The search for new compounds with defined properties and, in the same time, capable of creating complex supramolecular systems (architectures) are the challenges of modern chemistry. Currently, the selective synthesis and further functionalization of macromolecules (macrocycles and molecular cages) obtained from simple and of low molecular mass substrates is a dynamically developing area. Traditionally, the macrocyclic compounds are these, having at least 12-membred ring. In turn, a covalent organic cage is called a polycyclic compound of defined shape and dimensions, built of atoms connected only by covalent bonds. Macrocycles and cages made of regularly repeating units are called shape-persistent. A characteristic feature of shape-persistent macrocycles and molecular cages is their relatively small structural liability. For many years, it was thought that macrocyclic compounds could not exist due to the angle strain (widely known as Baeyer Strain). Ružička's work is considered a breakthrough point. Ružička determined and described the structures of 15- to 17-membered ketones: muscone and civetone. These findings initiated the rapid development of chemistry of macrocyclic compounds, caused, on the one hand, by the discoveries of new synthetic methods and, on the other hand, by the biological activity of some macrocyclic compounds, e.g. macrolide antibiotics and immunosuppressive drugs.

The observed development of this field was reflected in the verdicts of the Nobel Committee. In 1987, Donald James Cram, Jean-Marie Lehn and Charles John Pedersen were jointly awarded the Nobel Prize for developing and applying molecules with particularly selective structure-dependent interactions. In 2016, Jean-Pierre Sauvage, Sir James Fraser Stoddart and Bernard Lucas Feringa received the Nobel Prize for designing and synthesizing molecular machines. One can risk the claim that without macrocycles and supramolecular chemistry there would be no molecular machines.

Synthesis of macrocycles and cages still represents a challenging task. Among many methods, those based on the Dynamic Covalent Chemistry concept, allow for the effective synthesis of macrocycles of cages. In reactions, carried out in accordance to the DCvC concept, the substrates form higher-order systems (products) as a result of reversible formation of covalent bonds. Among the reversible reactions, the most important reaction in the macrocycle and cage compounds chemistry is the imination reaction. The design and synthesis of macrocycles and molecular cages is based on the use of substrates characterized by specific structural features (structurally predisposed). That is why, this particular approach to synthesis resembles building blocks.

The possibility of introducing various functional groups into the macrocycle and molecular cage skeleton leads to different functions. At the molecular level, macrocycles can be used in catalysis to form new carbon-carbon or carbon-heteroatom bonds or as highly specific receptors allowing the detection of individual selectant molecules. Not less important is the use of macrocycles and cages at the supramolecular level. In this case, the non-covalent interactions of different strengths and directionalities, determine the structure of forming associate and properties of thus obtained material.

The mechanism of action of the compounds will resemble the way of functioning of living organisms, where the final effect is determined by the cooperation between particular subunits. As a part of this project, we are planning to synthesize a library of macrocycles and molecular cages. These compounds will have either a defined structure and properties or they will be able to change the structure under external stimuli. Among the compounds obtained, the most promising ones will be used as molecular receptors and tectons.

The use of the compounds obtained as the precursors of new materials, especially capable of selectively binding small molecules, including the chiral ones, will also be of great importance. We want to demonstrate how the structure of smaller "bricks" affects the construction of the macrocycle and molecular cage molecules but also the structure and properties of materials made of these molecules. Demonstrating the possibility of synthesis and then demonstrating the usefulness of these compounds in various aspects of chemistry will allow to define them as *privileged molecules*.