XXIV International Conference on Chemical Reactors
CHEMREACTOR-24
September 12 - 17, 2021

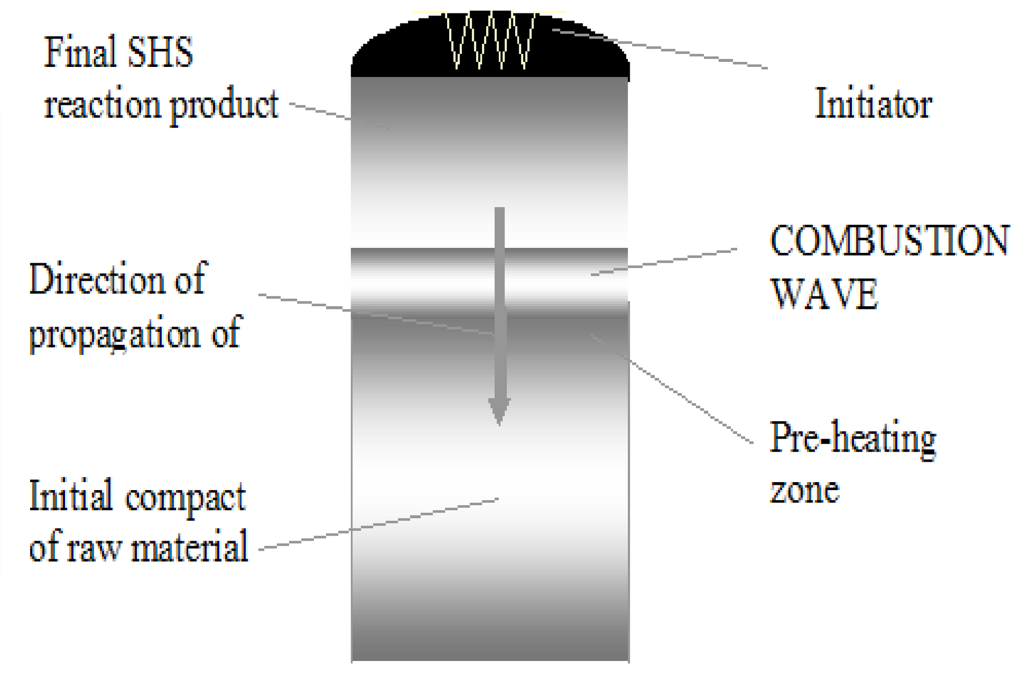
Biogas reforming on solution combustion synthesis

