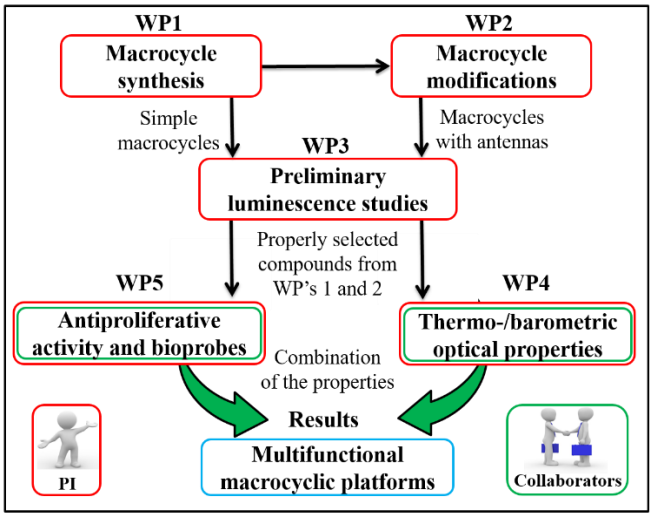
Multifunctional macrocycles of lanthanide ions as thermoluminescent probes for utilization in cellular imaging

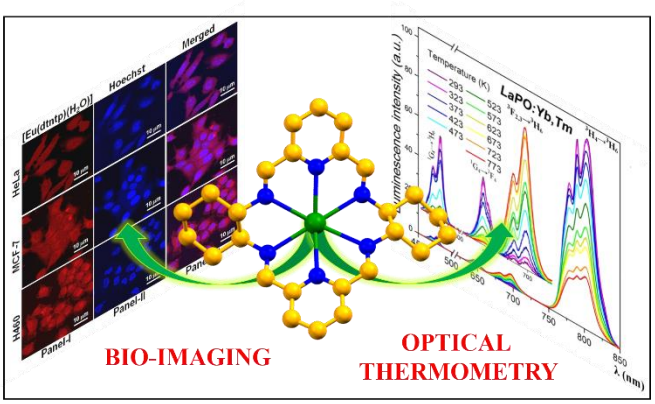
Aim of the project

The rational design of molecular architectures is crucial for synthesis of advanced functional materials in a targeted manner. These, in turn, should be used to solve problems of a global nature, such as (but not only) health problems, mainly cancer and diagnostic problems. In the presented project, we assume the synthesis of rationally designed lanthanide(III) macrocyclic complexes, which are intended to function as optical thermometers and barometers, and also serve as materials for bioimaging and cancer treatment in biomedical applications. The project is part of the theranostic approach, i.e. a new approach to medicine aimed at creating new technological solutions enabling the simultaneous detection and treatment of diseases.

Concept and work plan

The project was divided into 5 work packages (**WP**), which implementation will allow to obtain multifunctional platforms for use as thermoluminescent probes for cell imaging.





In **WP1**, the synthesis of lanthanide(III) ions macrocyclic compounds will be carried out, which in a further stage in **WP2** will be modified with additional molecules so-called antennas. This will allow to increase the amount of absorbed light and thus better luminescent properties important in cell imaging, especially in the biological transparency window (750-900 nm, near infrared NIR). Work in this area is aimed at reducing the scattering and absorption of light by biological tissues. **WP3** is aimed to preliminary assessment of luminescent properties and selection of the best compounds for further research. In **WP4**, studies of the influence of temperature and pressure on the luminescent properties of compounds will be carried out, which will allow to determine which compound can be used as an optical thermo-/barometer. **WP5** assumes the characterization of biological properties, such as the ability to produce reactive oxygen species (which can be used in cancer treatment in photodynamic therapy), determination of the cytotoxicity of compounds against healthy and cancerous cells in MTT tests, and cell imaging properties using a confocal microscope.

Anticipated results

This will demonstrate the multifunctional nature of the planned macrocycles, which will ultimately lead to the discovery of a new class of bifunctional platforms for simultaneous cell imaging and temperature measurement. In addition, the formation of reactive oxygen species (ROS) will be determined in order to test the ability of the synthesized compounds to be used as photodynamic anticancer therapy agents in theranostic approach. The above project follows the **theranostic** approach, which is in line with **the sustainable development goals (3. Good Health and Well-Being) discussed on World Economic Forum in Davos 23-26.05.2022.**