

Synthetic polymers have been extensively used as building blocks of drug delivery systems. They are used for the encapsulation of low-molecular weight drugs, what allows for the lowering of their toxicity. Synthetic polymers are multi-molecular chemical compounds derived from the connection of many simple molecules (monomers). Due to the fact, that these polymers can be linked through the combination of simple low-molecular molecules, we can prepare tailor-made macromolecules with tunable properties by appropriate composition of their building blocks (copolymerization). For example, by addition stimuli-responsive blocks, these tailor-made polymers can recognize the difference of pH or temperature between a normal cell and cancer cell, what imparts the alteration of their structure and as a consequence precise delivery of an anti-cancer drug into the tumor can be achieved. Moreover, these polymers should be biocompatible with human body if we think about smart delivery carriers, therefore, we will use biodegradable monomers which are neutral for the human organism. One example of such polymer is the polylactide (PLA) which can additionally form supramolecular complexes between enantiomeric macromolecules with opposite configuration and these complexes are called stereocomplexes. This complexation can be adjusted by varying the percentage of stereocomplexation what influences the degradation rate and as a consequence drug release rate.

The most effective way of drug delivery is a fabrication of nanoparticles from the stimuli-responsive polymers which contain the desired drug molecule. Nanoparticles exhibit extraordinary small sizes, which are measured in nanometres. The small size of these particles allows them to be not detected by the reticuloendothelial system and enables to freely circulate in a body. Due to defective or “leaky” vasculature in the tumor cells (enhanced permeability and retention (EPR) effect), nanoparticles can easily diffuse into their interior. Moreover, nanoparticles that possess the stimuli-responsiveness which can adjust to the surrounding environment, have an astonishing potential which can be used in the wide range of application, not only in the biomedicine.

In this project, we will develop the methods of the smart nanoparticles preparation, based on the PLA matrix. We will elucidate the influence of the character and structure of obtained copolymers and their ability to form stereocomplexes, on the morphology of resulting particles. We will investigate the release of drugs under external stimuli and with different degree of stereocomplexation. We believe that it will result in the formation of smart drug delivery carriers with potential therapeutic applications.