

Catalysis is one of the most important synthetic methodologies frequently used in modern organic chemistry. This unique technique of initiation, control of kinetics and the selectivity of the reaction is evidenced by its industrial applications. Its popularity results from the huge benefits of this methodology, which mainly concern the reduction of process costs and generated waste, energy savings as well as the reduction of the time necessary to obtain a specific product. Currently, there is an increasing demand from the chemical and pharmaceutical industry for reliable methods of obtaining pure stereoisomers. The result of this demand is the continuous development of efficient synthetic methods being their source. One of the most powerful synthetic tools for obtaining pure stereoisomers is asymmetric organocatalysis. This methodology allows for the use of various types of catalytic activation modes of the reactants, induction of the stereochemical reaction result and reactivity, leading to the production of molecules important both from the chemical and biological point of view. The continuous development of the field of asymmetric organocatalysis enables the introduction of innovative synthetic approaches to the literature and the identification of previously unknown methods of catalytic activation of organic compounds, thus still expanding our knowledge. Identification of new, stereoselective higher-order cycloadditions is an important issue in contemporary organic chemistry. This project aims to develop cycloaddition reactions in which more than 6π electrons are involved with catalysis being a synthetic platform for these transformations. It is anticipated that utilization of *in situ* generated intermediates (higherenes/higherenophiles) containing covalently bound catalyst or activated polyene structural motif will enable access to innovative reaction profiles. Development of previously unknown higher-order cycloadditions will be possible by the application of new reagents capable of participating in such transformations. Another proposed approach relies on utilization of important catalytic activation modes and reactivity concepts that have not yet been applied within this field of research. Particular efforts will be devoted towards the development of enantio- and diastereoselective versions of the proposed processes, mainly using organocatalysis to control the stereochemical outcome of the reaction. It is worth to emphasize that the development of this synthetic approach should lead to the introduction of new synthetic methodologies providing access to libraries of novel polycyclic compounds and various chemically or biologically relevant molecules. In addition, studies on higher-order cycloadditions should be beneficial for a better understanding of these processes and research within this rapidly developing area possess high applicability and scientific potential.

