One of the most pressing problems facing the plastic-dominated era, which is referred to as the 'greatest innovation of the millennium', is the increasing mismatch between the amount of plastic waste generated and the actual amount of waste recycled. There are growing concerns related to waste management, the more so as the most popular method of eliminating polymeric materials from the environment is based on combustion and storage technologies, which leads to severe air and soil pollution. Thermoplastics such as polyethylene, polypropylene or polystyrene that are recyclable account for as much as 80% of the total weight of plastic waste. This value, of course, presents a huge threat to the environment, but at the same time represents a huge potential, in particular in relation to processes that can provide a significant amount of fuel fractions or starting materials for the production of many valuable intermediates used in organic synthesis. Considering the chemical composition of a PET bottle, it can be stated that it is one of the cleanest sources of obtaining carbon and hydrogen - fuel precursors or other intermediates useful for industry. It should be mentioned that the production of propylene is becoming more and more important in the processing of crude oil: the modification of the operation of the FCC process catalysts is precisely aimed at increasing the production of propylene from crude oil. Hence, the development of environmentally friendly disposal methods (incineration leading only to CO2 and H2O emissions) and, above all, effective recycling is a fundamental issue.

Catalyst selection plays a crucial role in chemical processes, allowing the reaction temperature to be lowered and increasing selectivity to the desired products. Both the activity and selectivity of the catalyst are determined by its structural, textural (porosity) and acidic properties. The final results of the project will concern the development of an effective method of cracking plastics conducted on new hierarchical catalysts with selectivity aimed at obtaining valuable industrial products. Optimization of catalyst properties will contribute to the sustainable use of energy in the processes of obtaining hydrocarbons/fuels, in the processes alternative to refining. The proposed solutions will have a much more positive impact on the environment than the existing ones. It will be possible thanks to solving the issues related to (i) the reaction mechanism of low-temperature cracking and the combustion of plastics, (ii) surface phenomena and (iii) the diffusion process accompanying the reactions mentioned above. Finding answers to questions about the issues as mentioned above will be enabled by the use of specialized spectroscopic-chromatographic analyzes using FT-IR, UV-Vis and Raman tests *in situ* and *operando* modes. Thanks to the application of 2D COS IR (*two-dimensional correlation IR spectroscopy),* it will be possible to assess the nature of the impact of a polymer or an organic compound resulting from incomplete combustion of plastic with the surface of the catalyst as well as the determination of the steps of the catalytic reaction. A comprehensive approach to this subject is a rational concept leading to the achievement of the this project's goals, at the same time leading to the design of catalysts with the desired selectivity and lifespan. Zeolites have long been designated as environmentally friendly catalysts. The use of the catalytic potential of zeolites is, therefore, part of the research related to the European Green Deal strategy by more efficient use of resources (here: waste) thanks to the transition to circular economy.