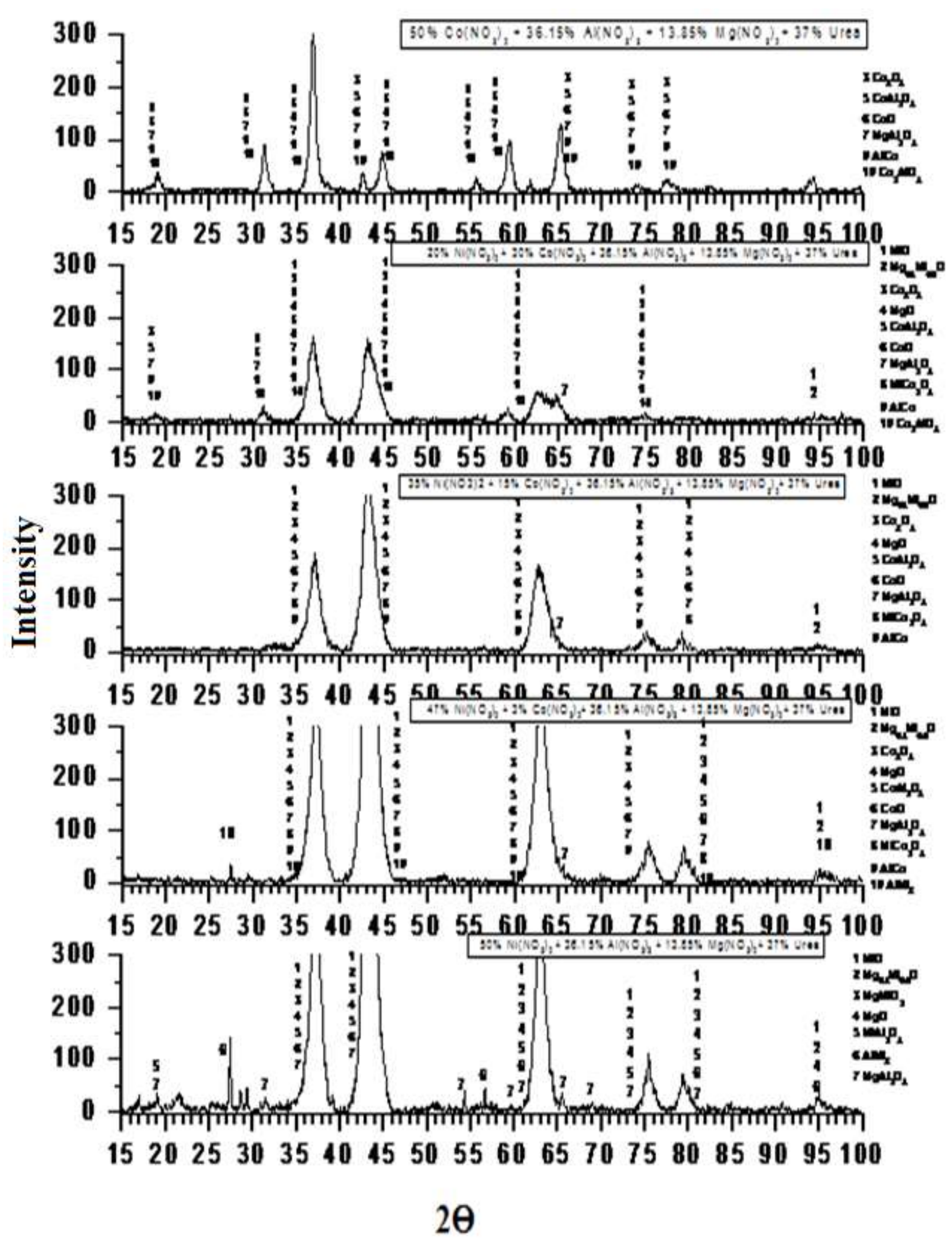
Zhumabek M.[1,2], Tungatarova S.A.[1,3*], Baizhumanova T.S.[1,3], Kotov S.O.[4], Massalimova B.K.[4]
[1]D.V. Sokolsky Institute of Fuel, Catalysis and Electrochemistry, Almaty, 050010, Kazakhstan; [2]Satbayev University, Almaty, 050000, Kazakhstan; [3]al-Farabi Kazakh National University, Almaty, 050040, Kazakhstan; [4]M.Kh. Dulaty Taraz Regional University, Taraz, 080012, Kazakhstan;
tungatarova58@mail.ru

The aim of project: Development of effective thermally stable catalysts of the new generation for biogas reforming processes (model mixture of methane and carbon dioxide) into synthesis gas and hydrogen rich fuel compositions.

