Description for the general public (in English)

In Nature, chemical reactions take place in confined environments. Products of one reaction often are the substrate or catalyst of the subsequent one. Such reaction can be coupled in time and place through the use of well-defined reaction environment and nanometer-sized, simple systems such as enzymes or more complex biological assemblies such as cells. Synthetic nano and micro-reactor systems are focused on the mimic of processes occurring in nature, but they can also be used to produce electricity through biochemical transformation of organic waste or as systems supporting cleaning up the environment. Investigation of the processes taking place in attoliter volume (10^{-18} L) systems is crucial for many disciplines, such as molecular biology and advanced synthetic chemistry.

The growing demand in medicine, food technology, biotechnology directs the research on designing and producing new nano and microstructures as reaction chambers that enable carrying out efficient and selective chemical reactions. The main goal of such systems is to protect encapsulated substances, ensure high local concentration and controlled release if necessary. Encapsulation of active compounds is a simple, inexpensive and gentle method used to entrap biomaterials such as enzymes, nucleic acids, vaccines, drugs, catalysts, and dyes. With the certain modifications to the capsules structure their contents can be mixed with contents of another capsules as the result of their fusion.

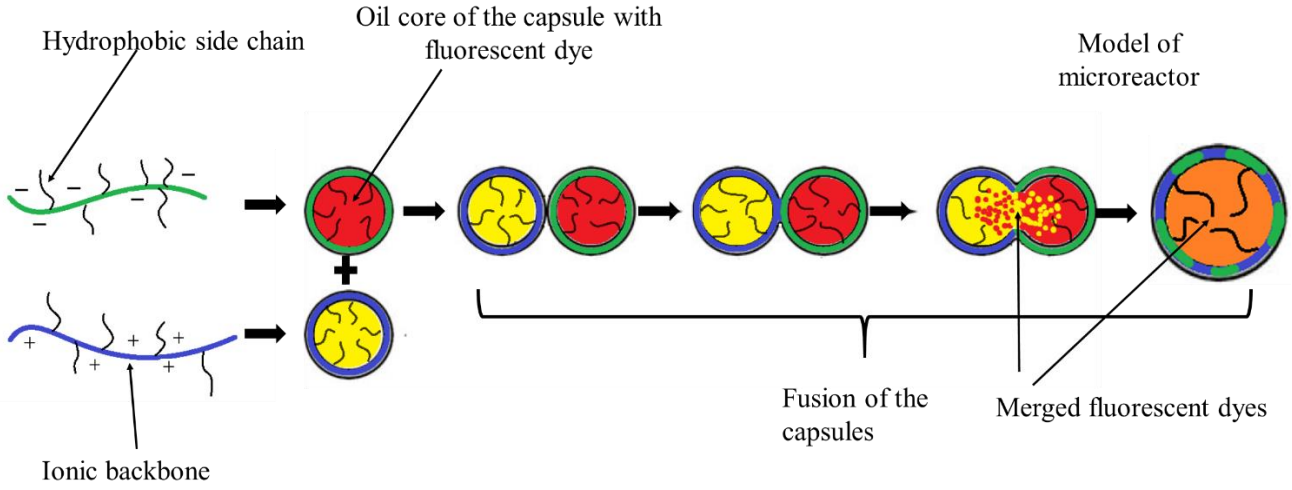

Fig. 1 Scheme of preparation capsules on liquid cores, their fusion and mixing their contents

The main goal of the project is to obtain microreactor systems from capsules templated on liquid, attoliter volume cores via self – assembly way. The capsules will be obtained from oppositely charged biopolymers derivatives such as chitosan and hyaluronic acid. Liquid cores will be prepared from naturally occurring fatty acids, what additionally allow to obtain environmental friendly systems, what is one of the advantages of presented structures. Oil cores of the obtained capsules will be stabilized by anchoring hydrophobic arms into a droplet of oil, without any additional low molecular weight surfactants. Use of cationic and anionic polyelectrolytes will allow to obtain capsules conglomeration, their fusion and mixing the contents of oil, liquid cores without any external trigger (Fig.1). Tracking of the hydrophobic compounds encapsulation and capsules fusion would be able with the use of different fluorescent dyes. The fusion ability of capsules will be examined according to the external environment such as pH and ionic strength. Moreover, the ability to perform chemical reactions e.g. so-called “click” reactions inside liquid cores of capsules will be checked.

The results of the project will contribute to increase the knowledge in the field of designing and preparation of microreactors based on capsules with liquid cores. Such innovative approach in the field of multicompartment system and microreactors can be a milestone in development of biocatalysis and other environmental applications.