The emergence of new scientific fields such as tissue engineering and biomimics enabled significant progress in medical practices giving more and more treatment options for people with chronic and terminal illnesses. Their main role is to remove the key obstacles to transplantation. Despite the ability to perform complex transplant more and more types of organs and tissues, doctors invariably are facing significant barriers to recover efficiency and health due to insufficient donor, as well as the rejection of the transferred portion of the body of the recipient. Each year 1,500 people are expecting transplantation of tissue or an organ, while the implant prosthesis approx. 120,000 people. As many patients are waiting for a transplant of cornea and skin. A significant problem is the transplantation of lost limbs. It is estimated that in Poland per million inhabitants, there are only 40 donors. Therefore, it is crucial for the development of medicine to find innovative technologies for replacing defective, damaged or lost tissues and organs without having to search for the donor and eliminating the risk of infection and, therefore, rejection of the transplant.

The main objective of the following project is the obtainment of the novel thermoplastic biomaterials based on chitosan. Chitosan is a chitin derivative known of its many favorable properties like antibacterial, antipyrogenic and hemostatic activity as well as biocompability and biodegradability. New polymers will be characterized by controlled biodegradability and will be processed by extrusion or 3D printing technology. This functionality of chitosan derivatives has never been described in the literature before. New biomaterials will be obtained by chemical modification of few types of chitosan with different deacetylation degree and average molar mass. The synthesis pathway includes acylation followed by epoxidation and ring opening reaction. Thermal resistance will be achieved by incorporation of long aliphatic chains of unsaturated fatty acids chlorides. Since such modification will lead to the significant decrease of hydrophilicity on the biomaterial surface hydroxyl groups will be grafted in the controlled manner. Obtained chitosan derivatives physicochemical and thermal properties will be precisely investigated. Chemical structure and composition will be determined by spectroscopic (FT-IR, NMR, UV-Vis) and chromatographic methods (HPLC, GPC). Morphology of the ready biomaterials will be evaluated using SEM microscopy. Thermal resistance and other correlated properties will be studied applying TG/DSC method. Biological characteristics of the obtained chitosan derivatives will be also analyzed. Biodegradation study that will be performed will provide information about susceptibility of the biomaterial to biological degradation, its mechanism and speed. New materials of potential biomedical application will be also tested for their cytotoxicity and bioactivity. In the last phase of the project studies of toxic effect of living cells will be evaluated. Trials of breed of skin cell line will be also proceed. Issues that will be realized during the project are of interdisciplinary and innovative character. The main effect of the project will be obtainment of new, unknown and undescribed biomaterials of potential application in tissue engineering as three-dimensional scaffolds with super-precise shape for cell culture. Biomaterials can be also used in bionics as special biocompatible coatings of biomimetics elements (bioelectrodes, biosensors etc) which will significantly increase tissue affinity of the injected elements. The results of the following project will enable to proceed complexed cell culture in purpose to obtain functional tissue or organ substitute without any damage or burden to the living organism. The choice of raw materials will enable application of the obtained chitosan-based thermoplastic biomaterials in the laboratory conditions or be inserted into patient’s body without causing oxidation stress or pyrogenic effects. The whole synthesis pathway proceeded according to Green Chemistry principles and ready biomaterials will not be a contamination for the environment.