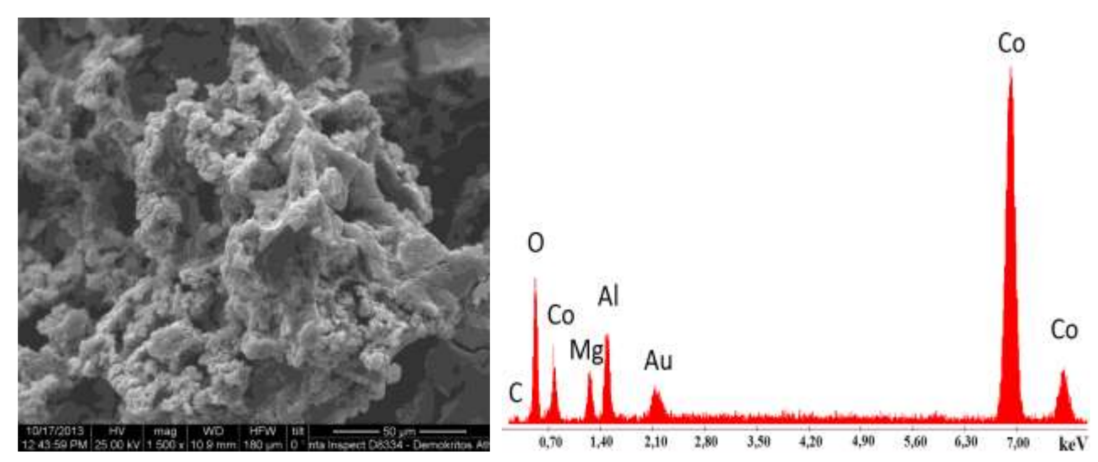
Works on research of intermetallic compounds of transition metals as a contact mass for the conversion of methane were carried out. The method of self-propagating high temperature synthesis (SHS) was used for the synthesis of catalysts. Catalysts of this type are characterized by thermal stability, mechanical strength and high thermal conductivity. SHS is a heterogeneous combustion process, which proceeds without the participation of oxygen with low energy consumption, high efficiency and rapidity. Self-propagating mode of chemical interaction is realized at local initiation, which moves along the mixture. In this case, almost no gas is released. The very high temperature develops in the reaction zone.

Schematic diagram of the SHS process and propagation of the wave through a powder compact. An initiator (electric discharge or chemical reaction) is not always necessary as the exothermic reaction can be self-igniting at the pre-heating temperature.

