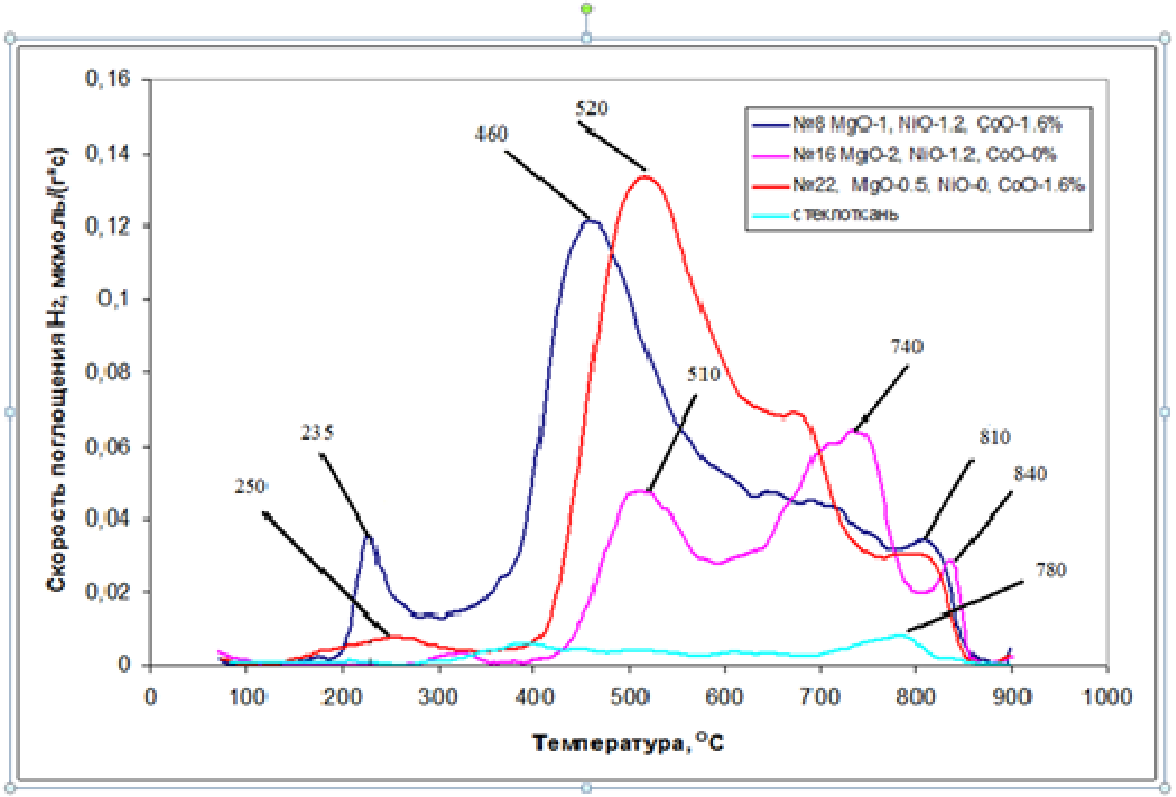


Figure 4 – Absorption rate in TRM experiments. 1 – sample 8, Co/Ni=1,6/1,2%, 2 – sample 16, Co/Ni=0/1,2%, 3 – sample 22, Co/Ni=1,6/0%. The samples were tested in argon 500°C/30 minutes.

