Multivalent organocatalysis for asymmetric synthesis
Summary for general public

Molecules of many chemical compounds are chiral – they can exist in two enantiomeric forms constituting nonsuperimposable mirror images. Chemists often tend to obtain such compounds in the enantiomerically pure form, *i.e.* consisting of one type of molecules. This is particularly important in the synthesis of compounds endowed with a potential biological activity, *e.g.* new pharmaceuticals. They interact with biomolecules, for example, proteins and nucleic acids, which are also chiral as they consist of chiral components (amino acids, sugars) built in as single enantiomers. As a consequence, sometimes one of the enantiomeric forms of a drug has a therapeutic effect, while the other is inactive or even toxic (like in case of infamous thalidomide). This is why more and more new medications are marketed in the enantiomerically pure form.

For the efficient synthesis of these compounds, chiral catalysts are typically used. Applied in a small amount, they induce generation of desired product in high yield and enantiomeric purity. Chiral metal compounds frequently act as catalysts, but they have several drawbacks. Among them, the risk of contamination of the final product (*e.g.* a drug) with the traces of catalyst should be mentioned. In order to avoid this, non-metal catalysts are used more and more often for the synthesis. Unfortunately, these organocatalysts are not free from limitations – typically, they have to be used in relatively large amounts.

The proposed research project focuses on the design and synthesis of new systems containing chiral multivalent organocatalysts, *i.e.* assemblies containing multiple individual catalytic species attached to the appropriately preorganized bigger molecule serving as a scaffold. We believe that this approach should result in the significant increase of the efficiency of our organocatalysts which could be thus used in smaller amount. In addition, to facilitate separation from reaction products, we plan to attach our catalytic assemblies to a solid support. The use of continuous-flow microreactors – relatively small vessels allowing a continuous supply of reactants and product collection – should additionally increase the efficiency of the process. It will be aimed at the preparation of new chiral iminosugars, *i.e.* carbohydrate analogues bearing a basic nitrogen instead of the endocyclic oxygen atom. They can find an application as highly selective inhibitors of enzymes such as glycosidases and glycosyltransferases, and therefore for the possible treatment of diabetes and lysosomal storage disorders (*e.g.* Fabry and Gaucher diseases).