Today, catalysis is a dynamically developing field of knowledge. The overwhelming majority of industrial processes are carried out with the help of catalysts whose role is to accelerate their progress, and thus makes the chemical industry an indispensable link from the perspective of modern civilization. The leading aspect is continually the issue of environmental protection, and in the proposed research project on methane combustion. The problem of emission of methane into the environment considered as the primary greenhouse gas, and hence its attempts to reduce emissions, is often taken up by scientists, but remains unresolved. Meta is not an easy molecule to study in catalysis, primarily due to its high stability, which is not easily burned and requires high concentration and processing temperature. The precious metal admixtures based on the catalysts used greatly increase the cost of producing such a catalyst. The problem of reducing methane emissions is a key challenge in terms of environmental protection and economics.

The purpose of the proposed project is to develop a qualitative and quantitative methodology for the study of active centers on oxide catalysts based on IR infrared spectroscopy. Research focuses on catalysts of metal oxides for oxidation and reduction processes, particularly for the complete oxidation of methane.

The phenomenon of catalysis refers to the outermost surface of the catalyst, where adsorption of molecules, formation of active complexes and release of reaction products actually occur. It is the active centers present on the surface of the material that are responsible for these catalytic reactions. These atoms or their specific moieties on which these phenomena take place determine the activity of the catalyst.

Designing new industrial catalysts in a rational way is a constant priority for engineers and scientists, while being a serious challenge and requires a solid knowledge of active centers. It is therefore important to define active centers, which can be determined by their nature, acido-basic and redox properties and their quantification. Despite long-term research on metal oxides as an alternative to noble metal catalysts, material gaps remain in this science area. The obtained results of the undertaken studies will in particular provide information leading to a description of the structure, based on the analysis of the interaction of the surface structures with the selected probes. As a result, it will be possible to determine the number of active centers and their chemical nature, to better standardization of the reaction rate. The results will translate directly into the development of search engines for researchers and industry correlations between structure and activity of catalysts. The results will influence the tools development for searching of correlations between structure and activity of catalysts, relevant for researchers and industry.