Scanning electron microscopy

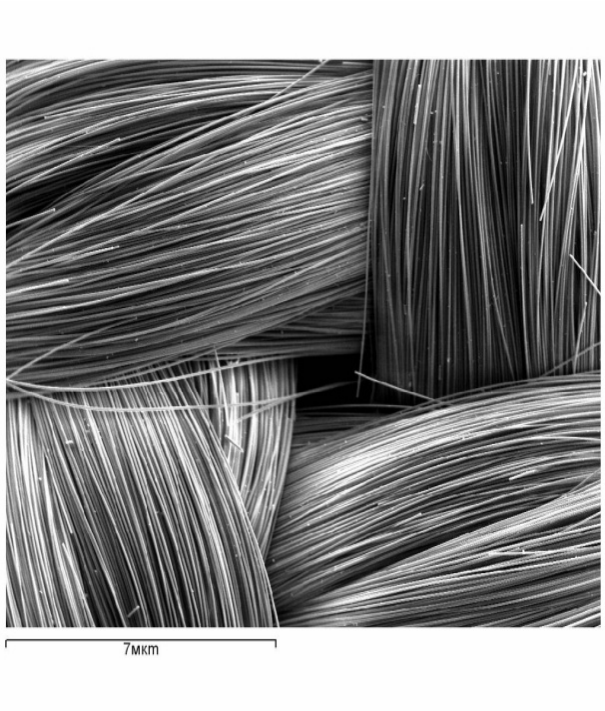


Figure 5 – The images of surface of fiberglass catalyst № 5

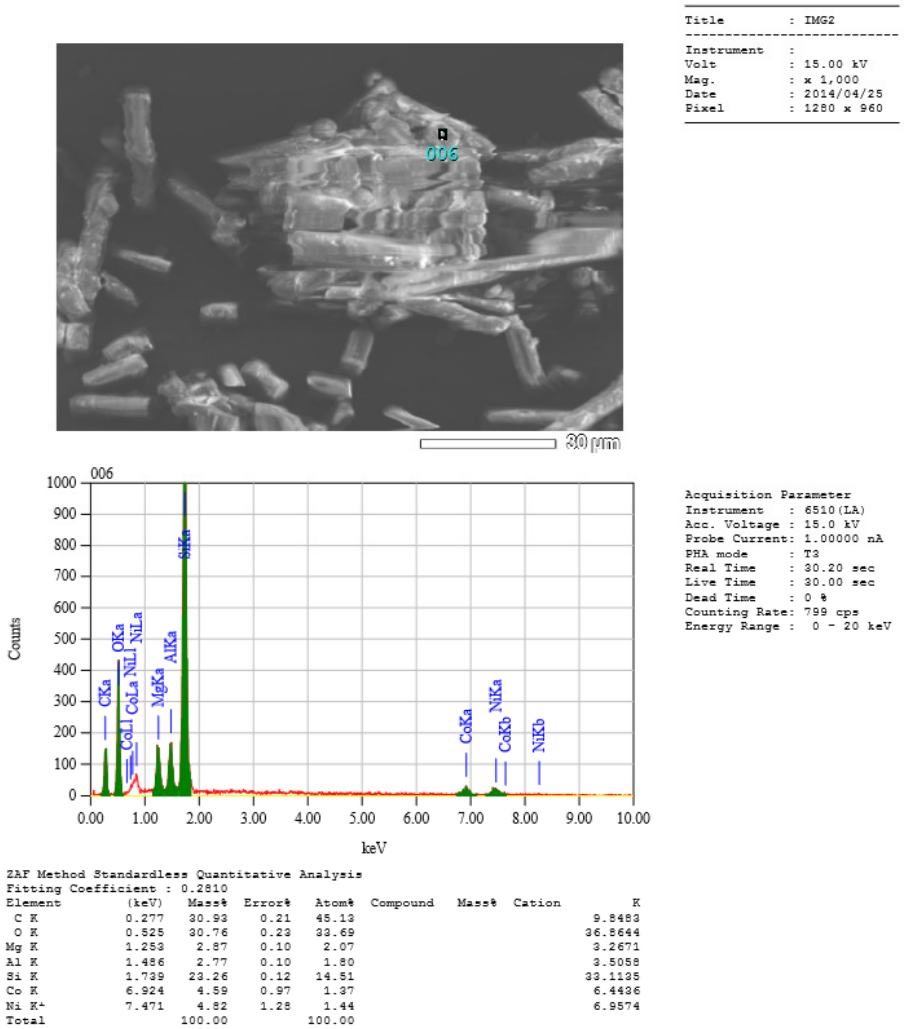
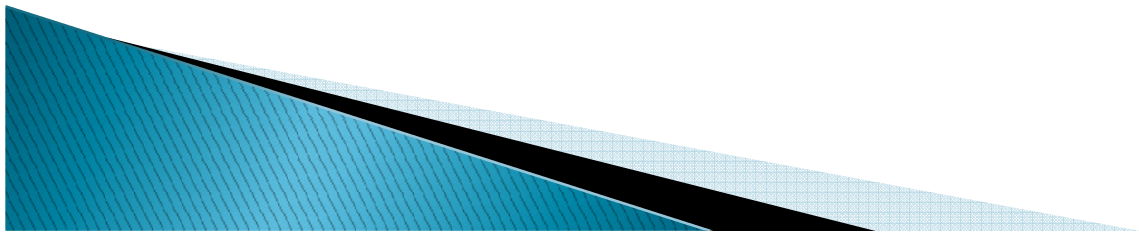