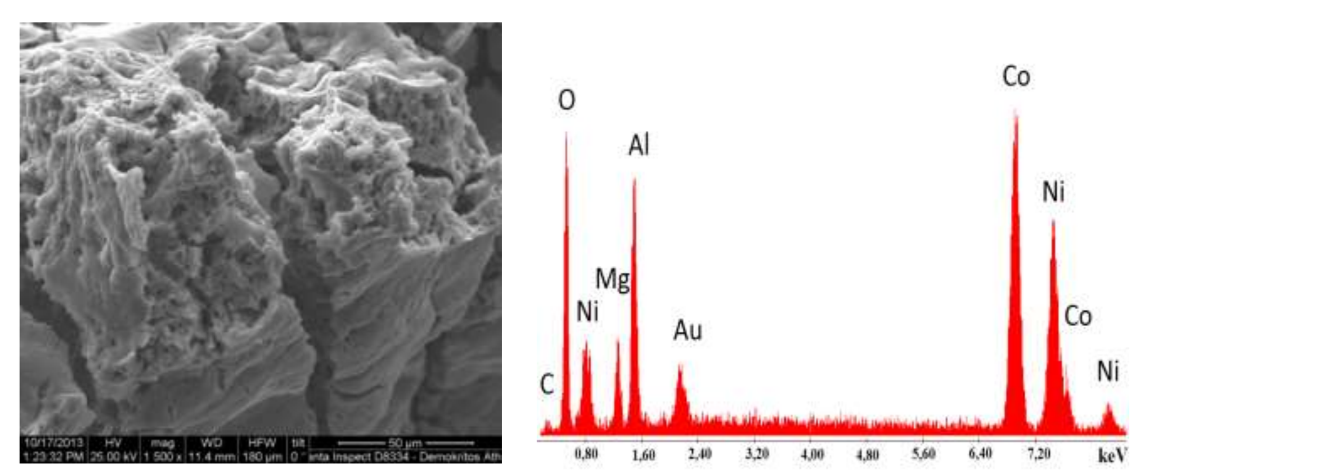




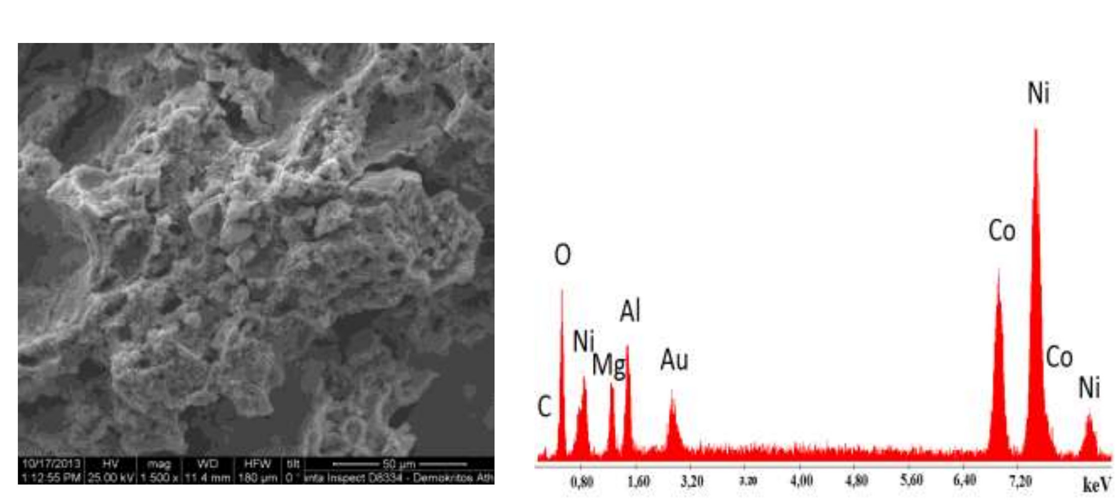
XRD analysis of catalysts based on initial feedstock $Ni(NO_3)_2 + Co(NO_3)_2 + Al(NO_3)_3 + Mg(NO_3)_2$ + urea



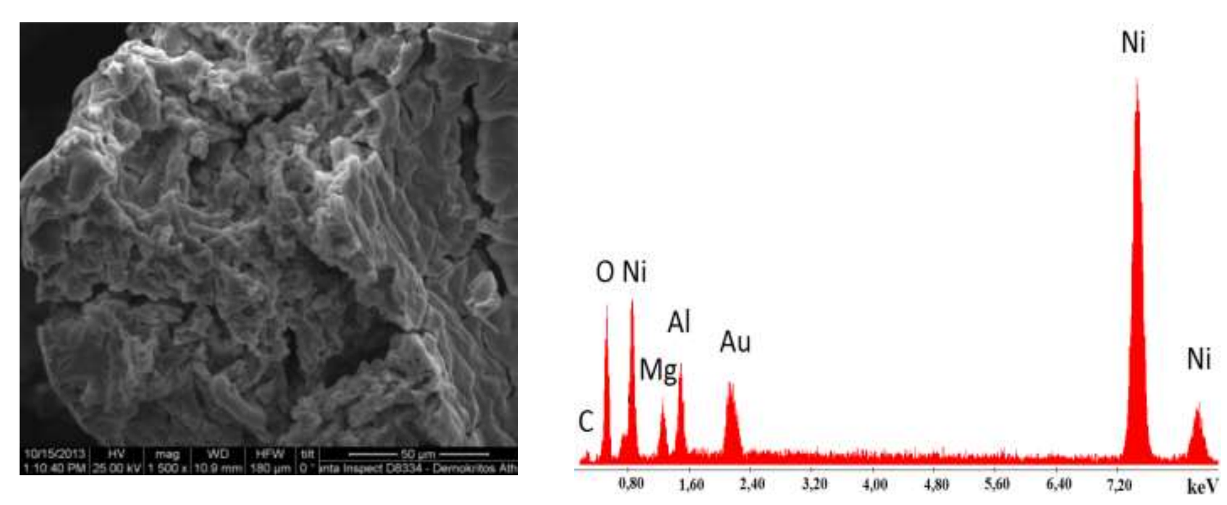
SEM image and results of chemical analysis of catalyst 50% $Co(NO_3)_2$ + 36.15% $Al(NO_3)_3$ + 13.85% $Mg(NO_3)_2$ + 37% urea



