DESCRIPTION FOR GENERAL PUBLIC

The change of stimuli-responsive polymeric system properties, induced by such factors as temperature, pH or light should be reversible. This is an important aspect with the aim of their applications e.g. in medical biology.

Because of the good biocompatibility and ease of control the properties, thermoresponsive poly(2-substituted-2-oxazoline)s (P2Ox), structurally similar to peptides, have a great potential for such applications. Many (co)polymers of 2-oxazoline exhibit thermosensitivity in the range close to physiological temperature, thus they are studied for example as systems for controlled drug delivery in the human body. However, during prolonged incubation of P2Ox solutions at characteristic for thermoresponsive systems temperature, so called critical solubility temperature (LCST or UCST), polymer chains arrange into elementary cell and start to crystallize. Alternating arrangement of side chains of P2Ox and the presence of the amide group in the backbone causes that P2Ox macromolecule in solution adopts a helical or zig-zag-like conformation, similar as in case of peptides. Such conformation is favored in solution during organization of P2Ox chains into elementary cell, and therefore crystallization occurs. This is an undesirable process because precipitated, crystalline phase is not soluble after changing the temperature to the initial value. This fact potentially disqualifies such systems from applications where thermoresponsive behavior is necessary. Crystallization of P2Ox as exemplary drug carriers in human body could potentially lead to dangerous vascular occlusion.

The main aim of the proposed project is to develop methods to control the crystalline properties of P2Ox, for preventing of their undesired crystallization. The most probable way to control the P2Ox crystallization is to change the conformation of the polymer chain which is adopted in solution.

Research will be carried out using a model P2Ox, poly(2-isopropyl-2-oksazoline) (PIPOx), which is a promising material for biomedical applications due to biocompatibility, thermosensitivity in the range of the human body temperature and the monomer chemical structure similar to leucine.

Disruption of PIPOx conformation will be carried out by chemical modification: incorporation or removal of the structural elements. The presence of these additional elements in the PIPOx chain will disturb the repeatability of the side chains. It is expected that these modifications will hinder the arrangement of PIPOx chains under the influence of temperature and, consequently, the crystallization. Additional elements introduced into the polymer chain may, however, interfere with the hydrophobic-hydrophilic balance of macromolecule, and change the value of LCST. Therefore, these modifications will be carried out in a controlled manner so that the critical solubility temperature of obtained copolymers will not be changed significantly and remain within desired physiological temperature range.

An innovative aspect is formed in the project: the disruption of undesirable polymer crystallization by controlling its chain structure. Simultaneously, the hydrophobic-hydrophilic balance of the macromolecule in water needs to remain unchanged. The obtained modified copolymers, similar as a homopolymers of 2-isopropyl-2-oxazoline, will exhibit a critical solubility temperature at physiological temperature and, on the other hand, will not crystallize, conversely to homopolymers of IPOx.

Investigations planned in the project fit in the latest trend of the basic research in the field of modeling, design and control of the properties of polymeric materials which can be used as biomaterials in medicine.