1. Objectives of the project

The aim of the described project is to obtain new photosensitizers composed of dipyromethene ligands (DPM) and aza-dipyromethene (aza-DPM) coordinated with the zinc ion. The planned heteroleptic zinc complexes will also have iodine-based ligands. **Photosensitizers designed for the purpose of the grant can potentially be used in photodynamic therapy (PDT),** which is a non-invasive and effective method of cancer treatment. It consists in introducing a photosensitizer in the place attacked by the tumour, followed by irradiation with light of the appropriate wavelength leads to the generation of singlet oxygen, which is destructive for tumour cells. To increase the anti-cancer effect, the use of nanocarriers in the form of gold nanoparticles (AuNPs) was planned.

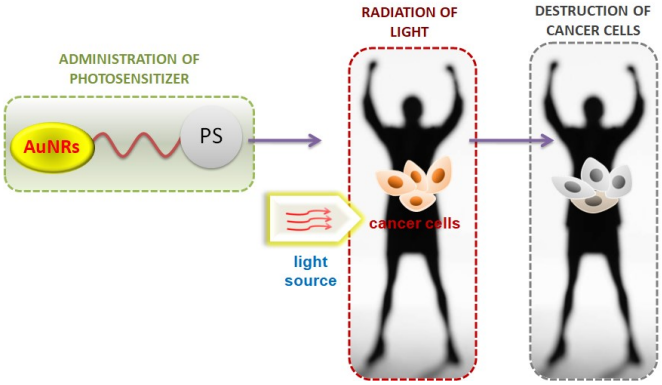

Fig. 1. Simplified PDT mechanizm.

2. Research to be carried out

The project implementation was divided into several stages, including the most important research tasks:

I. Multistep synthesis of zinc (II) dipyromethene and azadipyromethene complexes, their isolation and purification
II. Full characterization of the obtained compounds, including purity, structural and physicochemical tests
III. Embedment of the obtained compounds on previously synthesized gold nanoparticles, such as gold nanorods (AuNRs)
IV. Characterization of the obtained gold nanoparticles with embedded photosensitizers, these studies will be performed in cooperation with a foreign research center, which will be the University of Strasbourg
V. Assessment of the physicochemical properties (absorbance, emission and fluorescence studies) of the obtained nanostructures, including the ability to generate singlet oxygen
VI. Determination of photodynamic anticancer activity of the obtained nanostructures on selected neoplastic cells

3. Reasons for choosing the research topic

The subject of the project concerns the development of new compounds from the group of photosensitizers, used in broadly defined photodynamic methods, including anticancer photodynamic therapy. The topic undertaken in the project is fit in the concept of *National Program for Combating Cancer Diseases*, which one of the goals is to create conditions for use of oncological practice and a huge advancement of knowledge. It is recommended to create preferential conditions for the development, implementation and dissemination of new methods enabling the use of more effective methods of treatment. The zinc complexes with DPM and aza-DPM ligands selected for the project are an innovative approach in development of new photosensitizers. These compounds have properties that meet the criteria for use in PDT, but so far only few research groups have taken up this topic. Therefore, it seems advisable to thoroughly investigate these types of compounds in the context of their activity in PDT. Moreover, photosensitizers currently used in clinical practice have many disadvantages, including low penetration tissue and relatively long accumulation in the body. In addition, photosensitizers currently being developed by many researchers show low bioavailability, hydrophobicity and a tendency to aggregate. Therefore, the use of nanogold seems to be extremely promising, mainly due to the increase in bioavailability and the shift of the maximum absorption band towards longer wavelengths, which will significantly increase the penetration of light into the tissues, which futher will allow to treat of non-surface neoplasms. An additional factor in increasing tissue penetration is the incorporation of iodine into the structure of zinc complexes, a procedure known as the "heavy atom effect".

4. The most important expected effects

The discovery of new photosensitizers linked with AuNPs will significantly improve the tissue penetration and allow using PDT in deeper localized tumours. Development in the design of photoactive agents linked with nanoparticles suggests that oncological phototherapy will have broader applications in the future.