

In my project I intend to synthesize new series of receptors which are able to bind sulfate anions. Recognition of sulfate is an important issue because of the significant role it plays in a range of technological, biological and environmental processes. For example sulfate presence in the nuclear waste decreases effectiveness of waste-form production processes. One potential means of dealing with this problem is removing sulfate via liquid-liquid extraction using anion receptor which can tightly bind anion, prevent it from contact with water molecules and then transport it from water to organic solvent. On the other side, sulfate is the major source of sulfur in many organisms. Misregulation of sulfate transport proteins is present in a number of disease states as chondrodysplasia resulting with symptoms such as dwarfism, spinal deformations and other abnormalities of the joints. Simple synthetic receptors might serve as models for studying transportation process through biological layers and in the best scenario may even become therapeutic agents by taking the role of damaged proteins. Moreover, there are no simple methods of sulfate concentration monitoring using colored indicators or anion selective electrodes. However, receptors which will be studied during this project, change their optical properties during sulfate binding and additionally they might be used to construct anion selective electrodes. Main problem hindering successful sulfate binding in above examples is extremely high hydration energy of anion which force it to stay in water.

Sulfate is also increasingly used as template agent in self-assembly of receptors into well-defined structures such as helices, molecular cages or orthogonal complexes. It led for example to successful synthesis of rotaxane which is dumbbell shaped molecule, threaded through a macrocycle. Rotaxanes are building blocks of molecular machines, because they can be used as switches.

Proposed receptors consist of two sulfate binding moieties which are connected together by linker. In this project I am looking for the relationship between structure of the linker and properties of receptor-sulfate assembly. I suspect that using long and flexible linker might allow two sites to bind together the same anion leading to extremely strong and tight association. Such receptor might be later used in the extraction or anion transport through biological membrane. On the other hand, short or rigid linker can hinder joint cooperation and cause self-assembly of more complex structures with sulfate as template such as helices, supramolecular polymers or unprecedented grids. Positive results would allow us to better understand and control self-assembly processes around sulfate anion.