Catalytic processing of coalbed methane into useful chemical products to reduce the carbon footprint and anthropogenic impact on the climate.

Ismagilov Zinfer R.,[1,2*] Matus Ekaterina V.[2], Ismagilov Ilyas Z.[2]

[1] *FRC CCC SBRAS, pr. Sovetski 18., 650000, Kemerovo, Russia*

[2] *Boreskov Institute of Catalysis,, pr. Lavrentieva 5, 630090, Novosibirsk, Russia*

* *E-mail: zinfer1@mail.ru*

Methane emissions into the atmosphere lead to an increase in the greenhouse effect and the destruction of the Earth's ozone layer. As a greenhouse gas, methane has a high impact on climate change. Its direct radiation effect is 26 times higher than that of carbon dioxide.

The huge reserves of coalbed methane in the Kuznetsk Basin (~ 13 trillion m3), the high potential for impact on global warming, as well as the commercial value.

In this paper we will present a review of scientific foundations and technologies for the integrated processing of methane into useful chemical products and our latest results in catalytic approach for processing of coalbed methane. We consider the catalytic tri-reforming of methane - a process that combines steam reforming, dry reforming and partial oxidation of methane as the most attractive for processing of methane consisting a variable composition of methane-air mixture. A thermodynamic analysis of the tri-reforming of (CH4 + O2 + CO2 + H2O) and its constituent reactions - steam reforming (CH4 + H2O), dry reforming (CH4 + CO2), partial oxidation (CH4 + O2), autothermal reforming (CH4 + O2 + H2O), steam carbon dioxide reforming (CH4 + CO2 + H2O) of will be presented. The equilibrium composition of the conversion products of various types of coalbed methane in the tri-reforming are revealed, depending on their concentration characteristics, for selection and optimization of the reaction conditions.

Catalysts for the processing of coalbed methane are synthesized and for the first time systematically studied by a complex of ex situ and in situ physical and chemical methods, the regularities of their formation and genesis of the active component have been established.

A number of special methods for designing the catalytic systems under development, including the use of the effects of mutual enhancement of the action of metals and modification of the composition of the carrier. Our approaches for elucidation of the relationship between the conditions of promotion (composition, content, method of introducing the promoting additive) and the physicochemical characteristics (dispersion, morphology, phase composition, etc.) of the catalyst will be presented.

Acknowledgement

The investigation was carried out with support from the Russian Science Foundation under Project No. 22-13-20040, https://rscf.ru/project/22-13-20040/» and from the Region – the Kemerovo Region – Kuzbass.