Amphiphilic polymer networks are an interesting class of materials that combine the properties of chemically different polymers. The attractiveness of such cross-linked polymers is caused by improved dimensional stability, mechanical strength, thermal stability, and solvent resistance when compared to linear polymers. Especially interesting are the polymeric networks, that are capable of absorbing large amounts of water (hydrogels) and are invaluable tools to several applications including biomedical areas.

Within the presented project we are going to develop a new class of amphiphilic networks by cross-linking of hydrophilic poly(isopropenyl-2-oxazoline) with carboxyl-terminated polyesters through the simple addition reaction. Poly(2-isopropenyl-2-oxazoline) is a relatively new, functional polymer that can be applied at biomedical applications due to nontoxicity and hydrophilicity. It is expected that the use of polyesters as macro-crosslinkers would enable the formation of networks in which hydrophilic segments are connected by the hydrophobic, biodegradable blocks. It can be anticipated that the availability of a wide range of aliphatic polyesters (PLA, PCL, others) would allow facile tailoring of the physical and chemical properties of obtained amphiphilic networks toward specific applications. The proposed strategy should provide access to biodegradable materials differing in hydrophilic-hydrophobic properties which could be fine-tuned by several parameters (including the nature of polyester chains- as well as the length and quantity of the cross-linker). In this way, it should be possible to build a whole series of novel networks with a well-defined structure and controlled cross-link density applying proper combination of building blocks.

In the first stage of research, network precursors will be obtained: poly(isopropenyl-2-oxazoline) and polyesters with controlled molar masses with different number of arms terminated with carboxyl groups. Next, the efficiency of the crosslinking reaction will be explored by mixing the network components in a biocompatible solvent (DMSO), at the appropriate temperature, without the addition of any catalyst (potential impurity).

Within the presented project the synthesized networks will be carefully characterized based on swelling behavior, morphology, surface wettability, degree of crystallinity, and hydrolytic degradation studies. It is planned to investigate fundamental structure/property relationships including the effect of network topology and composition on the hydrophilic/hydrophobic balance, mechanical and degradative properties, as well as the sorption behavior of the obtained material. As it can be expected that the obtained materials due to the specific structure and properties may perform multiple functions. After precise characterization selected materials will be tested at sorption experiments, drug loading, and release tests.

It is assumed that the planned research will allow obtaining innovative hydrogel materials. Furthermore, the proposed method leading for covalent cross-linking is relatively simple and safe, thus suitable for the preparation of biomaterials, what places the project in the area of research on environmentally friendly polymer materials and processes. The results of the proposed basic research should significantly contribute to the development of a new class of amphiphilic networks with potential applications as biomedical hydrogels and filtration materials.