One of the most serious threats related to the development of civilization is an increase in an amount of anthropogenic pollution emitted to the environment. They include volatile organic compounds (VOCs), which are an important group of atmospheric pollutants identified in all urban and industrial areas. VOCs are characterized by easy diffusion as well as high reactivity and toxicity, which contribute to the deterioration of health of living organisms, the formation of tropospheric ozone and photochemical smog. Due to their harmful properties, VOC emissions to the atmosphere should be strictly monitored and limited. It is also very important to propose effective methods of VOC elimination, among which catalytic combustion may play an important role. The most commonly used catalysts in the total oxidation of VOCs are materials containing noble metals (mainly Pt, Pd, Au, Rh, Ag). A replacement of the expensive and poison-prone active metallic phase with transition metal oxides is one of major challenges for environmental catalysis. The oxide catalysts are less active, which implies a need to use higher reaction temperatures. For this reason, when developing such systems, a special attention should be paid to stability of their work related to, among others, mechanical strength and tendency of the active phase to sintering. The construction of catalysts in the form of core-shell structures can improve these properties.

As part of this project, the synthesis of core-shell materials containing Co_3O_4 nanoparticles protected in a porous SiO_2 or TiO_2 shell is planned. The created shells should separate and protect the active phase against aggregation and sintering, as well as allow free diffusion of both the reactants and reaction products. The development of the described structures would allow the use of catalysts containing Co_3O_4 nanoparticles on a commercial scale in the future. However, it is necessary to develop an appropriate synthesis method that would guarantee the formation of the nanorattle structures. The project is based on the application of the bottom-up strategy. Thus, in a first step, spherical copolymer particles containing components showing the ability to adsorb transition metal ions which will be precursors of the catalytically active phase will be produced. A protective porous shells will then be produced around the modified polymer cores. The described approach will allow to control the process of forming nanoparticles of the Co_3O_4 spinel phase resulting from calcination of the starting composites. The project tasks include, in the first steps, the development of optimal pathways for the synthesis of $Co_3O_4@SiO_2$ structures. The developed methodology will then be used in the construction of $Co_3O_4@TiO_2$ materials. Therefore, it is expected to obtain materials that, apart from the typical catalytic properties in the VOC combustion, will show photocatalytic activity, which will enable their use for the photothermocatalytic elimination of VOCs. The use of hybrid technology will allow for coupling the advantages of both pathways of VOC oxidation. In addition, the combination of the use of determinants of the total oxidation reaction (thermal energy and electromagnetic radiation) will enable more efficient utilization of renewable solar energy.