Figure 6 – The images of surface of fiberglass fibers of second electrones (SEI) and micro-x-ray-pattern of sample surface №5

The study of catalytic activity of polyoxide catalysts in the process of carbon-dioxide conversion of methane



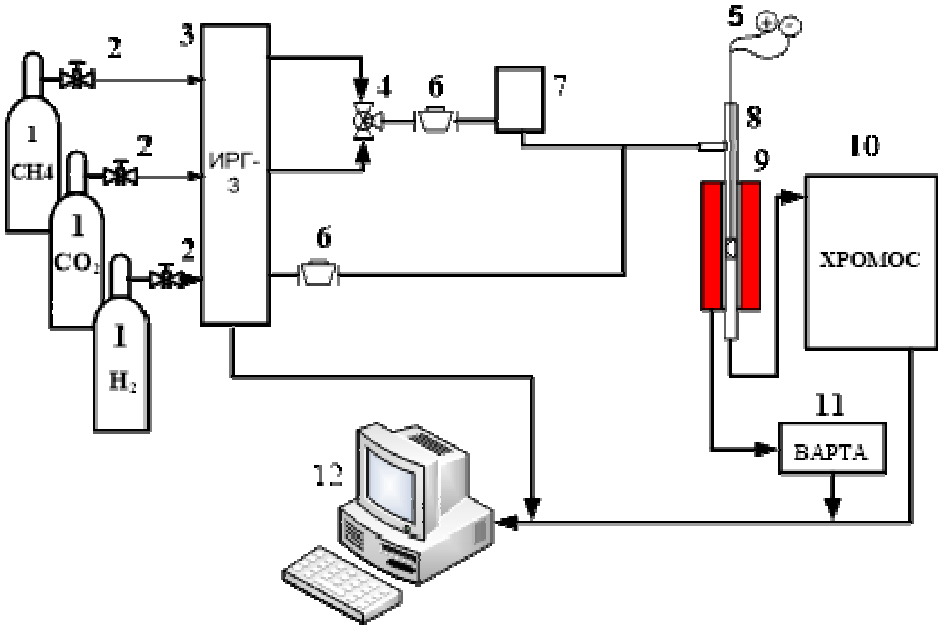
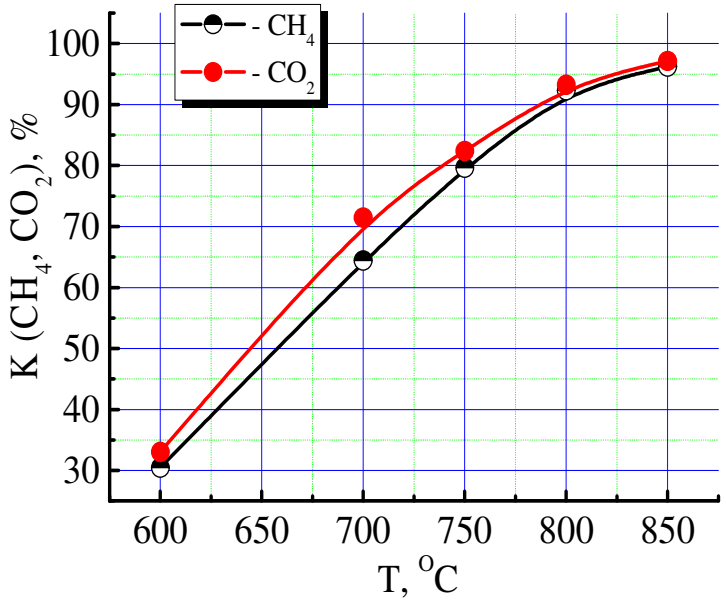
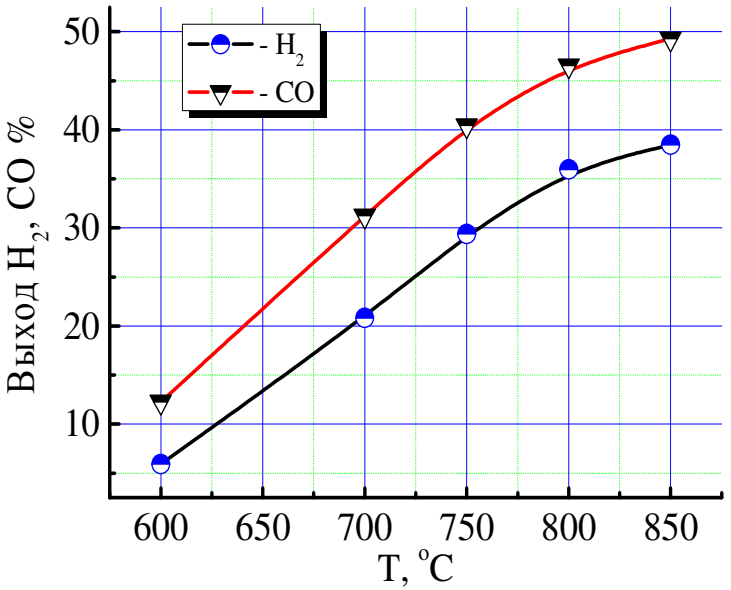