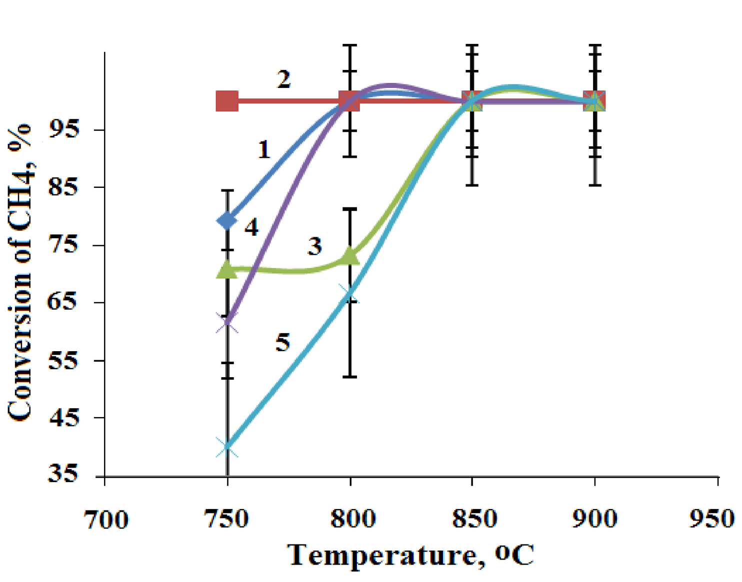
SEM image and results of chemical analysis of catalyst 20% $Ni(NO_3)_2$ + 30% $Co(NO_3)_2$ + 36.15% $Al(NO_3)_3$ + 13.85% $Mg(NO_3)_2$ + 37% urea

