Novel nanomaterials for triple-punch therapy of liver cancer

One of the most common causes of death in the world is cancer. The most common types of cancer include lung cancer, stomach and liver prostate. That is why more and more attention is paid to nanotechnology to fight against cancer. This led to the emergence of a new field - nanomedicine, which is an interdisciplinary field of research at the interface of chemistry, materials science, physics and medicine, and biology.

The development of nanotechnology has contributed to the creation of nanomaterials, which are thousands of times smaller than the average of human hair and thanks to modern chemistry and physics methods, it is possible to modify their surface so that they can be used in medicine to fight against cancer. The advantage of nanomaterials is the ability to deliver drugs to cancer cells and the possibility of their simultaneous use in imaging, e.g. using nuclear magnetic resonance (MRI).

Currently, one of the goals of nanomedicine is to build "smarter" nanocarriers that allow to combined several modalities for cancer at one time, for example, by combining chemotherapy with phototherapy or gene therapy. Besides, it is desirable that the carrier still has diagnostic features allowing to use various imaging methods. Furthermore, it needs to show the active targeting of cancer cells. Both nanomaterials carrying a cytostatic drug on their surface, as well as chemotherapeutics administered in standard chemotherapy show, reduced efficacy due to the occurrence of multidrug resistance (MDR). This phenomenon is defined as the acquisition by cancer cells of a simultaneous insensitivity to several groups of various therapeutic agents that develop in response to the use of a single cytostatic drug.

Therefore, the project aims to develop advanced nanomaterials that allow overcoming the effect of multidrug resistance while maintaining the positive features of nanocarriers, i.e. combining several anticancer therapies in a single material, MRI contrasting properties (or other imaging technique) and active targeting of cancer. The model of research is hepatocellular carcinoma, which is the most common type of liver cancer and for which there is a lack of routine treatment methods. The study will be conducted by an interdisciplinary team built of biologists and physicists chemists and toxicologists using the latest equipment and animals.