Modern organic chemistry reactions require very active and selective catalysts that allow obtaining the most desirable products with high selectivity and high conversion of substrates. This reduces the cost of separation of post-reaction mixtures, as well as reduces the cost of managing undesirable by-products of the undergoing reaction. Therefore, new and effective catalysts for many reactions in organic chemistry are sought, the methods of synthesis of already known catalysts are modified, e.g. synthetic zeolite catalysts (mainly to increase their durability or to expand their scope of application for reactions involving larger organic molecules) or the surface of porous materials is modified to increase their activity (increase in the number of active centers of the catalyst). An example of catalysts belonging to the first group (the group of new catalysts) may be catalytic materials belonging to the MXene group. Studies on these 2D materials began after the discovery of graphene, and the first mention of their synthesis appeared in 2011. These are materials that are currently attracting the attention of many scientists due to the wide range of their possible applications. Materials belonging to the MXene group are currently widely studied for their use as constructional materials for electrodes in electrochemical capacitors and batteries. Besides, these materials are also used as catalysts in electrolysis and photocatalysis. However, in conventional heterogeneous catalysis used in organic chemistry, MXene materials are hardly studied at all, and they certainly have not been studied as catalysts in the isomerization or oxidation processes of olefinic compounds, such as α-pinene.

The main goal of this project is to obtain effective and durable catalysts based on $Ti_3C_2T_x$ MXene materials for the α-pinene isomerization reaction to obtain with the highest selectivity the three most valuable products of this reaction: camphene, limonene and tricyclene (compounds found numerous applications in cosmetics, in medicine, in the perfume industry, in the food industry and chemical syntheses). In the research, we will want to determine how the morphology, structure and surface structure of these materials affect their catalytic activity and their selective action towards creating the most desirable products. Our preliminary studies indicate that $Ti_3C_2T_x$ MXene materials show very high activity (higher than e.g. titanium silicates) in the process of α-pinene isomerization. These studies show that it is possible to achieve with $Ti_3C_2T_x$ MXenes the selectivity of transformation to camphene up to 60 mol% and conversion of α-pinene to 100 mol% after the reaction time of 4 hours. Such good results of catalytic tests of MXene $Ti_3C_2T_x$ materials indicate the desirability of further catalytic tests of these materials in the reaction we describe. It should be emphasized that the way we conduct the α-pinene isomerization reaction will be environmentally friendly (no solvent in the reaction, low temperature, atmospheric pressure, glass apparatus) and will meet the requirements of sustainable development in chemical reactions, because α-pinene can be obtained in large quantities from renewable raw material such as turpentine. The α-pinene isomerization reaction itself can therefore be qualified as "green reaction".