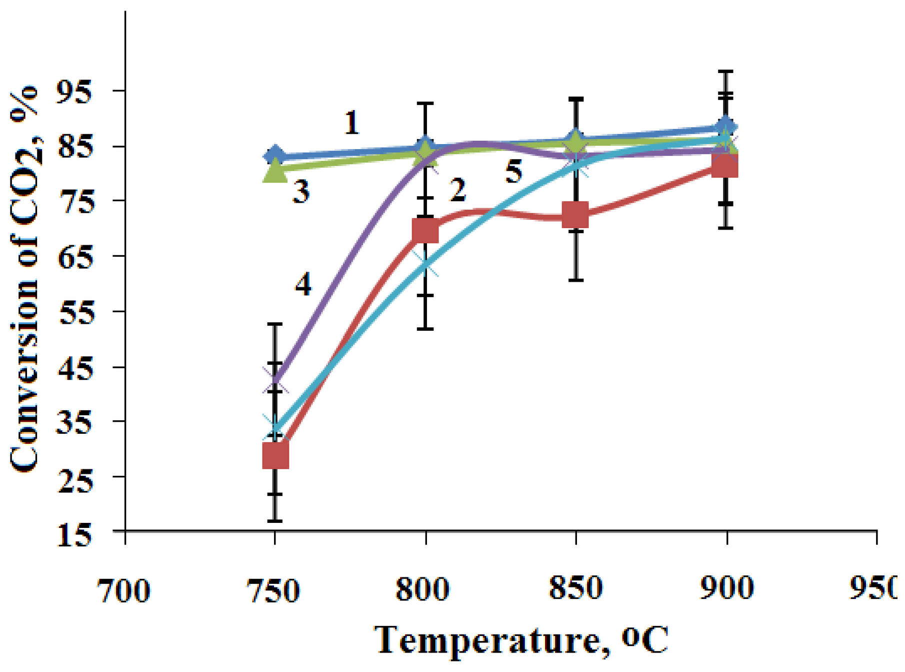


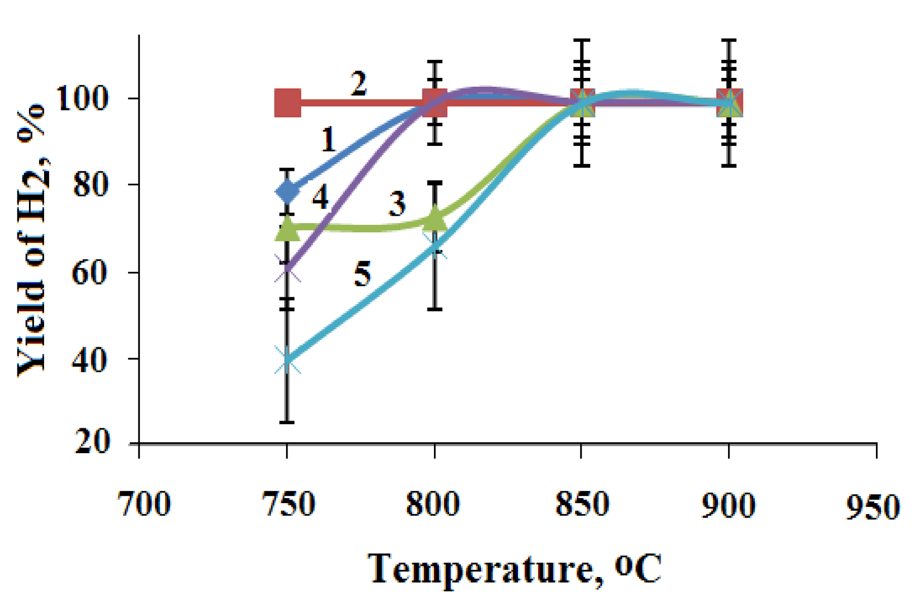
SEM image and results of chemical analysis of catalyst 35% $Ni(NO_3)_2$ + 15% $Co(NO_3)_2$ + 36.15% $Al(NO_3)_3$ + 13.85% $Mg(NO_3)_2$ + 37% urea

