Nitrous oxide is claimed to be one of the most dangerous greenhouse gases, which lifespan in the atmosphere is about150 years and global warming factor is up to 310 times higher than with CO_2. In addition, N_2O participates in stratospheric ozone layer depletion. Due to the above, decomposition of N_2O to N_2 and O_2 is the subject of intensive research. Taking into account high temperature of nitrous oxide thermal decomposition (over 650°C), conditions of catalytic deN_2O process are more favorable for industrial deployment. One of the main source of nitrous oxide is nitric acid plant, in case of which, N_2O decomposition at 400ºC, in the presence of residual gases (900 ± 100 ppm NOx, 2.0 ± 0.2 vol% O2 , 0.8 ± 0.2 vol% H_2O) inhibiting the process, was acknowledged the most efficient solution of N_2O emission reduction. At present, a lot of studies are being carried out in order to find the best deN_2O catalyst for this application. Hitherto, several types of catalytic systems, such as based on noble metals, metal oxides, zeolitic ion exchangers, hydrotalcites or mesoporous silica were investigated and tested. Another source of nitrous oxide emission is hospital installation, where gas is often used as an anesthetic during treatments and surgeries, which implies a high level of its emission. Applying deN_2O catalyst to hospital installation is a different research problem from the nitric acid plant because of completely different reaction conditions: mixture gases composition (50 vol.% H_2O) and temperature window (400-600ºC). There are no reports in source literature about examined and active catalytic systems in the aforementioned application. Moreover, the number of carried out studies, in this matter, is also surprisingly low.

One of the most promising catalytic system that exhibits high activity is cobalt spinel. Its phase can be modified both structurally, by introducing cations to spinel network in place of cobalt, as well as surface, by decorating spinel with alkali metal. In spite of encouraging deN_2O results of mentioned system, high price of cobalt excludes preparing final catalyst based only on Co_3O_4. This problem can be easily solved by very common practical application - dispersing the active phase on formed support with high specific surface area, such as alumina, silica, magnesium, or cerium. Out of all examples, Al_2O_3 is the best solution from the practical point of view (high heat resistance, low price, easy forming). However, in case of installations with catalyst bed formed into pellets, tablets or rings, the significant pressure drop is still an urgent industrial problem. An alternative solution which ensures both a low content of expensive active phase, high resistance to temperature variations and easy flow of reaction gases through the catalyst bed is an innovative structural catalyst. This system consists of four components: active phase, promoters, intermediate phase -washcoat and structural body of support. The plan of this project takes into account an additional stimulation of the spinel phase catalytic activity (Co_3O_4) through its structural and surface modification. So modified an active phase will be dispersed on the surface of structural carrier (monolith, foam), previously coated with a thin layer of the washcoat, which will stabilize deposited active phase, inhibit unwanted ions migration from support to the spinel and increase specific surface area.

The main aim of the project is to develop a structural catalyst for decomposition of nitrous oxide emitted from hospital installations and nitric acid plants, with particular emphasis on composition, morphology and preparation method of catalyst as well as aspects, important from practical point of view: simplicity and low cost of the catalyst preparation method, possibility of its regeneration, or ecologic aspect of used materials. Due to the different chemical nature of components used in the system, it is very important to select an appropriate and accurate research techniques, mainly structural and surface (sometimes non-standard), in order to gain knowledge about the optimized part of the system and impact of various synthesis parameters, material characterization and interaction between components.

The project assumes using gained knowledge to provide a scientific basis, for the development of new-generation structural catalyst, resistant to inhibitors, for decomposition of nitrous oxide in two variants: for hospital installation and nitric acid plant. The measurable result of the project, in addition to scientific publications, will be developing, in terms of price and efficiency, a competitive (in nitric acid plants) and innovative (in hospital installation) structural catalyst, which will contribute significantly to reducing emission of nitrous oxide which affects negatively the environment.