Catalysis constitutes one of the most fundamental techniques allowing for the initiation and kinetic as well as stereochemical control of chemical reactions. The main benefits of catalysis are associated with the high efficiency and atom-economy of catalytic processes, since catalysts are used in sub-stoichiometric amounts. Furthermore, catalytic technologies save energy and reduce the waste generation, time and costs required to access desired products. In recent years, an increasing demand for enantiopure compounds from the pharmaceutical, fragrance and flavor industries has led to a tremendous development in the field of asymmetric catalysis. As a consequence, the development of methods for the preparation of pure stereoisomers has received increasing attention. In particular, enantioselective reactions where prochiral substrates are converted into enantiomerically enriched products in the presence of chiral catalysts has become increasingly more important in recent few years.

Identification of novel reaction profiles constitute one of the most important goal of the modern organic chemistry. The proposed project aims at opening of a new research front within the field of asymmetric organocatalysis and discovering new [4+2]-cycloadditions for asymmetric synthesis. In particular, we aim to address issues related to their site- and stereoselectivity. Furthermore, based on the developed methodologies studies on the cascade reactivities will be undertaken. Notably, the introduction of innovative catalytic and stereoselective solutions for efficient promotion of organic reactions offering access to novel reaction pathways fulfills the requirements of “green chemistry” and is in accordance with the European strategy concerning Sustainable Chemistry. The project should lead to establishment of new synthetic methodologies providing access to libraries of novel chiral building blocks and various chemically or biologically relevant molecules. Furthermore, novel organocatalytic activation modes of organic molecules will be introduced as a consequence of the project, thereby enriching our knowledge on selected classical reactions of organic compounds.