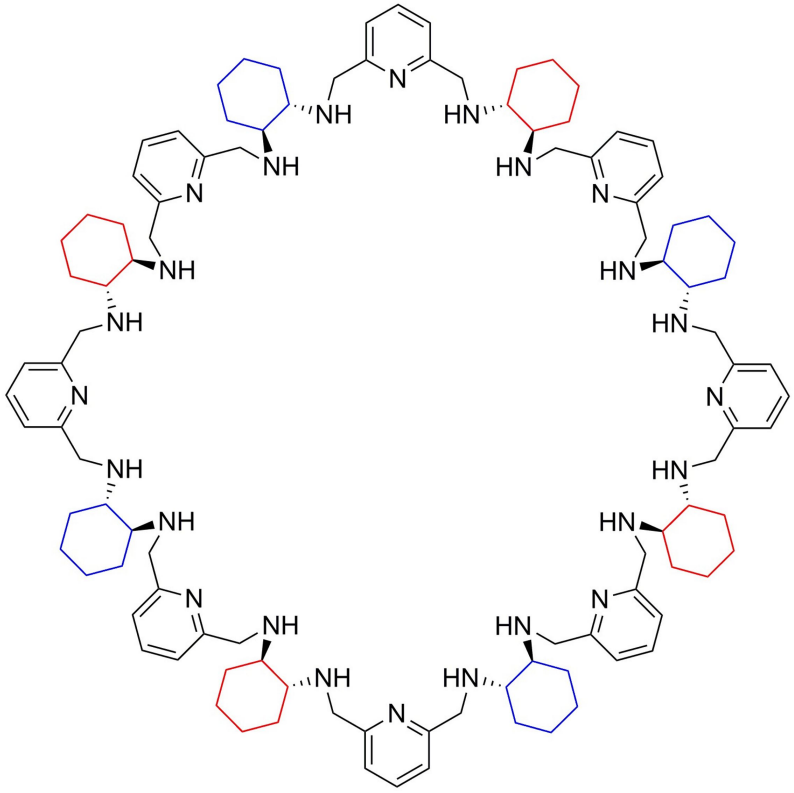
The key chemical events that are responsible for the functioning of living organism consist in recognition of molecules by receptors (proteins) corresponding to so called host-guest interactions. Chemists mimic these essential processes by synthesizing artificial compounds of predefined shape and properties, which act as host molecules, i. e. molecules capable of recognizing and binding of other, usually smaller molecules – so called guest molecules. The host-guest interaction is based on complementary of shape and complementary of chemical interactions between host and guest molecules. The chemical guests may be of various types: they may be metal ions, organic molecules, anions or gas molecules. The study of host-guest interaction, the synthesis of ever more elaborated host molecules and the formation of metal complexes of designed, tuned hosts continue to attract enormous attention of researches. These activities evolved to a separate field of chemistry – supramolecular chemistry. The activity of in this field is aimed not only at mimicking and elucidation of biological processes, but also at practical applications in medical diagnostics, drug delivery, sensing, catalysis and in engineering of new materials for instance materials for gas storage.



One of the most important type of artificial host molecules are macrocycles – large molecules of ring shape. Many compounds of this type are used by nature for binding of metal ions (for instance iron in hemoglobin, magnesium in chlorophyll and cobalt in vitamin B12). Macrocylic complex DOTA of the metal gadolinium is commonly used nowadays in medicine as contrast agent magnetic resonance imaging. It is not surprising that chemist try to design and synthesize new macrocyclic host compounds. In this project I propose the synthesis and characterization of macrocycles that are much larger than the typical macrocyclic hosts. For instance the proposed 8+8 macrocyle A in the illustration above is much larger than the macrocyle B - protoporphyrin IX used by nature to bind iron in hemoglobin, macrocyle C -DOTA used commonly in medical diagnostics or macrocyle D - crown-6 used commonly in chemistry for binding of potassium ions.

The exceptionally large size of the macrocyles proposed here may result in unique binding properties. In particular they will be able to bind simultaneously six or more metal ions and likely they will exhibit new modes of binding of organic molecules. On one hand the design, synthesis and characterization of such a large molecules is a goal of itself for a chemist pursuing ever better control over matter and trying to reach level of chemical complexity found in living organisms. On the other hand in my research project will be directed to long-term potential applications of large macrocycles and their complexes. These aspects are related to discovery of new multimetalic catalyst, magnetic materials, materials for gas storage and selective sensing of chemical compounds.