

The dynamic development of medicine in recent years happens not only through the studies on people and diseases, but also thanks to the rapid development of various medical technologies. They make possible the synthesis of a new drugs and the creation of better and better devices for supporting diagnostics and therapies. This progress is also visible in the field of implantology (regenerative medicine), the history of which began over 4,000 years ago. Medical implants are elements replacing missing tissue. They support damaged biological structures. They are usually made from biomedical materials such as titanium alloys, silicon or apatite, depending on which of them is the most functional for a given application. Unfortunately, they can cause unwanted reactions of the body, inflammation and infections. They are biostable. Additional treatments and operations are necessary to remove them.

An interesting alternative are elements made from biodegradable (bioresorbable) polymers. They are a specific group of polymers that undergo hydrolytic degradation in the biological environment to neutral for the body components. The exact mechanism of their breakdown is determined among others by the chemical structure. One of the basic polymers used in innovative solutions in the field of regenerative medicine is polylactide (PLA). Implants adapted to patient's physiognomy, including scaffolds (to rebuild organs, e.g. bones), stent grafts (being a rescue for people with aortic aneurysm), or popular coronary stents are being prototyped. One of the main methods used for their production is called selective laser sintering (SLS) of polymer micropowder. It is based on applying successive layers of material and selectively fusing it (sintering) with the use of laser beam. Then, material that did not merge is removed and as a result a finished 3D structure is obtained. The dynamic spread of laser formation techniques (both additive and substrate) in recent years, however, seems to overtake knowledge about the modification of the often used thermally sensitive polylactide and its composite with hydroxyapatite (HAp). Hydroxyapatite as a mineral that is the basic building material of bones is a natural filler in many composites, enabling the modification of their mechanical properties.

The aim of the project will be to analyse the impact of the laser process of forming structures on the physicochemical properties of the material, which determine its suitability in implantology, and on this basis, development of method that will make possible reduction of undesirable effects. Available nowadays research seems to omit this aspect, what may be the result of the erroneous assumption that the impact of the CO₂ laser limits the destruction of the material under the influence of heat in the broadest sense possible (degradation, reversible and irreversible structural change, etc.). The expected effect of the research is better understanding of both the preparation process and the composition of the batch material as well as the laser sintering process itself.

In the project, the usage of a novel sintering method in which polymer microspheres are preheated using an additional laser beam is planned. This method does not require heating of the entire material volume on so called micropowder bed, what prevents prolonged exposure to the thermal impact of the material that will not be used to create the structure. This technique has not been applied on bioresorbable polymers so far. The selected laser system will also allow flexible change of beam parameters as well as the process atmosphere, which is not possible with commercially available laser sintering stations. There will also be a detailed documentation of changes in the physicochemical properties of the material and an attempt will be made to determine the material degradation mechanisms. In conclusion, the planned research will make possible the effective production of safe, tailored to the patient needs, bioresorbable medical implants.