Figure 7 – Scheme of catalytic installation.

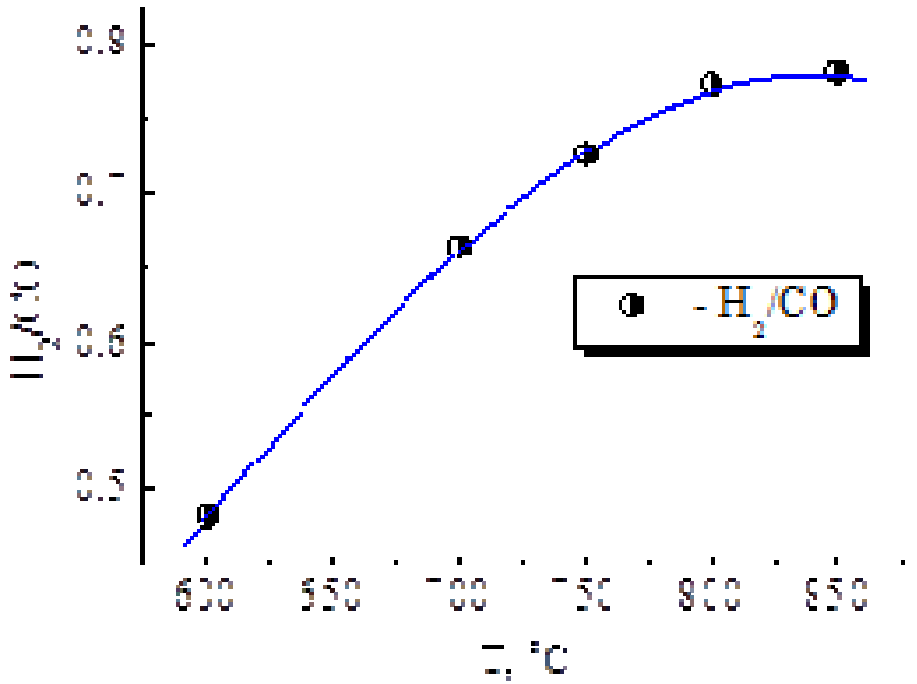
1 – Gas balloons ; 2 – Gas pressure regulator; 3 – Gas flow meter -3;
4 – Triple adaptor; 5 – Thermocouple; 6 – Stop valves; 7 – Mixer unit;
8 – Catalytic reactor; 9 – Tubular laboratory furnace; 10 – Gas chromotograph;
11 – Thermo controller;12 – Computer





