NIO/CO_3O_4 MICRO-PARTICLES PREPARED BY SOLVOTHERMAL METHOD – PROMISING CATALYSTS FOR CO2 METHANATION

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Abstract - The combustion of hydrocarbons in industry, energy, and transportation generates large amounts of CO2, which pollutes the Earth's atmosphere [1]. Over the past 300 years, the amount of CO2 in the earth's atmosphere has increased by 50% [2]. This gas has a negative impact on nature due to global warming, melting ice and rising water levels in the oceans[3]. The growing consumption of electricity, active motorization and the construction industry have led to an increase in the CO2 content in the atmosphere. The problem has worsened due to the reduction of forest area worldwide. However, in recent years, ways to solve this problem have begun to appear. The Orca factory appeared in Iceland 4 years ago, and previous year the Mammoth factory was opened in Switzerland [4,5]. Plants use direct air capture (DAC) technology to condense excess CO2 from the atmosphere. However, the gas storage capacity will not be endless, and the question arises about the rational use of liquefied natural gas.

CO2 methanation seems to be a very promising process due to the relative ease of implementation and production of methane. In essence, methanation (hydrogenation) is the reverse process of burning methane (hydrocarbons) [6]. In the future, it will be possible to obtain a completely closed cycle - to produce products by methanation (hydrogenation) and use them in the energy industry, and the resulting carbon dioxide can be used again to produce methane (or hydrocarbons).

The synthesis of micro- (MPs) and nanoparticles (NPs) of metals and metal oxides is of great interest to researchers from all over the world. These substances are used in a wide variety of fields of science and technology: catalysis, sensors, magnetic tomography, magnetic fluid hyperthermia, separation of biomolecules, targeted drug delivery. Nickel oxide (NiO) and cobalt oxide (Co3O4) are widely used as a catalyst for various processes of hydrogenation or reduction of organic compounds with hydrogen. Due to the greater surface activity of metal oxide MPsand NPsthis improves the catalytic properties of these substances. However, the synthesis of NiO/Co3O4MPs/NPs with a narrow granulometric composition is not the easiest process. In this study, the synthesis of NiO/Co3O4MPs/NPs was carried out by a simple solvothermal method in an atmosphere of organic solvents and high-temperature decomposition of nickel/cobalt hydroxides. Using this method, particles of various morphologies (hexagonal,nanodiscs etc) were obtained using various solvents and stabilizers [7].

In heterogeneous catalysis, nickel/cobalt oxidesare used as an excellent methanation catalyst in the modified Fischer-Tropsch reaction. However, CH4 selectivity and CO2 conversion strongly depend on the shape, size, and surface area of NiO/Co3O4 MPs and NPs. The obtained catalysts were tested during the hydrogenation of CO2 in the gas phase with excellent conversion rates and high selectivity for producing CH4. The best results were obtained using NiO/Co3O4 with disk or spherical morphology, which produced methane with a selectivity of about 100% and a conversion rate close to 92 % [8].

Keywords - Nickel Oxide, Cobalt Oxide,Carbon Dioxide, Methanation, Modified Fischer-Tropsch Reaction

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