The [60]fullerene-based theranostic agent for pancreatic cancers treatment and diagnosis

The rapid development of nanotechnology caused a fast increase of interest by scientists dealing with targeted anti-cancer therapies. Currently, the most popular uses of nanotherapeutics include cancer diagnosis and treatment, targeted drug delivery systems, and animal imaging. Pancreatic adenocarcinoma is an extremely aggressive type of cancer with poor prognosis and a 5- year survival rate of less than 7%. Unfortunately, traditional chemotherapy, which is usually based on gemcitabine, is ineffective. Although intensive research is carried out in this area, with novel types of therapies (immunotherapies, gene therapies and nanotherapeutics), there have been no effective therapeutics for this type of cancer.

The main goal of the project is to develop fullerene nanotherapeutics for the treatment and diagnosis of pancreatic cancer. In the presented research plan, three generations of fullerene derivatives will be prepared, which combine two different approaches to inhibit tumor growth, that can jointly inhibit the development of pancreatic cancer in a better way. For this purpose, we will focus on the conjugation of drug Erlotinib (an FDA-approved chemotherapeutic) to the fullerene molecule and then to the delivery of short interfering RNA fragments (siRNA) using an aminofullerene nanotherapeutic. In addition, it is planned to examine the effects of enhancement of magnetic resonance imaging (MRI), which will be possible due to the presence of chelated gadolinium ions in the structure of fullerene derivative or also by the creation of a hybrid nanomaterial with superparamagnetic iron oxide (C_{60}-ERLOTINIB-SPION).

The obtained carbon nanomaterials will be further tested for their biological activity at the cellular level (determination of cytotoxicity, cellular localization, siRNA transfection and enzymatic panel studies) in order to better understand their mechanisms of action. Based on the experiments carried out at the cellular level, the most effective fullerene derivatives will be selected for further animal experiments, using human pancreatic cancer models.