New Catalysts for Asymmetric Phase Transfer Processes – from Simple Ammonium Salts to Supramolecular Catalysis

Phase transfer catalysis (PTC) is a well-known method of organic synthesis, which helps to make a contact between two chemical individuals dissolved in two different immiscible solvents, such as water and nonpolar organic solvent. This process can only occur when phase transfer catalyst is added. The most commonly used catalysts are tetraalkylammonium salts (Figure 1) and macrocyclic compounds, called crown ethers (Figure 2). They transport a chemical particle between solvents. Phase transfer catalysis is widely used in chemical laboratories, as well as in industry.

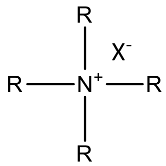


Figure 1

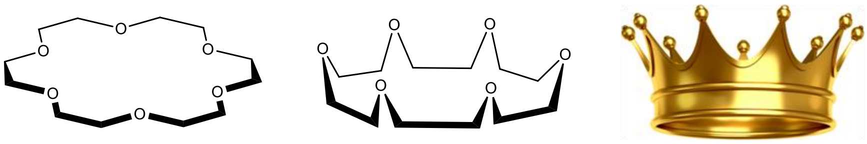


Figure 2

Since 1980s there has been growing interest in the development of phase transfer catalysis in terms of its asymmetric version, namely in synthesis of chiral compounds with high optical purity. That is why natural products such as *Cinchona* (extracted from *Cinchona* bark) have been successfully used in the synthesis of phase transfer catalysts (Figure 3). There are also examples of synthetic catalysts based on 1,1'-bi-2-naphthyl or tartrate cores.

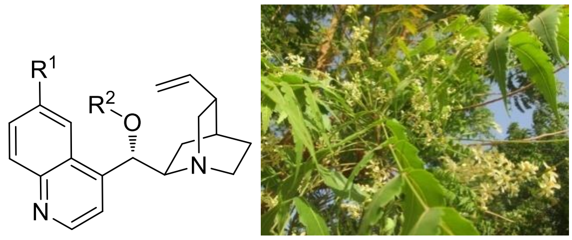
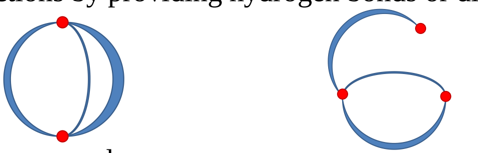


Figure 3

Our long-time studies have proven that the reaction of tertiary diamines with diiodo compounds under high-pressure conditions (ca. 10 000 atm) give macrocyclic tetraalkylammonium salts with high yield and purity. Due to these facts, first goal of this project is to establish a synthetic route toward new chiral phase transfer catalysts *via* high-pressure reactions. We will aim to synthesize new dimmeric C_2-symmetric catalysts, since it has been reported that these kinds of receptors are much more effective in asymmetric synthesis. We will use our new catalysts to investigate their catalytic properties in typical organic reactions and compare them with other known catalysts. Our new catalysts will be also studied in new variants of reactions as well as in reactions which cause synthetic problems in enantioselectivity. Moreover we would like to use macrocyclic compounds (receptors of cations and anions prepared by us) such as unclosed cryptands (Figure 4) to modify them into new class of phase transfer catalysts (Figure 5). These modification will cause two advantages: saving catalytic properties supported by supramolecular interactions by providing hydrogen bonds or dipole-ion interactions.


cryptand

„unclosed" cryptand

Figure 4

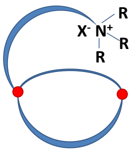


Figure 5

On the other hand we are going to use these new classes of macrocyclic catalysts to establish new PTC protocol. The classic approach is based on anion exchange, supported by phase transfer catalysts, between chemical individuals in water and nonpolar organic solvent. We are expecting, though, that our supramolecular macrocyclic catalysts will be able to transport insoluble salts (as whole ion pairs) from water into organic solvent, where the chemical reaction will occur (Scheme 6).

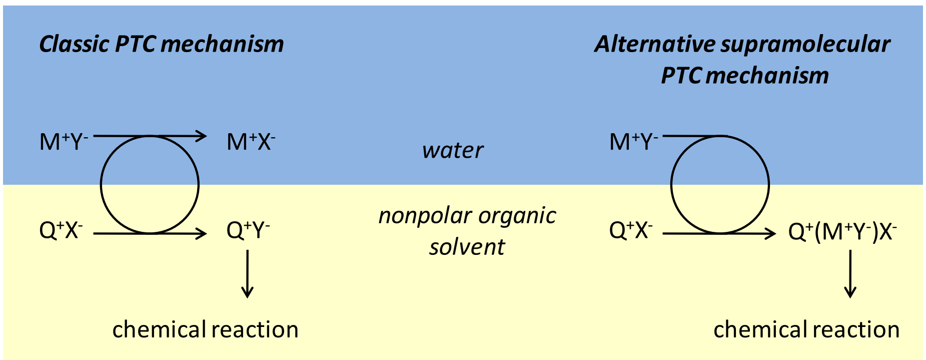


Figure 6