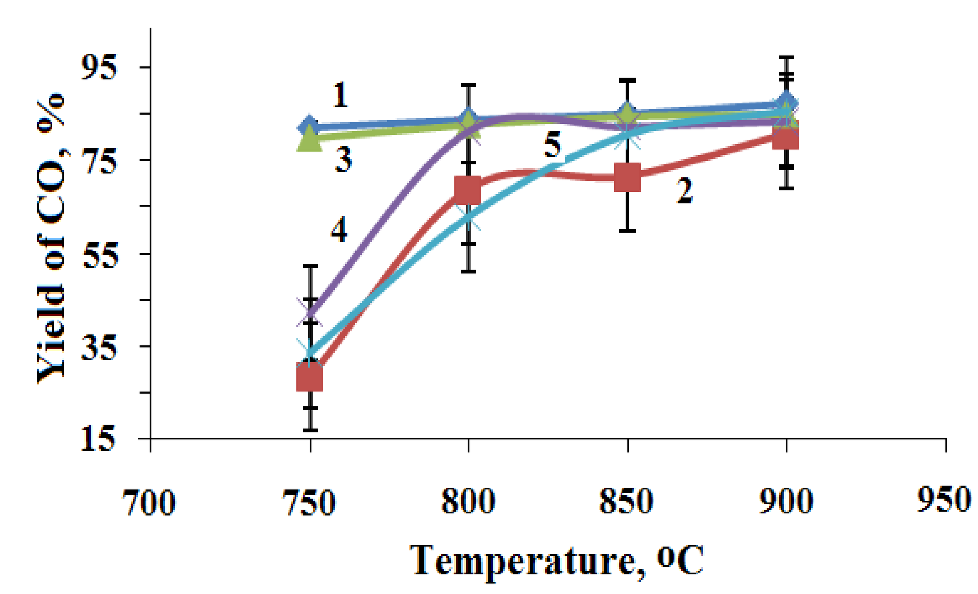


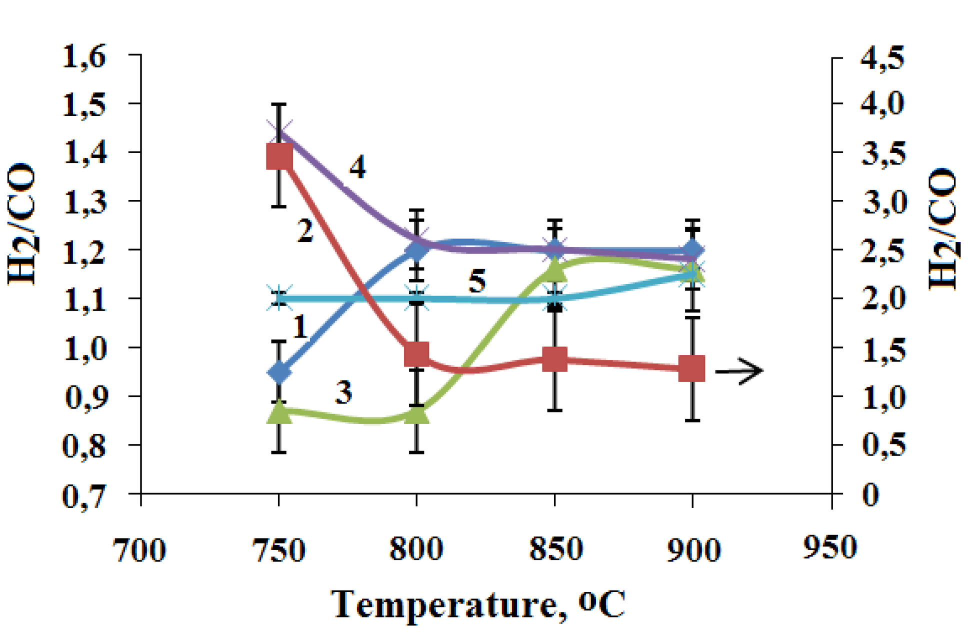
SEM image and results of chemical analysis of catalyst 50% $Ni(NO_3)_2$ + 36.15% $Al(NO_3)_3$ + 13.85% $Mg(NO_3)_2$ + 37% urea