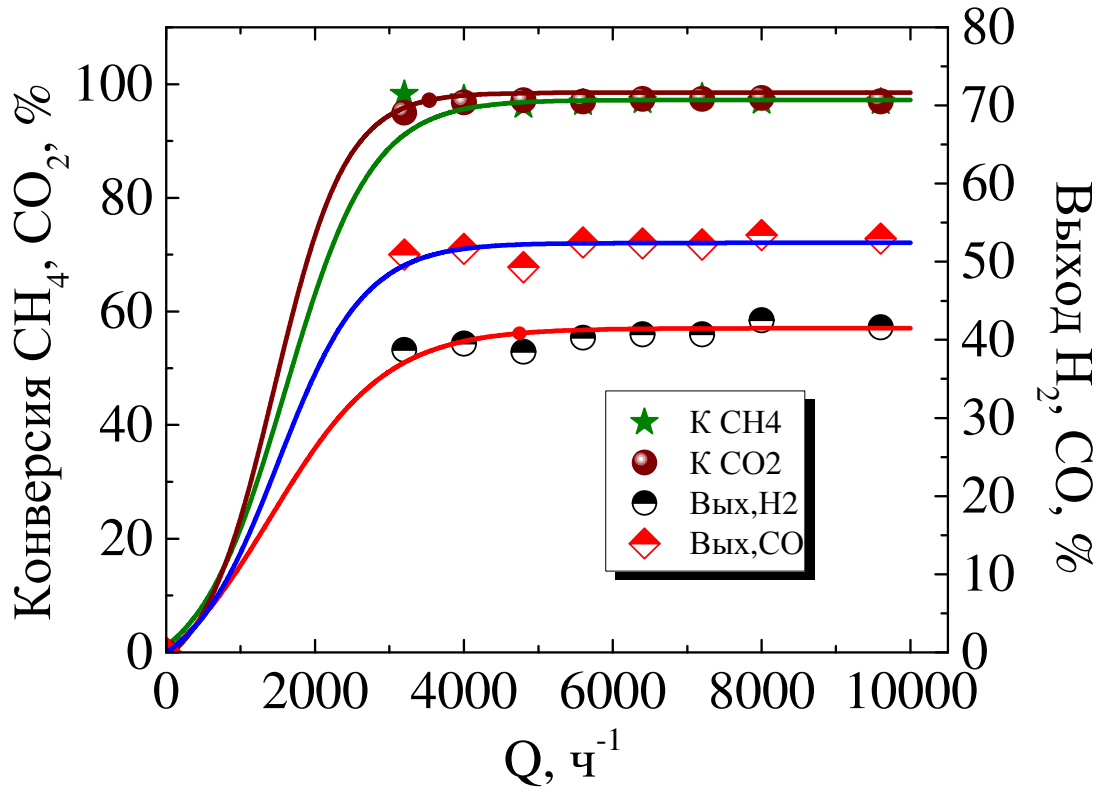
Conditions: MgO – 4,0 %; NiO – 0,4 %; CoO – 1,6 %; Q – 4800 $ч^{-1}$

Figure 8 – Dependences of methane conversion and CO_2, hydrocarbon and carbon oxide output from working temperature



