

Streszczenie w języku angielskim

The aim of this doctoral thesis was the synthesis and characterization of a new class of multifunctional, segmented polymer networks composed of hydrophilic poly(2-isopropenyl-2-oxazoline) (PiPOx) blocks and selected crosslinking polymeric segments – poly(ethylene oxide) (PEO), polylactide (PLA), and polycaprolactone (PCL). Additionally, the study evaluated the potential application of these materials as carriers for biologically active substances, scaffolds for cell culture, sorbents for water purification, and substrates for plant cultivation.

A main stage of the research involved the preparation of reactive polymer blocks that enabled the formation of crosslinked networks with architecture controlled by the selection of components and covalent crosslinking density. For this purpose, PiPOx blocks and crosslinking segments with diverse physicochemical properties, containing terminal carboxylic acid groups (HOOC-PEO-COOH, HOOC-PLA-COOH, HOOC-PCL-COOH), were synthesized in the first stage. In the case of polyether, modification of terminal hydroxyl groups (to introduce carboxylic groups) was carried out enzymatically using succinic anhydride and lipase B from *Candida antarctica* (CALB) as a biocatalyst. For polyester functionalization (PLA and PCL), esterification of hydroxyl groups with succinic anhydride in the presence of 1,4-diazabicyclo[2.2.2]octane (DABCO) as a catalyst was carried out. The obtained reactive polymers were characterized using available methods including proton and carbon nuclear magnetic resonance spectroscopy (^1H -NMR, ^{13}C -NMR), size-exclusion chromatography (SEC), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and Fourier-transform infrared spectroscopy (FT-IR). These well-defined, telechelic polymers containing terminal $-\text{COOH}$ groups at both ends of the macromolecule served as macromolecular “branching agents” for the hydrophilic PiPOx segments. This enabled the formation of covalently crosslinked networks through a simple addition reaction between oxazoline rings and carboxyl groups. Appropriate selection of reaction conditions allowed to carry out crosslinking reaction without use of catalyst and without the generation of by-products.

The results confirmed that maintaining the appropriate ratio of ester units to oxazoline side rings allows the formation of networks with high efficiency using this relatively simple method (insoluble fraction > 93%). Furthermore, synthesis conditions were developed to introduce porosity, significantly increasing the water sorption capacity of the materials.

The obtained non-porous and porous materials were characterized in terms of composition and physicochemical properties using solid-state ^{13}C CP-MAS NMR, TGA, DSC,

scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), and FT-IR spectroscopy.

Application potential studies of both non-porous and porous materials were also carried out. These studies showed that the obtained segmented covalent networks exhibit multifunctional properties and may find application as scaffolds for cell culture, drug delivery systems, sorbents for water purification, and substrates for plant cultivation.