Natural processes in living organisms are determined by the global spatial structure of the biomolecules involved in that processes. The global structure (so called: tertiary and quaternary structure) is formed by the assembly of the local structures (so called: secondary structures). Any disorder of the structure of macromolecules, i.e. proteins, nucleic acids and others may lead to severe dysfunctions in the functioning of whole systems involved in fundamental biological processes, starting with the cellular communication until its programmed death. This is because 3D structure determines the way in which macromolecules interact with and recognize each other (it is so-called molecular recognition). The investigation of big molecules usually creates a lot of problems, that is why the smaller models are needed which will behave similarly to the original systems, but will be easier to obtain and control in the laboratory.

Scientific goal of this project is the synthesis of compounds mimicking the secondary, tertiary and even quaternary structure of natural peptides. These compounds are oligoureas and their isostructural derivatives. The backbone of those compounds folds into the helix similar to α-helix, known for peptides built from natural amino acids. Proposed compounds belong to the group of foldamers. This term was introduced to scientific terminology almost 20 year ago to sort out the nomenclature of oligomers inspired by Nature. It describes fully artificial oligomers able to adopt well defined, predictable and stable secondary structures.

In this project we aim to obtain few series of *N,N'*-substituted oligoureas and their isostructural hybrids, in which one or more urea moieties are substituted by thiourea or guanidinium moieties. Next, we plan to investigate the influence of the factors, crucial for the folding and self-assembly of obtained foldamers. Moreover, we plan to use these compounds in molecular recognition of guests molecules: anions and bigger compounds, such as amino acids or short peptides. Learning how helices of oligoureas and their hybrids interact with guests molecules is crucial, for example, in the investigation of the new systems, mimicking biological arrangements, using secondary structures as determinants of the chirality (for example artificial enzymes).

The chemistry of foldamers, including oligoureas and their derivatives, is now a rapidly and extensively developing research area at the interface of organic chemistry, peptide chemistry and supramolecular chemistry. Any research that involves the investigation of the interactions of foldamers with each other and/or other molecules will help to design compounds with well-defined structures, showing, potentially, biological activity at the same (or better) level than known natural analogs, but more stable for proteolytic enzymes due to unnatural structure of the backbone.