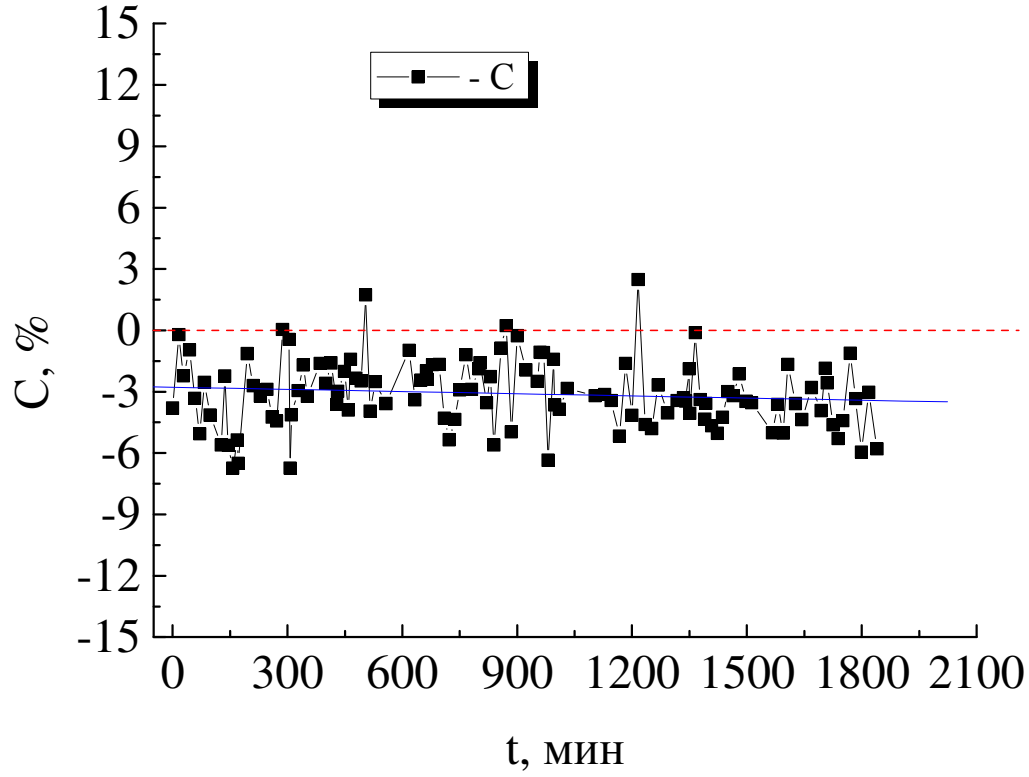
Conditions: MgO – 4%; NiO – 0,4%; CoO – 1,6%; Q - 4800 $ч^{-1}$, $T_{кат.}$ – 850°C

Figure 9 - The temperature effect of catalytic process on way of dependance $[H_2]/[CO]$



Conditions: MgO – 4,0 %; NiO – 0,4 %; CoO – 1,6 %; T – 850 C

Figure 12 – Dependences of methane conversion, carbon dioxide and outputs of H_2, CO from volume rate of process



Conditions: MgO – 4,0 %; NiO – 0,4 %; CoO – 1,6 %; T – 850 C; ; Q – 4800 $ч^{-1}$

Figure 13 - The data of material balance according in dependence on process duration

Conclusion

- Nanodispersed catalysts on the base of fiberglass, are modified by cobaltous oxides, nickel and magnesium by "Solution combustion" (Liquid-phase SHS) were developed
- It was found that at optimal conditions (T-850 ^{o}C, MgO-2 %, t_{kont} - 0,45c (Q = 8000 $ч^{-1}$) there are out puts H_2 - 45 %, CO - 48 %, at that the conversion is CH_4 и CO_2 approximately to 97-98 %.
- The testing of sample for duration of catalytic activity was carried out for 30 hours, and showed that during the run the catalytic activity was kept at the same level: for conversion of methane – 95-98% and for conversion of carbon dioxide – 96-98%

Thank You for attention!