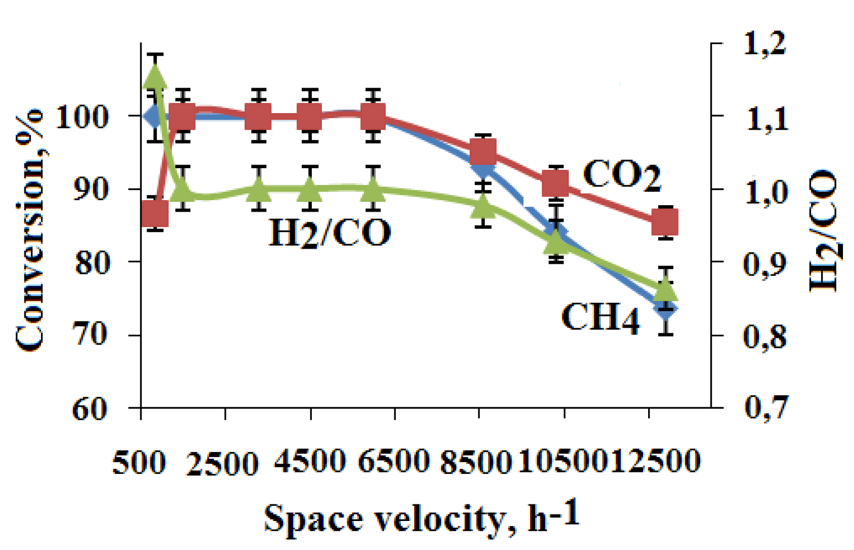


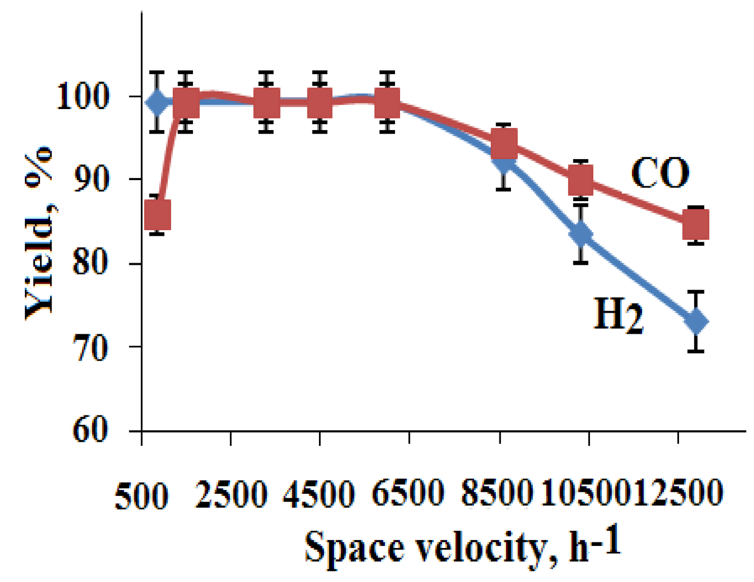


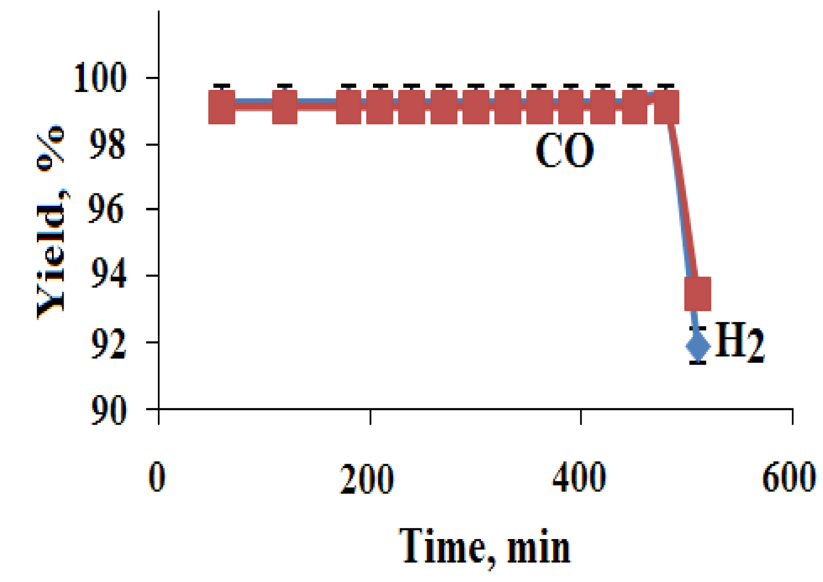












1. 50%$Ni(NO_3)_2$+36.15%$Al(NO_3)_3$+13.85%$Mg(NO_3)_2$+37% urea
2. 47%$Ni(NO_3)_2$+3%$Co(NO_3)_2$+36.15%$Al(NO_3)_3$+13.85%$Mg(NO_3)_2$+37% urea
3. 35%$Ni(NO_3)_2$+15%$Co(NO_3)_2$+36.15%$Al(NO_3)_3$+13.85%$Mg(NO_3)_2$+37% urea
4. 20%$Ni(NO_3)_2$+30%$Co(NO_3)_2$+36.15%$Al(NO_3)_3$+13.85%$Mg(NO_3)_2$+37% urea
5. 50%$Co(NO_3)_2$+36.15%$Al(NO_3)_3$+13.85%$Mg(NO_3)_2$+37% urea

Thus, effective catalysts for the production of synthesis gas and hydrogen rich fuel compositions from methane and carbon dioxide have been developed. The modern method of self-propagating high temperature synthesis and solution combustion method were used for the synthesis of catalysts. XRD and scanning electron microscopy of samples with chemical analysis before and after catalysis indicated on single-phase of produced systems and the absence of significant changes in the phase composition after experiments.