

Streszczenie w języku angielskim

The continuously increasing amount of plastics produced, together with their inefficient recycling, necessitates the development of new polymeric materials capable of accelerated degradation or chemical recycling. One of the promising directions of scientific research is the synthesis of polymers containing labile repeating units within their chains, which are susceptible to selective degradation under mild acidic conditions. The aim of this dissertation was to modify the physicochemical properties and chemical recyclability of selected aliphatic polyesters by incorporating acetal linkages into their macromolecular structures.

An important stage of the work involved the synthesis of functional, cyclic, five-membered acetals and subsequently investigating their ability to copolymerize with the cyclic ester, lactide. As a result, lactide (co)polymers with molar masses ranging from 9 000 to 19 000 g/mol were obtained, containing randomly distributed acetal units bearing allyl or chloromethyl groups. It was demonstrated that the presence of functional groups in the side chains enables straightforward modification of the copolyesters and the formation of more complex polymeric structures. Furthermore, it was demonstrated that the incorporation of acetal units into the polymer chain enables the controlled cleavage of acetal-ester linkages, facilitating polymer degradation at a user-defined stage.

The scope of the work also included the synthesis of ABA-type block (co)polymers containing internal, hydrophilic polyacetal (poly(1,3-dioxolane)) blocks and external, hydrophobic polyester blocks (poly(lactide) or poly(caprolactone)). New block (co)polymers with molar masses ranging from 11 000 to 54 000 g/mol were obtained. It was observed that varying the molar ratio of ester to acetal units leads to materials with different physicochemical properties, such as crystallinity and hydrophilic-hydrophobic character. The possibility of selective depolymerization of the polyacetal block to the monomeric 1,3-dioxolane under relatively mild conditions was also confirmed.

An integral part of the research involved the preparation of polymer films based on the previously synthesized ABA-type block (co)polymers (PLA-PDXL-PLA), containing external poly(lactide) blocks and an internal poly(1,3-dioxolane) block. The analyses performed demonstrated that the obtained films are characterized by high transparency, favorable mechanical properties, and appropriate potential for chemical recycling.

The results obtained in this work demonstrate that modification of the polyester structure through the incorporation of acetal groups is an effective approach to obtaining polymers with enhanced susceptibility to degradation, representing valuable polymeric materials in the context of a circular economy.