Hyperthermia (deliberate increase in tissue temperature in the range of 39-45°C) is a method of supporting or treating cancer. Before our era there were reports of its use in the treatment of breast tumors. However, at the beginning of the 21st century it gained greater popularity due to research confirming the incredible sensitivity to temperature changes (above 39ºC) of cancerous tissues. This is because above this temperature, proteins that build pathological tissues are self-destructing, while healthy tissues remain resistant to the prevailing thermal conditions. The answer to oncological hyperthermia in nanomedicine is photothermal therapy, which also uses the overheating process but not with the help of, for example, in the radio range as in oncological hyperthermia, but through nanoparticles that generate heat under the influence of laser beam excitation. The advantage of photothermal therapy is the possibility of targeted therapy only within cancerous tissues, then exposure to high temperatures of healthy tissues is limited.

However, it is worth noting that the hyperthermia process requires accurate temperature measurement and regulation, because above the maximum value, self-destruction of proteins occurs in healthy tissues. The solution to the problem of reading the temperature prevailing inside the body is luminescent nanothermometry, which allows its non-contact reading. In this technique nanoparticles are showing the process of emission of light caused by excitation by means of a laser beam. However, in order to penetrate the tissues, both the excitation beam (laser) and the emission of nanoparticles should fall within the so-called Biological Optical Windows (650-1800 nm), i.e. in the spectral range for which tissues show the highest light transmission. However, it is equally important that the luminescent nanothermometer show high sensitivity to the slightest temperature changes. Therefore, by doping nanoparticles with both transition metal (TM) and lanthanide (Ln) ions, one can obtain a system in which one band is highly sensitive to temperature changes (TM) while the other is the reference band (Ln).

Therefore, the combination of both techniques (photothermal therapy and luminescent nanothermometry) through the use of nanoparticles doped with transition metal ions and lanthanides, which perform simultaneous functions of nanoheaters and luminescent nanothermometers is the goal of this project.