During the last decades we have witnessed considerable development in the field of targeted and controlled delivery of drugs and other biologically active components to the human body. Among such systems, particular attention is drawn by the formulations based on nanoparticles – they boost the solubility and stability of drugs, prolong the time they reside in the bloodstream and help to reduce the side effects of the therapy. Up to date, despite much time and money spent on research focused on such systems, the progress in the field is far from being satisfactory: most of the works described in literature focus on the synthesis of new nanoparticles and not the final products – the nanocarriers. Therefore, we would like to sneak a peek at the bigger picture and use our expertise in nanoparticles synthesis to develop a kind of a universal platform, based on which we will be able to easily obtain carriers for particular medical purposes, based on similar chemistry and possessing similar properties. Such an approach will also reduce the costs of developing the final form of the drug.

The main goal of our project is to demonstrate the feasibility of the strategy described above. We will perform a complete study of the model nanocarrier for radioisotopes, designed for simultaneous oncological diagnosis and therapy (so called oncological theranostics). In the course of the project, we will synthesize nanoparticles made of a biocompatible polymer, equipped with proper chemical moieties enabling attachment of additional components. Those constituents, once attached to the nanoparticles, will confer the specific biological activity to these particles: selective accumulation in diseased organs and transport of theranostic radioactive isotopes. So designed and prepared materials will be thoroughly examined for their physicochemical (e.g. size and stability) and biological properties – their ability to selectively bind to cancer cells and destroy them will be demonstrated in *in vitro* and *in vivo* tests.

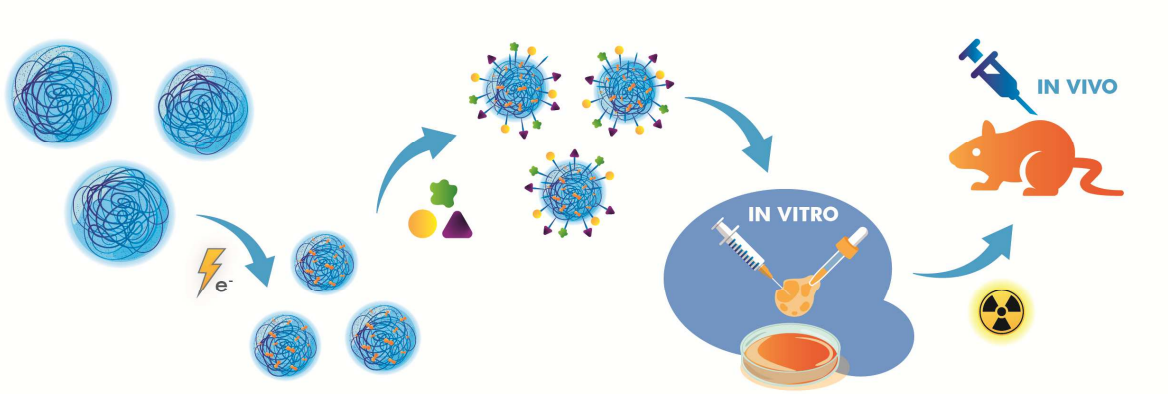

Diagram 1. The course of planned tasks in the project. From the left: synthesis of polymer nanoparticles by electron beam technique, attachment of biologically active ingredients, in vitro studies on cell cultures, binding of radioactive isotopes, destroying tumor cells in the in vivo studies.

Our nanoparticles are synthesized by a unique, one–step electron–beam technique; this method is exceptionally simple and clean, just perfect for fabrication of materials for medicine. It does not require any organic solvents, reaction initiators or any other potentially harmful additives, therefore, there is no problem with removing them after the reaction. Additionally, by using the electron beam of a sufficient energy, we can simultaneously sterilize our material.

The results of our project will contribute to broadening of knowledge about synthesizing polymer nanomaterials for medicine, and also about the relation of their activity with structure, composition as well as other physicochemical properties. Moreover, these studies will help to better understand the nature of the interactions between nanomaterials and living organisms (and their models). Outcomes of our project will lay the foundations for advanced platform of bioactive polymer nanostructures, thus enabling production of diverse novel materials for many medical applications. Improving the effectiveness of existing therapies and diagnostic tools requires continuous development of such new materials. Thanks to them, in the future, treatment of many diseases may be more effective than today.