Nowadays, permanent, metallic cardiovascular stents are long-term implants. Presence of such an implant for so long time in the human body can cause re-overgrowing of the tissue within the treated portion of the vessel, re-blockage of the circulatory system and many other clinical complications such as thrombosis, prolonged physical irritations or chronic inflammation. Therefore, a research on biodegradable metallic stents is conducted. Biodegradable implant is an implant which after certain and desirable time being in a human body will start to degrade and will degrade completely once treatment process will be finished. Materials for the biodegradable, metallic stents are the active metals, such as iron or magnesium which degradation is based on their subsequent corrosion process. However, the use of such materials in a clinical application requires the optimization of their degradation rate. The idea behind this proposal is to modify the surface of the oxidizable metal with the conducting polymer coating. Therefore, the aim of the project is to investigate the conditions of the synthesis and degradation of polypyrrole (PPy) coated iron for use of the biodegradable cardiovascular metallic stent. The studies will include the determination of the influence of the passivation layer on the synthesis and degradation of PPy coated iron, drug release process from PPy film during the degradation of iron coated with this polymer (PPy/Fe) and biological in-vitro studies of this biomaterial.

So far, the own work allowed determining the synthesis conditions of PPy electrodeposition on iron from aqueous solution containing salicylate derivatives. Depending on the employed different parameters of the synthesis, corrosion, morphological and electrical properties of polypyrrole film coated iron were identified. The degradation process of iron and iron modified with PPy were studied in a solution imitating the tissue environment at 37 °C. Based on these results, the theoretical model of the degradation process of such materials was proposed. It is noted that prior to the polypyrrole deposition on iron, there is a formation of the passivation layer, which has a significant effect on the degradation process of iron coated with this polymer. Therefore, the role of this passivation layer during the PPy synthesis on Fe and its influence on the degradation of iron coated with PPy will be studied. Also, the theoretical model of these processes will be indentified. It will allow for better understanding of processes and mechanisms occurring during the synthesis of PPy on Fe.

The polypyrrole coatings will be additionally doped with anti-inflammatory and/or antithrombotic drugs and released process of these drugs will be examined. The studies of the implant will be conducted in the physiological saline solutions imitating the tissue environment and in the temperature corresponding to the human body temperature. The basic biological in-vitro studies such as biocompatibility (cytotoxicity, cell viability and proliferation) studies of differently prepared polypyrrole/iron material will be performed in a presence of different kinds of cells. Also the influence of the drug release from the polymer coating on the viability of the cells will be studied. It is assumed that release of additionally incorporated in the polymer anti-inflammatory drugs will improve the cell viability and decrease the possible inflammations. Such information will confirm the usage of studied material as a biomaterial for cardiovascular stent technology.

Performed studies will allow synthesizing the optimized polymer films (polypyrrole) with certain corrosion and electrical properties which will allow for appropriate adjustment of the biodegradation process of the metallic implant. The drugs released from these coatings, during degradation of an implant, will reduce the inflammation and/or prevent formation of the new blood clots. These new results will open up new possibilities in a field of biodegradable metallic implants for stent technology.