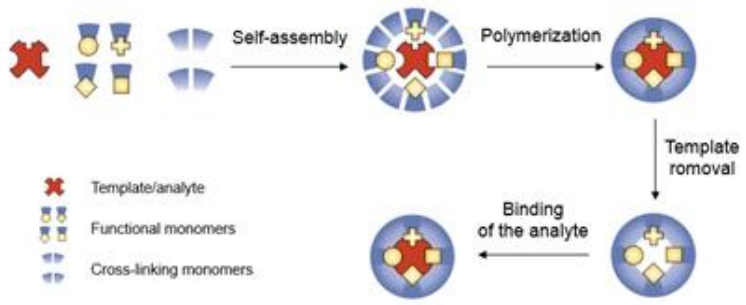
1. Research Project objectives

The principle of „one size fits all" should no longer be applied to drugs according to Prof. Aaron Ciechanover, Nobel Prize laureate in chemistry 2004. Nowadays, a patient wants to know "is the dose and treatment schedule well suited for me?" Adjustment of the drug dose and treatment schedule to patient's needs is particularly important for children and aged persons. The main goal of this Project is to develop fast and reliable methods for determination of representative drugs in body fluids e.g., plasma, serum, urine, and saliva. Current development of methods for sample preparation for bioanalysis is way behind recent advances in the efficiency of analytical instruments for drug measurements (ultra high-performance liquid chromatography and liquid chromatography/mass spectrometry). Moreover, big disadvantage of instruments used for this purpose is their size and cost. Therefore, our studies aims at development of selective molecularly imprinted polymers (MIPs) to be used for drug detection and determination. We would like to confirm that MIPs will become durable, reliable and effective tool for fast and selective analysis of drugs. Despite numerous reports on application of MIPs in bioanalysis, their successful use in the presence of interfering components of natural matrices, especially major metabolites, is scarce, and requires more comprehensive.

2. Research Project methodology

The studies require specialists from different fields of the life, natural, and computational sciences including pharmacy, bioanalysis, pharmacology, analytical chemistry, polymer and materials science, physical chemistry and statistics. Modern methodology will assure development of materials capable of selective binding of the selected drugs. This will allow application of these materials for drug isolation in complex biological fluids and as recognition elements in chemosensors. General scheme of preparation and use of imprinted polymers is presented in **Scheme 1.** In brief, this procedure requires first the formation of complex of a drug with selected functional monomer (elements capable of polymer formation) in solution. It is crucial that functional monomers contain in their structure both moieties capable of polymerization (binding with other monomers) and moieties capable of interactions with a drug. Subsequently, drug-monomers complex is polymerized in the presence of cross-linking monomer. This leads to formation of polymer with drug molecules embedded in its matrix. Next, the template is removed from the polymer leading to formation of molecular cavities with shape and size matching the selected drug molecule. A new material thus obtained is then capable of selective binding of the analyte, even in the presence of molecules with very similar structure. In this Project molecular imprinting will be applied for development of selective sensors and methods of separation of the selected drugs from the complex body fluids. For that purpose, we will initially perform series of computer simulations of drug-functional monomers and drug-polymer complex formation.



Scheme 1. General scheme of molecular imprinting.

Subsequently, we will compare obtained models with experimental results of drug-functional monomer interactions in solution. This research will allow us to learn how the drug is interacting with imprinted polymers and how the molecular cavities are formed. In the next step we will devise methods of deposition of thin films of imprinted polymer on magnetic nanoparticles, embedded in carbon sheaths (CEMNPs), and on signal transduction units by using electrochemical polymerization. This will permit production of solid extraction materials for selective isolation and chemosensors for selective determination of the target drug analytes, respectively. Finally, we will compare the analytical methods using imprinted polymers developed herein with the classical bioanalytical and sample preparation methods. This way a pioneering research will be conducted on separation and determination of selected drug with imprinted polymers on CEMNPs and transduction elements.

3. Expected impact of the research on the development of society

A positive outcome of our project will allow development of new bioanalytical tools in the form of imprinted polymer based extraction materials and chemosensors. These materials and procedures will enable the time-effective and environmental-friendly drug determination in patient body fluids. The results of our studies will assist introducing personalized pharmacotherapy in the everyday practice of clinical analysis, as well as development of convenient analytical methods, applicable in patient homes.