Evaluation of the photodynamic activity of upconversion nanoparticles coated with photosensitizers under infrared excitation *in vitro* and *in vivo*

Daria V. Pominova[1,2], Vera Y. Proydakova[1], Igor D. Romanishkin[1], Anastasia V. Ryabova[1,2]

[1] *Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia*

[2] *National research nuclear university MEPHI, Moscow, Russia*

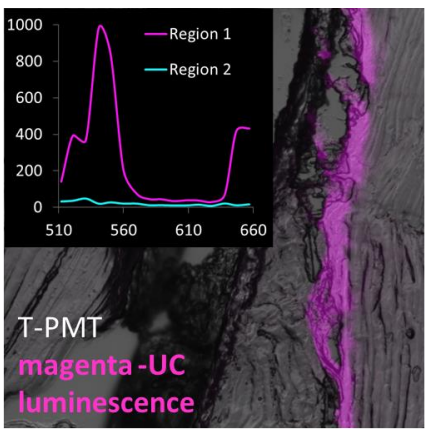
email: *pominovadv@gmail.com*

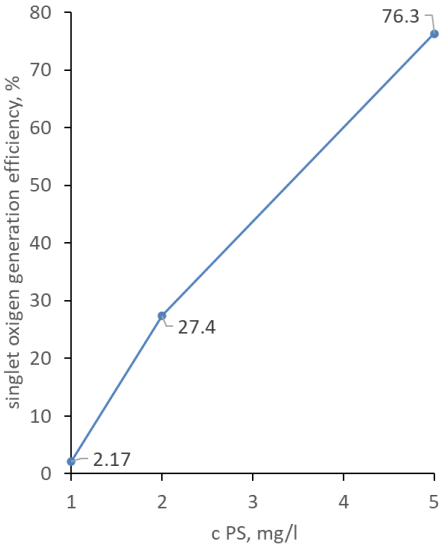
Motivation Today, photodynamic therapy is one of the most promising minimally invasive methods of treatment of various diseases, including cancer. The main limitation of this method is the insufficient penetration into the tissue of laser radiation used to activate photosensitizer molecules, which makes it difficult to carry out therapy in the treatment of large or deep-seated tumors. In this regard, there is a great interest in the development of new strategies for photodynamic therapy using infrared radiation for excitation, the wavelengths of which fall into the "transparency window" of biological tissues. In this work, it was proposed to use upconversion $NaGdF_4$:Yb-Er nanoparticles (UCNP), which absorb infrared excitation and serve as a donor that transfers energy to the photosensitizer.

Goal To study the photodynamic activity of upconversion nanoparticles coated with photosensitizers under infrared excitation in vitro, using biological tissue phantoms, and in vivo, on laboratory mice.

Methods Upconversion nanoparticles $NaGdF_4$:Yb-Er were synthesized by the anhydrous method in oleic acid. The clinically approved photosensitizers Photosens and Phthalosens not yet used in clinical practice were selected for the studies. The efficiency of singlet oxygen generation by nanoparticles coated with a photosensitizer upon excitation in the IR range in the absorption band of ytterbium ions was studied *in vitro* and *in vivo* after intramuscular administration of the studied nanoparticles to mice. Photodynamic activity was photodynamic assessed using histological cryosections of biological tissues prepared post-mortem after irradiation.

Results The efficient generation of singlet oxygen by the studied nanoparticles coated with a photosensitizer upon excitation in the IR range has been demonstrated.





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