Metals for Biological and Medical Diagnostics: Dual-mode Near-infrared Optical and Photoacoustic Imaging Agent based on Low Energy Absorbing Ytterbium Complex

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Medical and Biological Diagnostics are in great needs of non-invasive imaging approaches with responses in real-time using small footprints instruments. Photoacoustic (PA) and near-infrared (NIR) luminescence are novel imaging techniques that can uniquely address these requirements. They take advantage of the NIR light operating in the biological transparency window as an excitation source. The creation of dual-mode imaging agents would allow to combine the advantages of the two techniques: high sensitivity and high resolution of the NIR luminescence imaging with high signal detection depth of the PA imaging.

Lanthanide complexes formed with NIR-absorbing chromophores are promising candidates for the creation of the dual-mode agents. Lanthanide ions possess unique luminescence properties which makes them excellent candidates for the luminescence imaging. However, they have small values of molar excitation coefficients, so organic chromophores have to be used for the sensitization of the luminescent lanthanide ions. At the same time, organic chromophores can create the photoacoustic signal by dissipating the part of the excitation energy of the non-radiative processes. The presence of both the NIR-emitting lanthanide ion and the organic chromophore in the lanthanide complex allows using the same molecule for the creation of the bimodal imaging agents.

In this work, we present a new dual-mode photoacoustic and NIR luminescence imaging agent as polystyrene nanoparticles loaded with NIR-emitting lanthanide complexes containing NIR-absorbing chromophores. Evaluations of the performances of these new PA and NIR imaging agents for non-invasive detection in in biological systems were evaluated with the help of a phantom.