Over recent years, there has been a noticeable increase in the synthesis of active pharmaceutical ingredients (API), which are enantiomerically pure. Since most of the known pharmaceutical substances are chiral particles, their enantiomers often have different effects on the human body, where one of the enantiomers has a therapeutic effect. The need for asymmetric synthesis arises due to the desire to produce the safest form of the drug, limiting side effects while being highly active. In addition, the ecological aspect related to the use of catalysts or solvents in processes that are difficult to utilize, shows a strong need to discover new methods of API synthesis, enabling processes to be carried out under mild conditions**.**

Enzymes possess characteristics such as stereo-, regio- and chemoselectivity and could play a key role in the synthesis of optically pure compounds. They can be appropriately selected for the processes to catalyse the desired reactions as well as shortening the number of steps needed to perform to obtain an intermediate or the final active substance. In addition, the use of natural catalysts, such as hydrolases, in API synthesis effectively reduces the use of reagents that are harmful to the environment and the health of living organisms. However, due to the high sensitivity of enzymes to varying process conditions, they are subjected to immobilization processes to improve their stability, thanks to which they do not lose their catalytic properties. Additionally, the immobilization process facilitates the separation of the catalyst from the system, reducing the risk of system contamination and avoiding the step of multiple product purification.

To support the enzyme during catalytic processes, within the frame of the project, inorganic carriers consisting of, among others, magnetite, silica, zirconium oxide and additionally hybrid materials based on the presented oxides will be the target of synthesis. It is worth mentioning that the material containing magnetite with the immobilized enzyme will provide the ability of easy removal from the mixture using an external magnetic field. Additional modification of obtained supports with ionic liquids will increase the catalytic properties of the immobilized enzyme. **Biocatalysts containing immobilized lipase (fungal and/or bacterial) and/or esterase will be used in the synthesis/conversion of active pharmaceutical ingredients to obtain the desired enantiomers of selected compounds from the groups of sedatives such as selective serotonin reuptake inhibitors (SSRIs) and drugs used in chemotherapy.**

During the research, a lot of attention will be paid to the selection of appropriate process parameters during the synthesis of an appropriate support and its modification to obtain a material suitable for enzyme immobilization. In addition, the selection of appropriate process conditions during enzyme immobilization is important to ensure high immobilization efficiency and obtain a biocatalyst with high catalytic activity. During the synthesis of pharmaceutically active substances, the influence of applied process parameters will play a key role to ensure optimal process conditions for the biocatalysts used and to direct the reaction to the desired enantiomer while maintaining high process efficiency and enantiomeric excess.

The results obtained during the implementation of this project will allow the creation of a method of synthesis of inorganic supports and their modification with the participation of ionic liquids. Defining the relationships occurring in the immobilization processes with selected techniques and defining the optimal process conditions such as temperature, reaction medium, used biocatalyst and the amount of immobilized catalyst on the surface of the support will also be a key part of the investigation. **This will allow the development of innovative methods for the synthesis/conversion of active pharmaceutical ingredients using the obtained biocatalysts with immobilized hydrolases, making it possible to obtain API under milder conditions. The implementation of the project will enable the examination of the mechanisms involved in the presented processes, and the measurable effect will be the development of technological assumptions for biocatalytic API production.**