Dynamic imaging of short wave infrared luminescence lifetimes sensing microenvironment in biomedical applications – **LFTIME4SENS**

The main goal of this project is the development of new technique of advanced optical bioimaging and biosensing that utilizes rapid luminescence lifetime imaging along with the specially designed luminescent nanoprobes to detect, sense and image changes of their microenvironment in real time. The innovation of the proposed project steams from recently discovered ultra-high sensitivity of the lifetimes of some lanthanide ions doped nanoparticles to water molecules. We will select and synthesize various variants of fluoride based nanocrystals, study their luminescence lifetime sensitivity towards water and select the most promising ones. Moreover, the obtained water-sensitive nanoparticles can be coated with polymeric shell to initially protect nanoparticle surface from contact with water molecules. At the same time, we hypothesize that these polymeric coatings can be feasibly engineered in such a manner that they will degrade in response to the specific change in microenvironment of the nanoparticles, allowing for water access to the nanoparticle surface manifested by a change in luminescence lifetime. In such a way, it is possible to obtain a universal nanoplatform for real time sensing that could be adjusted for different types of sensed analytes through a specific modification of the polymer coating. **A development of the luminescence lifetime rapid in situ imaging system in conjunction with nanoplatform for microenvironment sensing will be the main goal of the project.** To the best of our knowledge, similar approach has not been described nor shown so far. As a proof of concept, we will select pH sensitive polymeric coating for the synthesized nanoparticles, which will degrade under basic or acidic pH allowing for rapid change of the luminescence lifetime and corresponding rapid imaging/mapping of the pH changes *in situ*. Developed luminescence lifetime microscopy and imaging system will be demonstrated, assessing pH distribution in the microenvironment of nanoparticles. Next, the design of polymeric coating degradable in response to the presence of bio-related molecules to explicitly sense/map their presence *in situ* will be also considered. The proposed project would greatly contribute to the development of the already established cooperation between Wroclaw University of Science and Technology in Poland and Shenzhen University in China by creating integrated interdisciplinary research team of scientists with a broad range of experimental experience. The combination of nanoengineering provided by Polish party would greatly supplement the expertise in advanced optical bioimaging and biosensing of Chinese Principal Investigator and Co-Investigator, this in turn could promote the progress of scientific research through collaborative exchanges, and by diversification and internationalization.

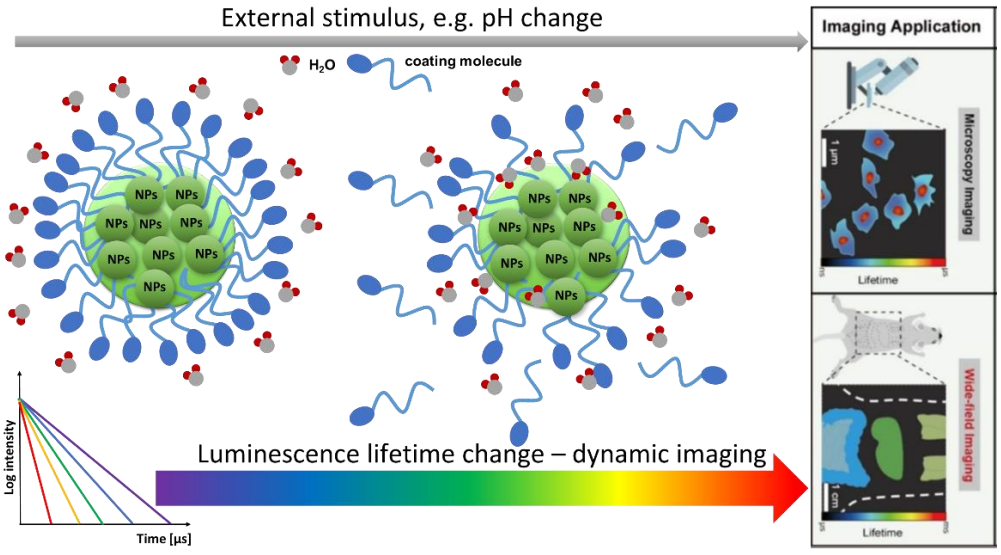

Figure 1. The schematic representation of the luminescence lifetime rapid imaging system in conjunction with nanoplatform sensing microenvironment, which Authors intend to develop within the proposed research project.